Subject: Supply Chain Management	
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Lesson No.: 1	Vetter:
Introduction to Supply Chain Management	

Structure:

1.0 Objectives

After studying this chapter, you would be able to understand

a) The meaning of supply chain
b) The evolution of supply chain management
c) The various issues and complexities in supply chain management
d) Meaning of development chain
e) Concept of optimization of supply chain
f) Scope of supply chain management

1.1 Introduction to Supply Chain Management

For many reasons, interest in logistics and supply chain management has grown explosively in the last few years. This interest has led many companies to analyze their supply chains. In most cases, however, this has been done based on experience and intuition; very few analytical models or design tools have been used in this process. Meanwhile, in the last two decades, the academic community has developed various models and tools to assist with the management of the supply chain. Unfortunately, the first generation of this technology was not robust or flexible enough to be effectively utilized by industry. This, however, has changed in the last few years. Analysis and insight have improved, and effective models and decision-support systems have been developed.

For example, transportation managers deciding which modes of transportation to use, inventory control managers wanting to ensure smooth production with as little inventory as possible, purchasing/supply managers designing contracts with their company's suppliers and clients, and logistics managers in charge of their company's supply chains all can be benefited from these newly developed decision support systems.

Today's fierce competition in global markets, the introduction of products with shorter life cycles, and the heightened expectations of customers have forced business enterprises to invest in, and focus attention on, their supply chains. This, together with continuing advances in communications and transportation technologies (e.g., mobile communication, Internet, and overnight delivery), has motivated the continuous evolution of the supply chain and of the techniques to manage it effectively. In a typical supply chain, raw materials are procured and items are produced at one or more factories, shipped to warehouses for intermediate storage, and then shipped to retailers or customers. Consequently, to reduce cost and improve service levels, effective supply chain strategies must take into account the interactions at the various levels in the supply chain. The supply chain, which is also referred to as the logistics network, consists of suppliers, manufacturing centers, warehouses, distribution centers, and retail outlets, as well as raw materials, work-in-process inventory, and finished products that flow between the facilities (see Figure 1-1).

What exactly is supply chain management? We may define it as follows:

"Supply chain management is a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system wide costs while satisfying service level requirements."

The above definition leads to several observations. *First*, supply chain management takes into consideration every facility that has an impact on cost and plays a role in making the product conform to customer requirements: from supplier and manufacturing facilities through warehouses and distribution centers to retailers and stores. Indeed, in some supply chain analysis, it is necessary to account for the suppliers' suppliers and the customers' customers because they have an impact on supply chain performance.

Second, the objective of supply chain management is to be efficient and cost-effective across the entire system; total system wide costs, from transportation and distribution to inventories of raw materials, work in process, and finished goods, are to be minimized. Thus, the emphasis is not on simply minimizing transportation cost or reducing inventories but, rather, on taking a systems approach to supply chain management. *Finally*, because supply chain management revolves around an efficient integration of suppliers, manufacturers, warehouses, and stores, it encompasses the firms' activities at many levels, from the strategic level through the tactical to the operational level.

What about logistics management, or value chain management, or demand chain management? Various companies, consultants, and academics have developed a variety of terms and concepts to stress what they believe are the salient issues in supply chain management. In the present chapter, supply chain management is used as the generic name for the set of concepts, approaches, strategies, and ideas that we are discussing.

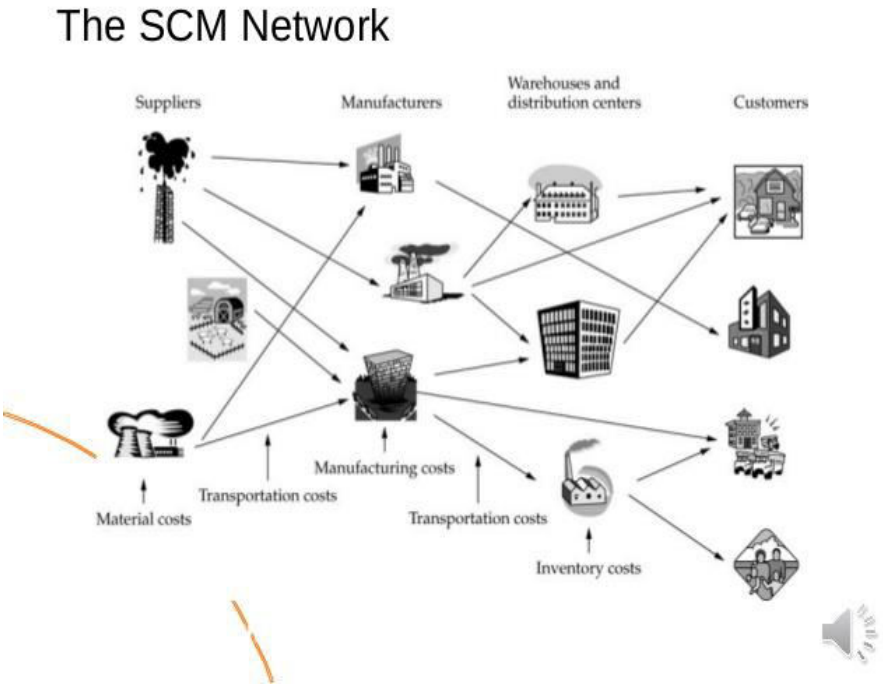

Figure 1: The SCM Network

What makes supply chain management difficult? Although we will discuss a variety of reasons throughout this chapter, they can all be related to some or all of the following observations:

a. Supply chain strategies cannot be determined in isolation. They are directly affected by another chain that most organizations have, the development chain that includes the set of activities associated with new product introduction. At the same time, supply chain strategies also should be aligned with the specific goals of the organization, such as maximizing market share or increasing profit.
b. It is challenging to design and operate a supply chain so that total system wide costs are minimized, and system wide service levels are maintained. Indeed, it is frequently difficult to operate a single facility so that costs are minimized and service level is maintained. The difficulty increases exponentially when an entire system is being considered. The process of finding the best system wide strategy is known as ***global optimization***.
c. Uncertainty and risk are inherent in every supply chain; customer demand can never be forecast exactly, travel times will never be certain, and machines and vehicles will break down. Similarly, recent industry trends, including outsourcing, offshoring, and lean manufacturing that focus on reducing supply chain costs, significantly increase the level of risk in the supply chain. Thus, supply chains need to be designed and managed to eliminate as much uncertainty and risk as possible as well as deal effectively with the uncertainty and risk that remain.

In the subsequent sections, we will discuss these issues in more detail.

1.2 The Meaning of Development Chain

The development chain is the set of activities and processes associated with new product introduction. It includes the product design phase, the associated capabilities and knowledge that need to be developed internally, sourcing decisions, and production plans. Specifically, the development chain includes decisions such as product architecture; what to make internally and what to buy from outside suppliers, that is, make/buy decisions; supplier selection; early supplier involvement; and strategic partnerships.

The development and supply chains intersect at the production point, as shown in Figure 2. It is clear that the characteristics of and decisions made in the development chain will have an impact on the supply chain. Similarly, it is naturally clear that the characteristics of the

supply chain must have an impact on product design strategy and hence on the development chain.

EXAMPLE:

Hewlett Packard was one of the first firms to recognize the intersection of the development and supply chains. A case in point is the inkjet printer introduction, where decisions about product architecture were made by taking into account not only labor and material cost, but also total supply chain cost throughout the product life cycle. More recently, HP has focused on making decisions such as what design activities to outsource and the corresponding organizational structures needed to manage the outsource design process by considering the characteristics of both the development and the supply chains.

Unfortunately, in most organizations, different managers are responsible for the different activities that are part of these chains. Typically, the Vice President (VP) of engineering is responsible for the development chain, the VP of manufacturing for the production portion of the chains, and the VP of supply chain or logistics for the fulfillment of customer demand. Unless carefully addressed, the typical impact of this organizational structure is a misalignment of product design and supply chain strategies.

To make matters worse, in many organizations, additional chains intersect with both the development and the supply chains. These may include the reverse logistics chain, that is, the chain associated with returns of products or components, as well as the spare-parts chain. In this chapter, we explore the various characteristics of each of these supply chains in order to better understand the impact of these on product and supply chain strategies. We illustrate how the consideration of these characteristics leads to the development of frameworks to assist in matching products with strategies.

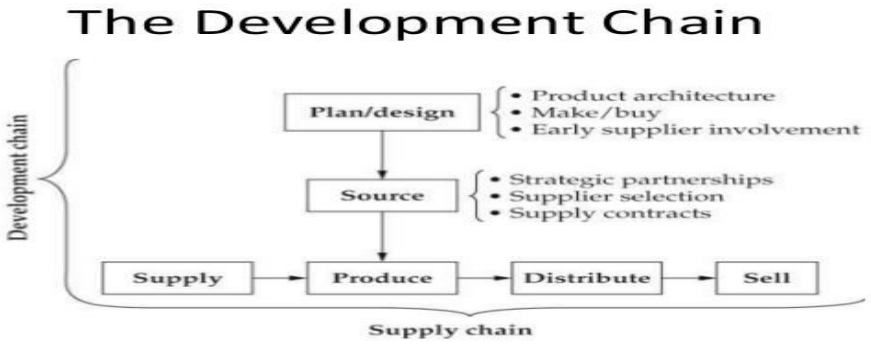

Figure 2 **The enterprise development and supply chain**

1.3 Global Optimization

What makes findings the best system wide, or globally optimal, integrated solution so difficult? A variety of factors make this a challenging problem:

1. **The supply chain is a complex network:** of facilities dispersed over a large geography, and, in many cases, all over the globe. The following example illustrates a network that is fairly typical of today's global companies.

   EXAMPLE:

   National Semiconductor, whose list of competitors includes Motorola Inc. and the Intel Corporation, is one of the world's largest manufacturers of analog devices and subsystems that are used in fax machines, cellular phones, computers, and cars. Currently, the company has four wafer fabrication facilities, two in the United States and one in Great Britain, and has test and assembly sites in Malaysia, China, and Singapore. After assembly, finished products are shipped to hundreds of manufacturing facilities all over the world, including those of Apple, Canon, Delphi, Ford, IBM, Hewlett-Packard, and Siemens. Since the semiconductor industry is highly competitive, short lead time specification and the ability to deliver within the committed due date are critical capabilities. In 1994, 95 percent of National Semiconductor's customers received their orders within 45 days from the time the order was placed, while the remaining 5 percent received their orders within 90 days. These tight lead times required the company to involve 12 different airline carriers using about 20,000 different routes. The difficulty, of course, was that no customer knew in advance if they were going to be part of the 5 percent of customers who received their order in 90 days or the 95 percent who received their order within 45 days, (www.national.com).

2. **Different facilities in the supply chain frequently have different, conflicting objectives:** For instance, suppliers typically want manufacturers to commit themselves to purchasing large quantities in stable volumes with flexible delivery dates. Unfortunately, although most manufacturers would like to implement long production runs, they need to be flexible to their customers' needs and changing demands. Thus, the suppliers' goals are in direct conflict with the manufacturers' desire for flexibility. Indeed, since production decisions are typically made without precise information about customer demand, the ability of manufacturers to match supply and demand depends largely on their ability to change supply volume as information about demand arrives. Similarly, the manufacturers' objective of making large production batches typically conflicts with the objectives of both warehouses and distribution centers to reduce

inventory. To make matters worse, this latter objective of reducing inventory levels typically implies an increase in transportation costs.

3. **The supply chain is a dynamic system:** that evolves over time. Indeed, not only do customer demand and supplier capabilities change over time, but supply chain relationships also evolve over time. For example, as customers' power increases, there is an increased pressure placed on manufacturers and suppliers to produce an enormous variety of high-quality products and, ultimately, to produce customized products.

4. **System variations over time** are also an important consideration. Even when demand is known precisely (e.g., because of contractual agreements), the planning process needs to account for demand and cost parameters varying over time due to the impact of seasonal fluctuations, trends, advertising and promotions, competitors' pricing strategies, and so forth. These time-varying demand and cost parameters make it difficult to determine the most effective supply chain strategy, the one that minimizes system wide costs and conforms to customer requirements.

Of course, global optimization only implies that it is not only important to optimize across supply chain facilities, but also across processes associated with the development and supply chains. That is, it is important to identify processes and strategies that optimize, or, alternatively, synchronize, both chains simultaneously.

1.4 The Evolution Of Supply Chain Management

In the 1980s, companies discovered new manufacturing technologies and strategies that allowed them to reduce costs and better compete in different markets. Strategies such as just-in-time manufacturing, kanban, lean manufacturing, total quality management, and others became very popular, and vast amounts of resources were invested in implementing these strategies. In the last few years, however, it has become clear that many companies have reduced manufacturing costs as much as is practically possible. Many of these companies are discovering that effective supply chain management is the next step they need to take in order to increase profits and market share.

In U.S. Economy, logistics and supply chain costs play an important role. The annual "State of Logistics Report," which is sponsored by the Council of Supply Chain Management Professionals, first published in 1989, provides an accounting of the nation's total logistics bill and tracks trends in transportation costs, inventory-carrying costs, and total logistics

costs. As one can see from Figure 3, U.S. logistics costs were over 12 percent of GDP in the early 80s, steadily decreasing until 2003. The absolute numbers are quite staggering: for 1998 the amount was $898 billion, while in 2005 it was $1.18 trillion. This $1.18 trillion represents an increase of $156 billion over 2004, which is even more striking if one considers that while the U.S. economy slowed down in 2005, logistics costs increased by about 15 percent. This increase was driven, according to the "State of Logistics Report," by "high fuel costs, truck driver and rail capacity shortages, off shoring and outsourcing and the costs of security."

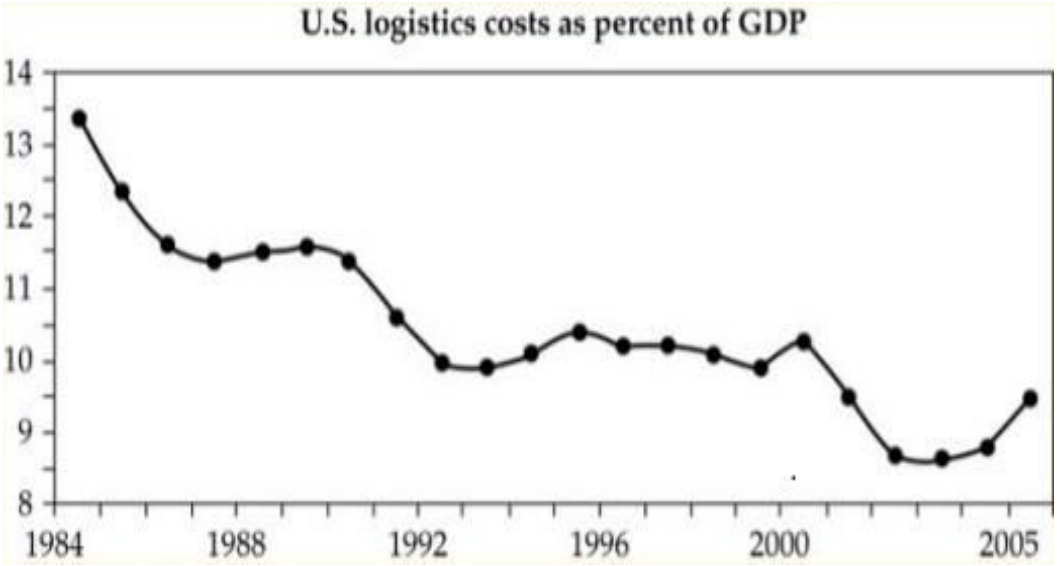

Figure 3: Logistics Cost Share of the U.S Economy

It is also interesting to understand the magnitude of the various cost components that constitute the U.S. logistics costs. These data are presented in Figure 4 (taken again from the "State of Logistics Report"), where transportation cost is by far the largest cost component; inventory cost is slightly higher than half of the transportation costs. Both costs have steadily increased in the last few years, except that, until 2003, total logistics costs increased slower than the economy growth, while they have increased faster than the economy in the last two years.

Unfortunately, this huge investment typically includes many unnecessary cost components due to redundant stock, inefficient transportation strategies, and other wasteful practices in the supply chain. For instance, experts believe that the grocery industry, a notoriously low-margin industry, can save about $30 billion, or 10 percent of its annual operating cost, by using more effective supply chain strategies. To illustrate this issue, consider the following two examples:

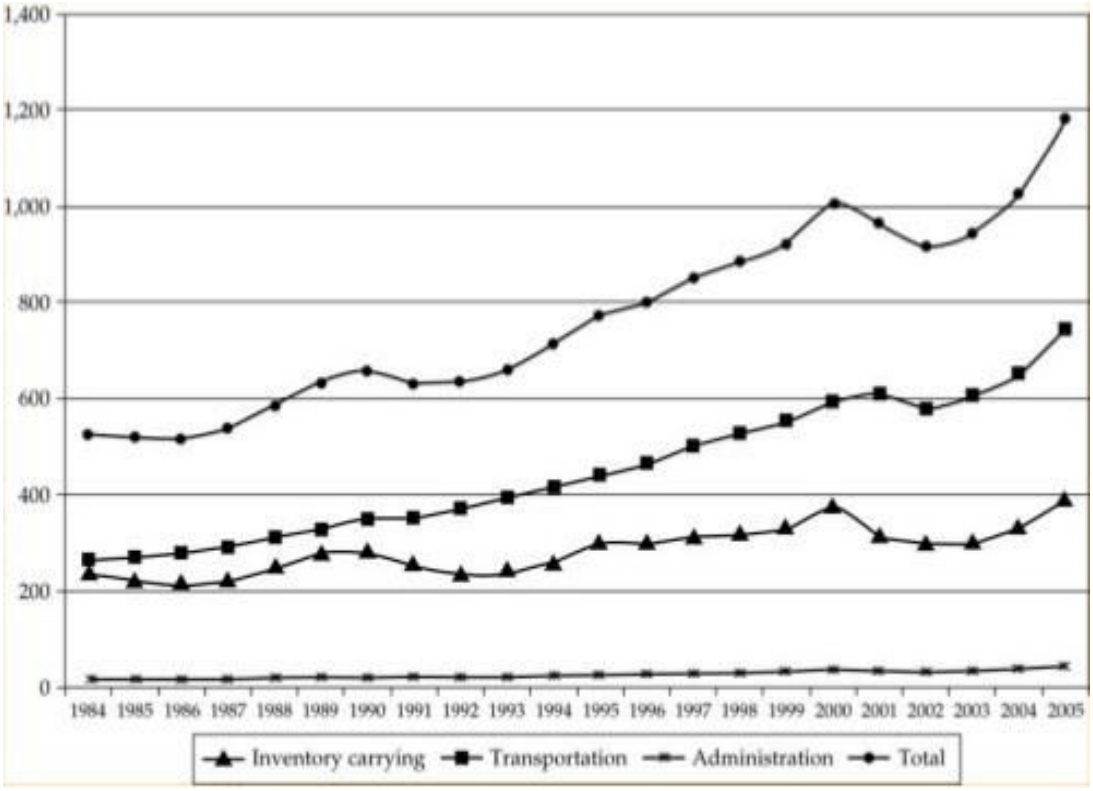

Figure 4: Total U.S. Logistics Cost Between 1984 and 2005

1. It takes a typical box of cereal more than three months to get from the factory to a supermarket.
2. It takes a typical new car, on average, 15 days to travel from the factory to the dealership. This lead time should be compared with the actual travel time, which is no more than four to five days.

Thus, in the 1990s many companies focused on strategies to reduce their costs as well as those of their supply chain partners.

EXAMPLE 1.1:

Procter & Gamble estimates that it saved retail customers $65 million in a recent 18-month supply chain initiative.“According to Procter & Gamble, the essence of its approach lies in manufacturers and suppliers working closely together ...jointly creating business plans to eliminate the source of wasteful practices across the entire supply chain”.

As the example suggests, an important building block in effective supply chain strategies is strategic partnerships between suppliers and buyers, partnerships that can help both parties reduce their costs.

Indeed, manufacturers such as Procter & Gamble and Kimberly-Clark and giant retailers like Wal-Mart have used strategic partnering as an important element in their business

strategies. Firms such as 3M, Eastman Kodak, Dow Chemical, Time Warner, and General Motors turned over large portions of their logistics operations to third party logistics providers.

At the same time, many supply chain partners engage in information sharing so that manufacturers are able to use retailers' up-to-date sales data to better predict demand and reduce lead times. This information sharing also allows manufacturers to control the variability in supply chains (known as the bullwhip effect), and by doing that reduce inventory and smooth out production.

EXAMPLE 1.2:

Among the first companies to utilize real-time information was Milliken and Company, a textile and chemicals company. Milliken worked with several clothing suppliers and major department stores, all of which agreed to use POS data from the department stores to "synchronize" their ordering and manufacturing plans. The lead time from order receipt at Milliken's textile plants to final clothing receipt at the department stores was reduced from 18 weeks to 3 weeks.

The huge pressure during the 90s to reduce costs and increase profits pushed many industrial manufacturers towards outsourcing; firms considered outsourcing everything from the procurement function to production and manufacturing. Indeed, in the mid 90s there was a significant increase in purchasing volume as a percentage of the typical firms total sales. More recently, between 1998 and 2000, outsourcing in the electronic industry has increased from 15 percent of all components to 40 percent. Finally, in the late 90s, the Internet and the related e-business models led to expectations that many supply chain problems would be solved merely by using these new technologies and business models. E-business strategies were supposed to reduce cost, increase service level, and increase flexibility and, of course, increase profits, albeit sometime in the future. In reality, these expectations frequently were not met, as many e-businesses failed. In many cases, the downfall of some of the highest-profile Internet businesses can be attributed to their logistics strategies.

EXAMPLE 1.3:

(Furniture.com), launched in January 1999, offered thousands of products from many furniture makers, although only a few brand names. The company had $22 million in sales in the first nine months of 2000 and one million visitors a month to its web site. Its downfall in November of 2000 was due to logistics details, and, in particular, in-efficient delivery processes. Initially, Furniture.com used carriers to ship its products from a central

warehouse to the customers. Since transportation costs were too high, the firm formed an alliance with six regional distributors. Unfortunately, these relationships were hard to maintain and left many problems unsolved, including handling of repairs and returns.

Of course, in many cases, the Internet introduced new channels and helped to enable the direct-to-consumer business model. These new channels required many companies to learn new skills, and added complexity to existing supply chains.

EXAMPLE 1.4:

According to the Stern Stewart EVA 1000 database, Dell Computers outperformed the competition by over 3,000 percent in terms of shareholder growth over the eight-year period from 1988 to 1996. Dell's success over this period can be attributed to its virtual integration, a strategy that blurs the traditional boundaries between suppliers, manufacturers, and end users. Dell's decision to sell computers built from components produced by other manufacturers relieved the firm of the burdens of owning assets, doing research and development, and managing a large workforce. At the same time, the Dell model of direct sales to consumers and production to order virtually eliminated finished goods inventory. These business decisions allowed Dell to grow much faster than its competition and maintain only eight days of inventory.

The landscape has changed in recent years. Industry recognized that trends, including outsourcing, off shoring, lean manufacturing, and just-in-time that focus on reducing manufacturing and supply chain costs considerably increase the level of risk in the supply chain. As a result, over the past several years, progressive firms have started to focus on strategies that find the right balance between cost reduction and risk management. A number of approaches have been applied by industry to manage risk in their supply chains:

- Building redundancy into the supply chain so that if one portion fails, for example, a fire at a warehouse or a closed port, the supply chain can still satisfy demand.
- Using information to better sense and respond to disruptive events.
- Incorporating flexibility into supply contracts to better match supply and demand.
- Improving supply chain processes by including risk assessment measures.

Of course, many of these approaches rely heavily on technology. Indeed, the implementation of ERP systems, motivated in many companies by year 2000 concerns, as well as new technology such as tools for supplier performance assessments, have created opportunities to improve supply chain resiliency and responsiveness. Similarly, advanced inventory planning systems are now used to better position inventory in the supply chain,

and to help firms better understand the impact of product design alternatives on supply chain costs and risks, thus facilitating the integration of the development chain and the supply chain.

With complexity driven by globalization, high transportation costs, poor infrastructure, weather-related disasters, and terrorist threats, managing the supply chain has become even more challenging. This may be overcome by using new technology and supply chain strategies which may deal with these challenges.

1.5 Managing Uncertainty and Risk

Global optimization is made even more difficult because supply chains need to be designed for, and operated in, uncertain environments, thus creating sometimes enormous risks to the organization. A variety of factors contribute to this:

- **Matching supply and demand is a major challenge:**
  a. Boeing Aircraft announced a write-down of $2.6 billion in October 1997 due to "raw material shortages, internal and supplier parts shortages and productivity inefficiencies . . ."
  b. "Second quarter sales at U.S. Surgical Corporation declined 25 percent, resulting in a loss of $22 million. The sales and earnings shortfall is attributed to larger than anticipated inventories on the shelves of hospitals".
  c. "There are so many different ways inventory can enter our system. It's a constant challenge to keep it under control"
  d. "Intel, the world's largest chip maker, reported a 38 percent decline in quarterly profit in the face of stiff competition from Advanced Micro Devices and a general slowdown in the personal computer market that caused inventories to swell".

Obviously, this difficulty stems from the fact that months before demand is realized, manufacturers have to commit themselves to specific production levels. These advance commitments imply huge financial and supply risks.

- **Inventory and back-order levels fluctuate considerably across the supply chain**, even when customer demand for specific products does not vary greatly. To illustrate this issue, consider Figure 5, which suggests that in a typical supply chain, distributor orders to the factory fluctuate far more than the underlying retailer demand.

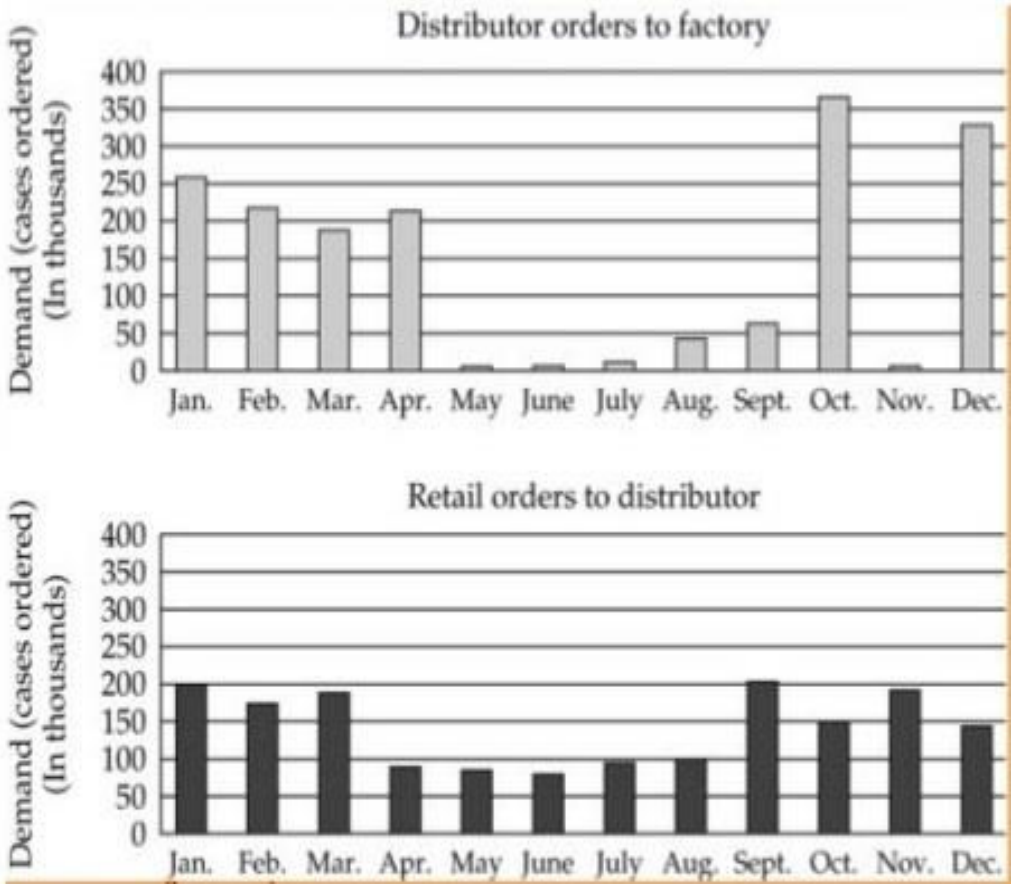

Figure 5: Order Variations in the Supply Chain

- **Forecasting doesn't solve the problem**. Indeed, we will argue that the first principle of forecasting is that "forecasts are always wrong." Thus, it is impossible to predict the precise demand for a specific item, even with the most advanced forecasting techniques.

- **Demand is not the only source of uncertainty**. Delivery lead times, manufacturing yields, transportation times, and component availability also can have significant supply chain impact.

- **Recent trends such as lean manufacturing, outsourcing, and offshoring that focus on cost reduction increase risks significantly**. For example, consider an automotive manufacturer whose parts suppliers are in Canada and Mexico. With little uncertainty in transportation and a stable supply schedule, parts can be delivered to assembly plants "just-in-time" based on fixed production schedules. However, in the event of an unforeseen disaster, such as the September 11 terrorist attacks, port strikes, or weather-related calamities, adherence to this type of strategy could result in a shutdown of the production lines due to lack of parts. Similarly, outsourcing and offshoring imply that

the supply chains are more geographically diverse and, as a result, natural and man-made disasters can have a tremendous impact.

Although uncertainty and risk cannot be eliminated completely, there are many examples when the companies make the use of product design strategies, network modeling, information technology, procurement, and inventory strategies to minimize uncertainty, and to build flexibility and redundancy in the supply chain in order to reduce risks.

1.6 Key Issues and Complexities in Supply Chain Management:

In this section, we introduce some of the supply chain management issues that we would also discuss in much more detail throughout the remaining chapters. These issues span a large spectrum of a firm's activities, from the strategic through the tactical to the operational level:

- The strategic level deals with decisions that have a long-lasting effect on the firm. This includes decisions regarding product design, what to make internally and what to outsource, supplier selection, and strategic partnering as well as decisions on the number, location, and capacity of warehouses and manufacturing plants and the flow of material through the logistics network.
- The tactical level includes decisions that are typically updated anywhere between once every quarter and once every year. These include purchasing and production decisions, inventory policies, and transportation strategies, including the frequency with which customers are visited.
- The operational level refers to day-to-day decisions such as scheduling, lead time quotations, routing, and truck loading.

Below we introduce and discuss some of the key issues, questions, and trade-offs associated with different decisions.

(i) Distribution Network Configuration: Consider several plants producing products to serve a set of geographically dispersed retailers. The current set of warehouses is deemed inappropriate, and management wants to reorganize or redesign the distribution network. This may be due, for example, to changing demand patterns or

the termination of a leasing contract for a number of existing warehouses. In addition, changing demand patterns may require a change in plant production levels, a selection of new suppliers, and a new flow pattern of goods throughout the distribution network. How should management select a set of warehouse locations and capacities, determine production levels for each product at each plant, and set transportation flows between facilities, either from plant to warehouse or warehouse to retailer, in such a way as to minimize total production, inventory, and transportation costs and satisfy service level requirements? This is a complex optimization problem, and advanced technology and approaches are required to find a solution.

(ii) **Inventory Control:** Consider a retailer that maintains an inventory of a particular product. Since customer demand changes over time, the retailer can use only historical data to predict demand. The retailer's objective is to decide at what point to reorder a new batch of the product, and how much to order so as to minimize inventory ordering and holding costs. More fundamentally, why should the retailer hold inventory in the first place? Is it due to uncertainty in customer demand, uncertainty in the supply process, or some other reasons? If it is due to uncertainty in customer demand, is there anything that can be done to reduce it? What is the impact of the forecasting tool used to predict customer demand? Should the retailer order more than, less than, or exactly the demand forecast? And, finally, what inventory turnover ratio should be used? Does it change from industry to industry?

(iii) **Production Sourcing:** In many industries, there is a need to carefully balance transportation and manufacturing costs. In particular, reducing production costs typically implies that each manufacturing facility is responsible for a small set of products so that large batches are produced, hence reducing production costs. Unfortunately, this may lead to higher transportation costs. Similarly, reducing transportation costs typically implies that each facility is flexible and has the ability to produce most or all products, but this leads to small batches and hence increases production costs. Finding the right balance between the two cost components is difficult but needs to be done monthly or quarterly.

(iv) **Supply Contracts:** In traditional supply chain strategies, each party in the chain focuses on its own profit and hence makes decisions with little regard to their impact on other supply chain partners. Relationships between suppliers and buyers are established by means of supply contracts that specify pricing and volume discounts, delivery lead times, quality, returns, and so forth. The question, of course, is whether supply contracts also can be used to replace the traditional supply chain strategy

with one that optimizes the entire supply chain performance. In particular, what is the impact of volume discount and revenue-sharing contracts on supply chain performance? Are there pricing strategies that can be applied by suppliers to provide incentives for buyers to order more products while at the same time increasing the supplier profits?

(v) **Distribution Strategies:** An important challenge faced by many organizations is how much should they centralize (or decentralize) their distribution system. What is the impact of each strategy on inventory levels and transportation costs? What about the impact on service levels? And, finally, when should products be transported by air from centralized locations to the various demand points? These questions are not only important for a single firm determining its distribution strategy, but also for competing retailers that need to decide how much they can collaborate with each other. For example, should competing dealers selling the same brand share inventory? If so, what is their competitive advantage?

(vi) **Supply Chain Integration and Strategic Partnering** As observed earlier, designing and implementing a globally optimal supply chain is quite difficult because of its dynamics and the conflicting objectives employed by different facilities and partners. Nevertheless, Dell, Wal-Mart, and Procter & Gamble success stories demonstrate not only that an integrated, globally optimal supply chain is possible, but that it can have a huge impact on the company's performance and market share. Of course, one can argue that these three examples are associated with companies that are among the biggest companies in their respective industries; these companies can implement technologies and strategies that very few others can afford. However, in today's competitive markets, most companies have no choice; they are forced to integrate their supply chain and engage in strategic partnering. This pressure stems from both their customers and their supply chain partners. How can integration be achieved successfully?

Clearly, information sharing and operational planning are the keys to a successfully integrated supply chain. But what information should be shared? How should it be used? How does information affect the design and operation of the supply chain? What level of integration is needed within the organization and with external partners? Finally, what types of partnerships can be implemented, and which type should be implemented for a given situation?

(vii) **Outsourcing and Offshoring Strategies:** Rethinking your supply chain strategy not only involves coordinating the different activities in the supply chain, but also deciding what to make internally and what to buy from outside sources. How can a

firm identify what manufacturing activities lie in its set of core competencies, and thus should be completed internally, and what product and components should be purchased from outside sup4pliers, because these manufacturing activities are not core competencies? Is there any relationship between the answer to that question and product architecture? What are the risks associated with outsourcing and how can these risks be minimized? When you do outsource, how can you ensure a timely supply of products? And when should the firm keep dual sources for the same component? Finally, even if the firm decides not to outsource activities, when does it make sense to move facilities to the Far East? What is the impact of offshoring on inventory levels and the cost of capital? What are the risks?

(viii) **Product Design:** Effective design plays several critical roles in the supply chain. Most obviously, certain product designs may increase inventory holding or transportation costs relative to other designs, while other designs may facilitate a shorter manufacturing lead time. Unfortunately, product redesign is often expensive. When is it worthwhile to redesign products so as to reduce logistics costs or supply chain lead times? Is it possible to leverage product design to compensate for uncertainty in customer demand? Can one quantify the amount of savings resulting from such a strategy? What changes should be made in the supply chain to take advantage of the new product design? Finally, new concepts such as mass customization are increasingly popular. What role does supply chain management play in the successful implementation of these concepts?

(ix) **Information Technology and Decision-Support Systems:** Information technology is a critical enabler of effective supply chain management. Indeed, much of the current interest in supply chain management is motivated by the opportunities that appeared due to the abundance of data and the savings that can be achieved by sophisticated analysis of these data. The primary issue in supply chain management is not whether data can be received, but what data should be transferred; that is, which data are significant for supply chain management and which data can safely be ignored? How frequently should data be transferred and analyzed?

What is the impact of the Internet? What is the role of electronic commerce? What infrastructure is required both internally and between supply chain partners? Finally, since information technology and decision-support systems are both available, can these technologies be viewed as the main tools used to achieve competitive advantage in the market? If they can, then what is preventing others from using the same technology?

(x) **Customer Value:** Customer value is the measure of a company's contribution to its customer, based on the entire range of products, services, and intangibles that constitute the company's offerings. In recent years, this measure has superseded measures such as quality and customer satisfaction. Obviously, effective supply chain management is critical if a firm wishes to fulfill customer needs and provide value. But what determines customer value in different industries? How is customer value measured? How is information technology used to enhance customer value in the supply chain? How does supply chain management contribute to customer value? How do emerging trends in customer value, such as development of relationships and experiences, affect supply chain management? What is the relationship between product price and brand name in the conventional world and in the online world?

(xi) **Smart Pricing:** Revenue management strategies have been applied successfully in industries such as airlines, hotels, and rental cars. In recent years, a number of manufactures, retailers, and carriers have applied a variation of these techniques to improve supply chain performance. In this case, the firm integrates pricing and inventory (or available capacity) to influence market demand and improve the bottom line. How is this done? Can "smart" pricing strategies be used to improve supply chain performance? What is the impact of rebate strategies on the supply chain?

Each of these issues and strategies is discussed in great detail in the subsequent chapters. As you will observe, the focus in each case is on either the development chain or the supply chain and the focus is on achieving a globally optimized supply chain or managing risk and uncertainty in the supply chain, or both. A summary is provided in Table 1 as below.

Table 1-1: Key Issues in Supply Chain Management

	Chain	Global Optimization	Managing risk and Uncertainty
Distribution network configuration	Supply	Y	
Inventory control	Supply		Y
Production sourcing	Supply	Y	
Supply contracts	Both	Y	Y
Distribution strategies	Supply	Y	Y
Strategic partnering	Development	Y	
Outsourcing and offshoring	Development	Y	
Product design	Development		Y
Information technology	Supply	Y	Y

Customer Value	Both	Y	Y
Smart pricing	Supply	Y	

The preceding section describes a number of supply chain management success stories: Procter & Gamble, Wal-Mart, and others. They suggest that, in some industries, supply chain management is perhaps the single most important factor determining the success of the firm. Indeed, in the computer and printer industries, where most manufacturers use the same suppliers and identical technologies, companies compete on cost and service levels, the two key elements in our definition of supply chain management. The examples also raise an important question. If these firms have improved supply chain performance by focusing on strategic partnering, using information sharing and technology, or by applying risk mitigation strategies, what inhibits other firms from adopting the same techniques to improve their supply chain performance?

The earlier discussion suggests that the answer involves three critical abilities that successful firms must possess:

(a) The ability to match supply chain strategies with product characteristics. Indeed, it is clear that the supply chain strategy for products and industries where the technology changes frequently, the so-called fast clock speed products, must be fundamentally different than that of slow clock speed products. Similarly, product design strategy not only depends on characteristics of the development chain not also on supply chain characteristics. Thus, the intersection of the development chain and the supply chain has an impact on both product design and supply chain strategy.

(b) The ability to replace traditional supply chain strategies, in which each facility or party in the chain makes decisions with little regard to their impact on other supply chain partners, by those that yield a globally optimized supply chain.

(c) The ability to effectively manage uncertainty and risk. As observed earlier, initiatives such as outsourcing and offshoring and manufacturing strategies such as lean and just-in-time have significantly increased the level of risk for the enterprise. This is complemented by the significant increase in the level of demand uncertainty. Indeed, in high-tech industries, product life cycles are becoming shorter and shorter. In particular, many computer and printer models have life cycles of only a few months, so the manufacturer may have only one order or production opportunity.

Unfortunately, since these are new products, no historical data are available that allow the manufacturer to accurately predict customer demand. At the same time, the proliferation of products in these industries makes it increasingly difficult to predict demand for a specific model. Finally, significant price declines in these industries are common, reducing the product value during its life cycle.

EXAMPLE:

A Korean manufacturer of electrical products such as industrial relays is facing a service level of about 70 percent; that is, only about 70 percent of all orders are delivered on time. On the other hand, inventory keeps piling up, mostly of products that are not in demand. The manufacturer's inventory turnover ratio, defined as the ratio of the annual flow to average inventory at the manufacturer's main warehouse, is about four. However, in the electronics industry, leading companies turn inventory over about nine times a year. If the Korean manufacturer can increase its inventory turns to this level, it will be able to significantly reduce inventory levels. The manufacturer is thus searching for new strategies that will increase service levels over the next three years to about 99 percent and, at the same time, significantly decrease inventory levels and cost.

Just a few years ago, most analysts would have said that these two objectives, improved service and inventory levels, could not be achieved at the same time. Indeed, traditional inventory theory tells us that to increase service level, the firm must increase inventory and therefore cost. Surprisingly, recent developments in information and communications technologies, together with a better understanding of supply chain strategies, have led to innovative approaches that allow the firm to improve both objectives simultaneously. Throughout the rest of this book, we endeavor to present these approaches and strategies in detail. We will focus on demonstrating why certain strategies are adopted, what the trade-offs are between different strategies, and how specific strategies are implemented in practice.

1.7 Summary:

In the last few years, interest in logistics and supply chain management has grown many times because of many reasons. This has led many companies to analyze their supply chains. Previously it was being done just on the basis of experience and intuition of managers; very few analytical models or design tools were available for the purpose. Meanwhile, in the last two decades, the academic community has developed various models

and tools to assist with the management of the supply chain. This had brought revolution in analysis and understanding has improved significantly. Today, we have many decision support systems which are extensively used by business managers in their supply chain related issues.

For example, transportation managers deciding which modes of transportation to use, inventory control managers wanting to ensure smooth production with as little inventory as possible, purchasing/supply managers designing contracts with their company's suppliers and clients, and logistics managers in charge of their company's supply chains all have been largely benefited from these newly developed decision support systems.

"Supply chain management is a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system wide costs while satisfying service level requirements."

It is apparent from above definition that f*irst*, supply chain management takes into consideration every facility that has an impact on cost and plays a role in making the product conform to customer requirements: from supplier and manufacturing facilities through warehouses and distribution centers to retailers and stores. Indeed, in some supply chain analysis, it is necessary to account for the suppliers' suppliers and the customers' customers because they have an impact on supply chain performance.

Second, the objective of supply chain management is to be efficient and cost-effective across the entire system; total system wide costs, from transportation and distribution to inventories of raw materials, work in process, and finished goods, are to be minimized. Thus, the emphasis is not on simply minimizing transportation cost or reducing inventories but, rather, on taking a systems approach to supply chain management. *Finally*, because supply chain management revolves around an efficient integration of suppliers, manufacturers, warehouses, and stores, it encompasses the firms' activities at many levels, from the strategic level through the tactical to the operational level.

Today's fierce competition in global markets, the introduction of products with shorter life cycles, and the heightened expectations of customers have forced business enterprises to invest in, and focus attention on, their supply chains. This, together with continuing advances in communications and transportation technologies (e.g., mobile communication, Internet, and overnight delivery), has motivated the continuous evolution of the supply chain and of the techniques to manage it effectively. In a typical supply chain, raw materials

are procured and items are produced at one or more factories, shipped to warehouses for intermediate storage, and then shipped to retailers or customers. Consequently, to reduce cost and improve service levels, effective supply chain strategies must take into account the interactions at the various levels in the supply chain. The supply chain, which is also referred to as the logistics network, consists of suppliers, manufacturing centers, warehouses, distribution centers, and retail outlets, as well as raw materials, work-in-process inventory, and finished products that flow between the facilities.

In addition to above, this lesson will also cover many issues of supply chains and also discuss the different types of risks and complexities associated with the supply chain of a company.

1.8 Self-Assessment Questions

DISCUSSION QUESTIONS

1. Consider the supply chain for a domestic automobile.
    a. What are the components of the supply chain for the automobile?
    b. What are the different firms involved in the supply chain?
    c. What are the objectives of these firms?
    d. Provide examples of conflicting objectives in this supply chain.
    e. What are the risks that rare or unexpected events pose to this supply chain?

2. Consider a consumer mortgage offered by a bank.
    a. What are the components of the supply chain for the mortgage?
    b. Is there more than one firm involved in the supply chain? What are the objectives of the firm or firms?
    c. What are the similarities between product and service supply chains? What are the differences?

3. What is an example of a supply chain that has evolved over time?

4. A vertically integrated company is a company that owns, manages, and operates all its business functions. A horizontally integrated company is a corporation consisting of a number of companies, each of which is acting independently. The corporation provides branding, direction, and general strategy. Compare and contrast the supply chain strategies of the two types of companies.

5. If a firm is completely vertically integrated, is effective supply chain management still important?

6. Consider the supply chain for canned peaches sold by a major food processing company. What are the sources of uncertainty in this supply chain?

7. Consider a firm redesigning its logistics network. What are the advantages to having a small number of centrally located warehouses? What are the advantages to having a larger number of warehouses closer to the end customers?

1.9 Keywords:

Supply Chain Management: SCM is the management of a network of all business processes and activities involving procurement of raw materials, manufacturing and distribution management of Finished Goods.

Global Optimization: When a supply chain is a complex network of facilities dispersed over all over the globe, it needs to be optimized

Development Chain: The development chain is the set of activities and processes associated with new product introduction.

IT in SCM: IT provides various types of decision support systems which are helpful for the managers in their decisions pertaining to SCM.

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Subject: Supply Chain Management	
Course Code: POM-323	Author: Prof.(Dr) Hemant Sharma
Lesson No.: 2	Vetter:
Achieving Excellence in Supply Chain Management	

Structure

2.0 Objectives:

This chapter will help the students to understand the:

- Meaning of operational excellence in SCM as management strategy
- Dimensions of excellence in SCM
- Benefits of excellence in SCM for organization
- Beliefs in achieving excellence in SCM
- Principles of achieving excellence in SCM

2.1 Introduction

Supply Chain Management (SCM) is the streamlining of a business' supply-side activities to maximize customer value and to gain a competitive advantage in the marketplace. Supply Chain Management (SCM) represents an effort by suppliers to develop and implement supply chains that are as efficient and economical as possible. Supply Chain Management Excellence is a management strategy that helps manufacturers to optimize their performance in those areas that really matter, achieve preferred supplier status, and survive in extremely competitive markets. Implementing such program is challenging but possible when companies use appropriate software solutions.

Four Ways to Spot Supply Chain Improvement Ideas:

These are four places to start your search for places to improve your supply chain:

- **Information Flow:** With so many cogs in motion at every point of the supply chain, communicating the associated information is the oil that keeps things moving along. If any one point fails to communicate effectively with the next, things can easily slow down or, worse, seize up completely. A scheduled audit of information flow from beginning to end should occur anyway, but spot checks on individual areas are also worthwhile. Asking workers about frustrating elements of their daily routine or what they could be given to improve their job is one way to highlight gaps in communication. More often than not, someone needs something but hasn't asked for it, someone else doesn't know they should be providing it, or sometimes both! Simply asking questions on the subject can iron out basic information bottlenecks .Other issues may require more complex solutions, such as new reports or communication systems. Either way, you'll be able to highlight inefficiency and decide whether or not it's critical to resolve.

- **Cost Analysis:** Breaking down your processes into costs and comparing various stages of the supply chain helps to better understand where your largest logistics expenses are incurred. It may be that the patterns are just as you expected, with peaks at known expensive stages and troughs where you know costs to be cheaper. But flagging these spikes helps teams to place the value of their particular functions and the potential cost of mistakes. Some spikes may also be unexpectedly high, providing a point to start deeper research into reasons and improvements. Comparing the costs of each stage over time will also help to highlight any disproportional increases, perhaps prompting a

review of suppliers at that point in the process. An entire section of the supply chain may even require rethinking if costs rise too quickly, but your business will need to be monitoring that area to know when that's the case.

- **Waste Reduction:** Waste means much more than what we throw away. In essence, money is thrown away at any point in the supply chain where something takes more time than is necessary or requires additional work that doesn't benefit the overall process. Look for areas of the process where actions take longer to achieve than you would expect, or where there are frequent failures to deliver. It may be that an inefficient process or unnecessary rework is to blame. In transportation, areas of waste such as empty journeys, waiting time, and outdated routes or schedules should all be closely scrutinized for improvement potential. As with identifying information flow issues, anecdotal evidence can be an excellent source of ideas to reduce waste. Drivers and operations workers usually have comprehensive knowledge of their piece of the supply chain puzzle, and their information can help you to get a clearer idea of what the full picture should look like.
- **Reporting Gaps:** If information flow concerns the fluidity of day-to-day operations, reporting provides the longer term picture of how these areas are performing. Supply chain managers – and those above them in the organization – require these reports to make strategic decisions on sourcing, service providers, employment, and many other broader business considerations. Where reports are lacking, organization may be making blind decisions, or at least with incomplete information. Sometimes reports exist but fail to answer key questions. If one hears the same thing being asked at every meeting without a comprehensive answer, the likelihood is that there's a reporting gap to be filled. Even when the supply chain appears to be functioning correctly according to the numbers on show, be sure to probe individual elements of a report, especially those on which crucial decisions are made, to be sure that the calculations underpinning them are solid. Often reporting glitches can prove to be a trip down the rabbit hole, pulling a thread that unravels a variety of preceding areas for improvement.

The complete road map to achieve excellence in SCM is given as below:

a. Business as usual: Organizational elements pursuing self interests

b. Link Excellence: Starting point for supply chain excellence
c. Visibility: Next step in establishing visible presence with other supply chain links
d. Collaboration: using visibility to do the work smarter and meet market place demands
e. A continuous improvement process to harness the energy of change
f. Velocity: The ideal state of synthesis with speed, faster

2.2 Dimensions of Supply Chain Management:

It is important to understand the various dimensions of supply chain in order to achieve excellence in SCM. The different dimensions of supply chain have been described as following:

- ✓ **Alignment**: Supply Chains are characterized by having tightest alignment between the overall strategies and supply chain strategy and execution. Supply chain supports the business. Those supply chains that best synchronise that support with the strategies and objectives of the business are at the top of the performance heap – recognising that the business itself may not execute well, or have the wrong strategy.

- ✓ **Strategic Depth:** Great supply chains are characterized by detailed and "living" strategies that are directly connected to the support of the businesses. The strength of strategy, how well that strategy turns into what the supply chain actually does, is critical elements of supply chain excellence.

- ✓ **Customer Satisfaction with Supply Chain Performance:** This dimension takes into account the company's overall value proposition or unique value props to different markets- the supply chain expectations from customers should be different depending on that (e.g., efficiency vs. service).

- ✓ **Supply Chain Network Design:** Network design is tied at the hip with supply chain strategy. It is the crucible in which the trade-offs between cost, service, flexibility and more must be managed, either explicitly or implicitly. Supply chain is driven in large part by the quality of the network it operates in.

- ✓ **Macro Agility:** One of the few true sources of overall corporate competitive advantage is the ability to respond consistently faster to opportunities and changing strategies than the others do. There are two components to this agility, a more strategic, *longer term*

view and a more real-time, *right now view***.** This is the strategic component. CEOs want their companies to respond more quickly to market changes and opportunities. For product companies, this largely means how fast the supply chain can respond.

- ✓ **Micro Agility:** The other side of the flexibility dimension is the ability to react more quickly and intelligently to near-term changes in the supply-demand equation and other issues related to execution. Many current supply chain "buzz" concept relate to this micro flexibility: demand sensing, real-time planning, response management and more. This area is a little easier to measure than macro flexibility. It impacts both cost and revenue.

- ✓ **Talent Management:** It seems hard to argue against the idea that how well a company manages and develops its internal talent is a key component of how good the company's supply chain is. Clearly, many companies thought of as supply chain leaders (e.g., Procter & Gamble, Pepsico, The Limited Brands) focus on this dimension continuously, if that leads them to play the role of farm system for others that will not invest in that talent development. Talent management has a lot to do with how "sustainable" a company's supply chain really is and seeing growing recognition throughout the industry.

- ✓ **Technology Management:** This is another area that is often overlooked, but clearly there is a wide range of approaches and results between companies, often in the same industry. this has to do not only how much is invested in the technology but even more important than spend levels are such areas as how well new technologies are implemented, how often the returns are at or above what was projected, how well the full relevant capabilities are utilized, and more.

- ✓ **Collaboration Intensity:** Companies are realizing that the next natural path to improve supply chain performance versus the competition is in improving integration and collaboration with trading partners. Companies that are better at collaboration have better supply chains.

- ✓ **Supply Chain Culture:** Culture is set from the top, so leadership is the most important factor. But other elements include the approach to risk taking, the extent to which there is a "learning culture" in the supply chain, how well the supply staff is truly valued, how well innovation is fostered and more.

2.3 Operational Excellence in Supply Chain Management

Supply Chains are complex systems of interdependent organizations and processes. Engineering, sales, manufacturing, procurement, logistics all play a key role in the creation and delivery of goods to customers. Each of these processes has its own challenges, goals and optimal operating strategies that drive local actions. Reconciling these often conflicting actions and creating a single high performance whole is the key challenge for Supply Chain Operational Excellence.

Today, excellence is fast becoming "The Strategy" for manufacturing companies. Today's customers are continuously demanding higher quality, better service and lower costs. And globalization makes it easy to shift allegiance when suppliers do not satisfy their needs. Investors are likewise punishing companies that don't achieve consistent growth, increase earnings and higher return on assets. Surviving in the new competitive environment is a challenge. And economic depression across the globe makes it difficult. Operational excellence is a strategy and helps companies distinguish themselves, become preferred suppliers and expand market positions.

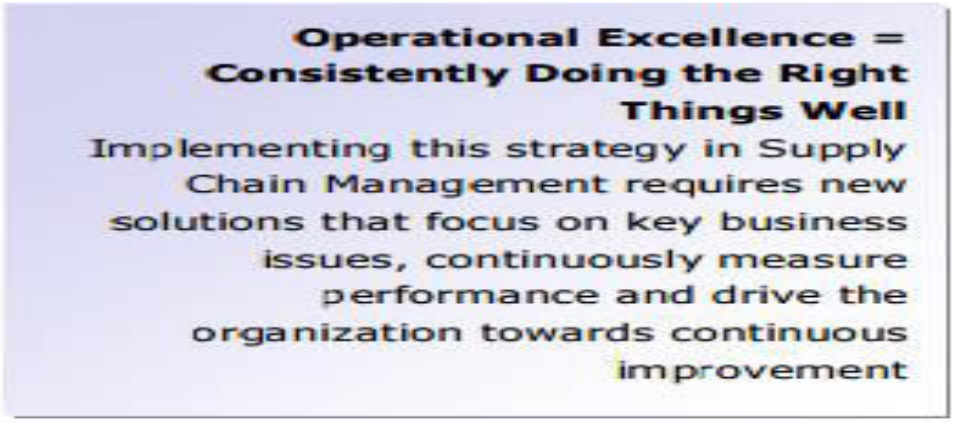


Figure 1: Operational Excellence

Performance of individual processes can be measured by two characteristics. First, how good is average performance in terms of quality, cost, service, reliability, lead time, etc. Second, how responsive is the process with respect to changes in requirements and reacting to internal problems. Customers expect their preferred suppliers to provide good performance all the time. Similarly, supply chain performance can also be measured by average performance and responsiveness to change, but on an end-to-end basis. Since the supply chain is a system, the "weakest and "least responsive" processes determine the performance of the entire supply chain.

Operational excellence in SCM implies Operational Excellence within each of the individual processes and in the way the supply chain operates as a whole. Customers have many touch points with supply chains and expect high levels of quality, cost and service in all of their interactions. They expect all supply chain processes to work together, with seamless information flow and smooth material handoffs.

Individual supply chain processes are generally complex and require some form of control. This includes planning system that determine what to do and execution system that ensure these plans are achieved. Operational Excellence programs focus on continuously improving these processes to ensure that performance is consistent reliable and achieve certain goals. As, it is clear from figure 2 that not only are daily tasks planned and executed, but past performance is analysed and used to adapt strategies to attain higher level of performance. While individual operational excellence programs are vital to establishing a reliable supply chain, these programs must be tempered by their impact on the supply chain's overall goals.

Figure 2: The basic Operational Excellence Process

For a better understanding, you may have a look on the following table no. 1 that comprises of various processes in KPI Industries where management needs to focus in order to gain operational excellence in supply chain.

Leveraging Operational Excellence for Supply Chain Management

Operational excellence for supply chain is focused on optimizing performance across all processes. Like individuals processes, Supply chains are also complex processes and demand their own, separate control systems to develop and execute optimal plans.

- Which plant should satisfy which order?
- What is the best production sequence considering manufacturing and distribution requirements?
- Should we increase inventories to enable longer production runs?

These are all question that require a global perspective of supply chain objectives. Depending upon supply chain complexity, this can result in a hierarchy of operational excellence processes with each new level addressing increasingly global issues across broader processes and process groups.

Table No. 1: Basic Processes in KPI Industry

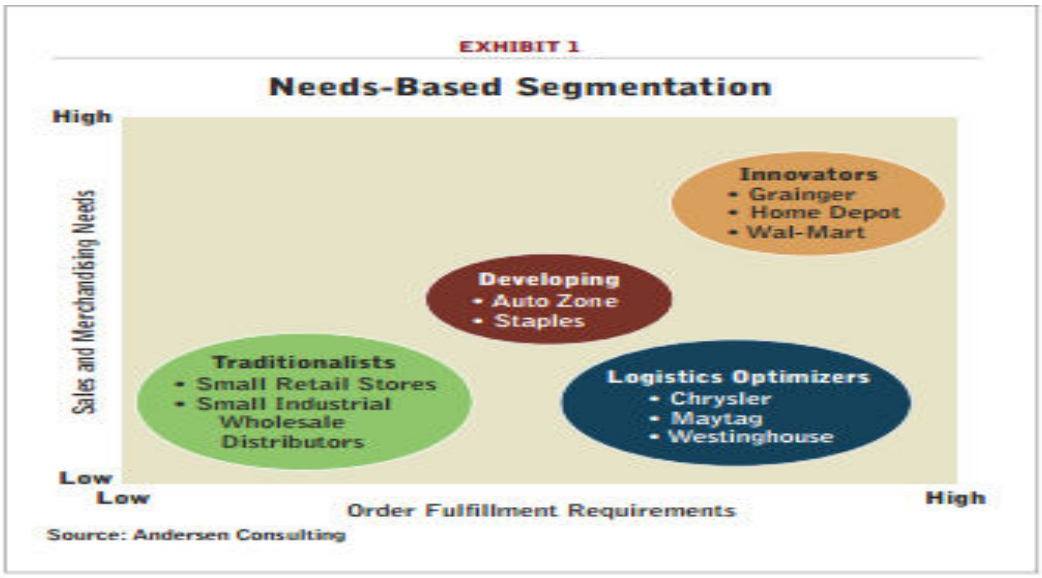
KPI	DESCRIPTION
Delivery Performance	The performance of orders that are fulfilled on or before customer request date or original scheduled date.
Fill Rate	% of shipments from stock orders shipped within 24 hours of order receipt
Lead Time	The average actual lead times consistently achieved from customer authorization to receipt of order.
Perfect Order Fulfilment	The % of orders meeting delivery performance, with complete and accurate documentation and not damaged
Supply Chain Response Time	The time it takes the Integrated Supply Chain to Respond to abnormal (significant) change in demand
Production Flexibility	Upside: number of days required to achieve an unplanned sustainable 20% increase in production Downside: % order reduction sustainable at 30 days prior to delivery with no inventory or cost penalties
Total Logistics Cost	Sum of Supply Chain Related Cost for: MIS Finance, Planning, Planning, Inventory, Material acquisition, Order Management
Value Added Productivity	calculated as Total Product Revenue, less Total Material
Warranty Cost	Materials, labour and problem diagnosis for product defects
Inventory Days Of Supply	Total gross value of inventory at standard cost before reserves for excess and obsolescence
Cash To Cash Cycle Time	Inventory days of Supply + Days Sales Outstanding-days of payables

2.4 Principles of Excellence in Supply Chain Management

Several principles of supply chain management have been discussed as below for attaining excellence in supply chain management.

❖ **Principle 1: Segment customers based on the service needs**

Segmentation traditionally group the customers by industry, product, or trade channel and then taken a one-size: fits-all approach to serving them, averaging costs and profitability within and across segments. However, in this type of segmentation, it is difficult to understand the relative value customers place on company's service offerings." But segmenting customers by their particular needs equips a company to develop a portfolio of services tailored to various segments. Surveys, interviews, and industry research have been the traditional tools for defining key segmentation criteria. Viewed from the classic perspective, this needs-based segmentation may produce some odd couples. For the manufacturer in Exhibit 1, "innovators" include an industrial distributor (Grainger), a do-it-yourself retailer (Home Depot), and a mass merchant (Wal-Mart).



Research also can establish the services valued by all customers versus those valued only by certain segments. Then the company should apply a disciplined, cross-functional process to develop a menu of supply chain programs and create segment-specific service packages that combine basic services for everyone with the services from the menu that will have the greatest appeal to particular segments. The goal is to find the degree of segmentation and variation needed to maximize profitability.

For example, all the segments in Exhibit 1, value consistent delivery. But those in the lower left quadrant have little interest in the advanced supply chain management programs, such

as customized packaging and advance shipment notification, that appeal greatly to those in the upper right quadrant. Of course, customer needs and preferences do not tell the whole story. The service packages must turn a profit, and many companies lack adequate financial understanding of their customers' and their own costs to gauge likely profitability. "We don't know which customers are most profitable to serve, which will generate the highest long-term profitability or which we are most likely to retain," confessed a leading industrial manufacturer. This knowledge is essential to correctly matching accounts with service packages—which translates into revenues enhanced through some combination of increases in volume and/or price.

Most companies have a significant untapped opportunity to better align their investment in a particular customer relationship with the return that customer generates. To do so, companies must analyse the profitability of segments, plus the costs and benefits of alternate service packages, to ensure a reasonable return on their investment and the most profitable allocation of resources. To strike and sustain the appropriate balance between service and profitability, most companies will need to set priorities—sequencing the rollout of tailored programs to capitalize on existing capabilities and maximize customer impact.

- **Principle 2: Customize the logistics networks**

Companies have traditionally taken a massive approach to logistics network design in organizing their inventory, warehouse, and transportation activities to meet a single standard. For some, the logistics network has been designed to meet the average service requirements of all customers; for others, to satisfy the toughest requirements of a single customer segment. Neither approach can achieve superior asset utilization or accommodate the segment-specific logistics necessary for excellent supply chain management. In many industries, especially such commodity industries as fine paper, tailoring distribution assets to meet individual logistics requirements is a greater source of differentiation for a manufacturer than the actual products, which are largely undifferentiated.

One paper company found radically different customer service demands in two key segments—large publishers with long lead times and small regional printers needing delivery within 24 hours. To serve both segments well and achieve profitable growth, the manufacturer designed a multi-level logistics network with three full-stocking distribution centres and 46 quick-response cross-docks, stocking only fast-moving items, located near the regional printers. Return on assets and revenues improved substantially thanks to the

new inventory deployment strategy, supported by outsourcing of management of the quick response centres and the transportation activities.

This example highlights several key characteristics of segment-specific services. The logistics network probably will be more complex, involving alliances with third-party logistics providers, and will certainly have to be more flexible than the traditional network. As a result, fundamental changes in the mission, number, location, and ownership structure of warehouses are typically necessary.

❖ Principle 3: Listen to Signals of Market Demand and Plan accordingly

Today, forecasting has become most critical, with multiple departments' independently creating forecasts for the same products—all using their own assumptions, measures, and level of detail. Many consult the marketplace only informally, and few involve their major suppliers in the process. The functional orientation of many companies has just made things worse, allowing sales forecasts to envision growing demand while manufacturing second-guesses how much product the market actually wants. Such independent, self-centred forecasting is incompatible with excellent supply chain management, as one manufacturer of photographic imaging found.

This manufacturer nicknamed the warehouse "the accordion" because it had to cope with a production operation that stuck to a stable schedule, while the revenue-focused sales force routinely triggered cyclical demand by offering deep discounts at the end of each quarter. The manufacturer realized the need to implement a cross-functional planning process, supported by demand planning software. Initial results were dismaying. Sales volume dropped sharply, as excess inventory had to be consumed by the marketplace. But today, the company enjoys lower inventory and warehousing costs and much greater ability to maintain price levels and limit discounting.

Like all the best sales and operations planning (S&OP), this process recognizes the needs and objectives of each functional group but bases final operational decisions on overall profit potential. Excellent supply chain management, in fact, calls for S&OP that transcends company boundaries to involve every link of the supply chain (from the supplier's supplier to the customer's customer) in developing forecasts collaboratively and then maintaining the required capacity across the operations. Channel-wide S&OP can detect early warning signals of demand lurking in customer promotions, ordering patterns, and restocking algorithms and takes into account vendor and carrier capabilities, capacity, and constraints.

❖ **Principle 4: Differentiate product closer to the customer**

Traditionally, manufacturers have production goals based on projections of the demand for finished goods and have stockpiled inventory to offset forecasting errors. These manufacturers tend to view lead times in the system as fixed, with only a finite window of time in which to convert materials into products that meet customer requirements.

While even such traditionalists can make progress in cutting costs through set-up reduction, cellular manufacturing, and just-in-time techniques, great potential remains in less traditional strategies such as mass customization. For example, manufacturers striving to meet individual customer needs efficiently through strategies such as mass customization are discovering the value of postponement.

They are delaying product differentiation to the last possible moment and thus overcoming the problem. They prefer to make brackets in the factory but package them at the distribution centre, within the customer order cycle. This strategy improved asset utilization by cutting inventory levels by more than 50 percent. Realizing that time really is money, there is a question mark on conventional wisdom that lead times in the supply chain are fixed. They are strengthening their ability to react to market signals by compressing lead times along the supply chain, speeding the conversion from raw materials to finished products tailored to customer requirements.

This approach enhances their flexibility to make product configuration decisions much closer to the moment demand occurs. The key to just-in-time product differentiation is to locate the leverage point in the manufacturing process where the product is unalterably configured to meet a single requirement and to assess options, such a postponement, modularized design, or modification of manufacturing processes that can increase flexibility.

❖ **Principle 5: Manage Sources of Supply Strategically**

Traditionally, manufacturers do not make efforts to develop good relationship with the suppliers. Instead, their focus is always on cutting the price as much as possible. According to one General Manager, “The best approach to supply is to have as many players as possible fighting for their piece of the pie—that’s when you get the best pricing.” Excellent supply chain management requires a more enlightened mind set—recognizing, as a more progressive manufacturer did: “Our supplier’s costs are in effect our costs. If we force our supplier to provide 90 days of consigned material when 30 days are sufficient, the cost of that inventory will find its way back into the supplier’s price to us since it increases his cost

structure." While manufacturers should place high demands on suppliers, they should also realize that partners must share the goal of reducing costs across the supply chain in order to lower prices in the marketplace and enhance margins.

The logical extension of this thinking is gain-sharing arrangements to reward everyone who contributes to the greater profitability. Some companies are not yet ready for such progressive thinking because they lack the fundamental prerequisite. That is, a sound knowledge of all their commodity costs, not only for direct materials but also for maintenance, repair, and operating supplies, plus the money spent on utilities, travel, and virtually everything else. This fact-based knowledge is the essential foundation for determining the best way of acquiring every kind of material and service the company buys.

With their marketplace position and industry structure in mind, manufacturers can then consider how to approach suppliers—seeking short term competitive bids, entering into long-term contracts and strategic supplier relationships, outsourcing, or integrating vertically. Excellent supply chain management calls for creativity and flexibility.

Principle 6: Develop a Supply Chain-Wide Technology:

Today, manufacturers have been focusing on replacing their inflexible, poorly integrated systems with enterprise-wide systems. Yet too many of these companies are not able to reap the benefits of the same because many leading-edge information systems cannot easily translate it into actionable intelligence that can enhance real-world operations. As per one Logistics Manager, "I've got three feet of reports with every detail imaginable, but it doesn't tell me how to run my business."

This manager needs to build an information technology system that integrates capabilities of three essential kinds. ***First for the short term***, the system must be able to handle day-to-day transactions and electronic commerce across the supply chain and thus help align supply and demand by sharing information on orders and daily scheduling. ***Secondly from a mid-term perspective,*** the system must facilitate planning and decision making, supporting the demand and shipment planning and master production scheduling needed to allocate resources efficiently. ***Thirdly to add long-term value***, the system must enable strategic analysis by providing tools, such as an integrated network model, that synthesize data for use in high-level "what-if" scenario planning to help managers evaluate plants, distribution centres, suppliers, and third-party service alternatives. Unfortunately, today's enterprise

wide systems remain enterprise-bound, unable to share across the supply chain the information that channel partners must have to achieve mutual success.

Ironically, the information that most companies require most urgently to enhance supply chain management resides outside of their own systems, and few companies are adequately connected to obtain the necessary information. Electronic connectivity creates opportunities to change the supply chain fundamentally—from slashing transaction costs through electronic handling of orders, invoices, and payments to shrinking inventories through vendor- managed inventory programs.

❖ **Principle 7: Adopt Channel-Spanning Performance Measures:**

"How do we perform?" to answer such question, most companies look inward and apply any number of functionally oriented measures. But excellent supply chain managers take a broader view, adopting measures that apply to every link in the supply chain and include both service and financial metrics.

First, they measure service in terms of the perfect order— the order that arrives when promised, complete, priced and billed correctly, and undamaged. The perfect order not only spans the supply chain, as a progressive performance measurement should, but also view performance from the proper perspective, that of the customer.

Second, excellent supply chain managers determine their true profitability of service by identifying the actual costs and revenues of the activities required to serve an account, especially a key account. For many, this amounts to a revelation, since traditional cost measures rely on corporate accounting systems that allocate overhead evenly across accounts. Such measures do not differentiate, for example, an account that requires a multi-functional account team, small daily shipments, or special packaging. Traditional accounting tends to mask the real costs of the supply chain—focusing on cost type rather than the cost of activities and ignoring the degree of control anyone has over the cost drivers.

To facilitate channel-spanning performance measurement, many companies are developing common report cards. These report cards help to keep partners working toward the same goals by building deep understanding of what each company brings to the partnership and showing how to leverage their complementary assets and skills to the alliance's greatest advantage.

High performance software solutions are vital to implementing Supply Chain Operational Excellence. Supply chains are simply too complex and too dynamic to be managed through spreadsheets, faxes, telephone calls and email systems. Companies that recognize this will establish high velocity, agile supply chain systems that please customers and achieve the coveted competitive advantage. Solutions are required to manage individual operations and the entire supply chain. Solutions for individual operations must support reliable, responsive management of local processes and visibility for higher level systems. Supply chain systems must support identification of global requirements and interoperability with individual operations for execution, evaluation and improvement.

❖ 2.5 Improving Performance on the Effective Frontier

In the absences of an appropriate measuring system, supply chain excellence exists in a world of grey, not black and white. The supply chain is a complex system with complex processes with increasing complexity. Improving supply chain performance requires the management of this complex system of tightly linked and interrelated metrics. In this complex system, supply chain leaders are attempting to balance four distinct priorities: improving growth, improving profitability, reducing cycle time, and managing the ever increasing complexity as shown in figure below.

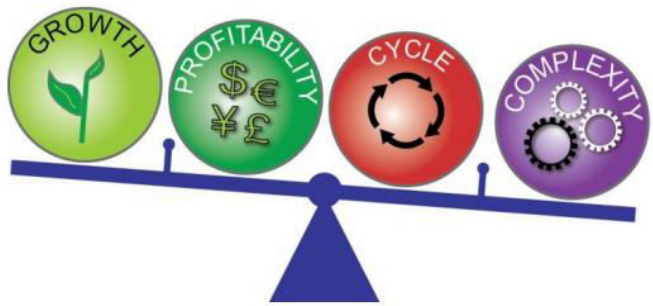


Fig: Supply Chain Effective Frontier

Core Tenets (Beliefs) of Manufacturing Supply Chain Excellence

Having faced many challenges, many companies have learned how to achieve supply chain excellence. These market leaders adhere to the following five core beliefs:

- **Embrace Customer Centricity:**

With customer demand across channels becoming increasingly volatile, leading manufacturers are focused on understanding their end customers better. This is necessary

not only at business-to-consumer companies, where the manufacturer has direct visibility into the end consumer, but also at business-to-business companies where the end customer may be just a few layers removed. Customer centricity goes beyond customer satisfaction surveys; it is about understanding what different customers buy, what influences that buying decision and how they buy. Leading manufacturers have learned from retailers in this regard, in that they are now able to define different customer personas and associated buying behaviours. By constructing different value versus cost-to-serve propositions, these leaders are able to service diverse customer needs more effectively, and in turn, tend to be more competitive and profitable.

- **Differentiate Service through Segmented Supply Chains:**

Customer-centric business strategies often result in manufacturers taking different value propositions to market to meet the needs of different customers while supporting corporate objectives. For instance, when pursuing market share growth for certain product-geography-channel combinations, manufacturers may need to adopt one supply chain posture: aggressive and dynamic pricing, high-product availability and superior lead times. When looking to retain market share for other product-geography-channel combinations, the supply chain posture may be different: fixed pricing and competitive lead times. The supply chains serving these distinct segments need to be configured differently from a demand planning, inventory planning, production and distribution planning perspective. The benefits can be significant. Example: Dell, a leading manufacturer of mobility and desktop products, well known for inventing the direct-to-consumer model in the computer industry, successfully reinvented its supply chain to serve different customer segments through retail stores. Contrary to some prevailing perceptions, customer-centric, segmented supply chains result in reduced complexity and costs for the manufacturer.

- **Design for Business Agility:**

Adapting effectively and rapidly to internal and external change is the essence of business agility. How long does it take for a demand change in a particular channel to be captured and reflected to all relevant stakeholders across the supply chain? How quickly is this change comprehended on the supply side and reflected in adjusted inventory plans, master production plans, factory plans and distribution plans? How soon do suppliers know what they need to do differently to accommodate this change? If there is a delay or disruption at a supplier, how quickly can a manufacturer determine the potential business impact and determine mitigation options? Leading manufacturers have been redesigning supply chain

processes with business agility in mind and regularly make strategic investments in inventory and capacity to absorb the impact of demand and supply changes.

Example: SanDisk Corporation, one of the leading flash memory product manufacturers in the world, has made extensive use of intelligent inventory staging and production postponement techniques to design an adaptive supply chain that balances superior customer service with speed, flexibility, scale and cost. It is important to note that business agility is not about speed alone; it is the ability to make intelligent decisions faster.

To the extent that supply chain professionals help design and drive business agility at their corporations, they also enable corporations to stay profitable as business conditions change.

- **Drive End-to-End Synchronization:**

Supply chain management has multiple specialized disciplines, ranging from forecasting customer demand to positioning corresponding supply and creating optimal procurement plans. These disciplines span functional roles across sales, marketing, business units, manufacturing operations, procurement, engineering and finance. Given the pace of change corporations face today, it has become increasingly important to keep internal and external stakeholders aligned with the most current business plan. Over the last decade, and especially since the global financial crisis a few years ago, leading manufacturers have focused on driving rapid synchronization across different functional stakeholders internally and externally through the systematic deployment of sales and operations planning (S&OP), also referred to at some companies as integrated business planning. Identifying and bridging gaps between the stated business plan and the most recent view of reality across new products, demand, supply and finance is the primary objective of this process.

The sheer cross-functional nature of the S&OP process, however, makes it difficult to execute the process consistently month after month. To drive end-to-end synchronization across different stakeholders, senior-level S&OP champions have emerged at many manufacturing companies over the past few years. What-if scenario analyses have become a standard method for evaluating different options to bridge demand, supply and financial gaps. Several leading consumer goods manufacturers are developing integrated business plans with their strategic retail partners, engaging in structured, weekly collaborative processes to keep the extended value chain synchronized. In fact, it has been observed that companies with more mature S&OP processes have better operational and financial results relative to their competition.

- **Leverage Advanced Optimization:**

Advanced supply chain management is based on intelligent trade-offs within the factory and across the entire supply chain. Optimization techniques continue to be the backbone of the intelligent decision-support technology supply chain practitioners use today, whether they work in the realm of predicting demand or positioning supply. What has changed over the last few decades is the ease-of-use and universal availability of such optimization techniques to help end users in manufacturing corporations drive real results. For instance, a leading semiconductor manufacturer; well established in the industry for the quality of its analogue products and now for its supply chain prowess, deployed advanced optimization solutions to improve its customer request date delivery performance by approximately 20 percentage points, while reducing its overall network inventory by 25 percent at the same time. Recognizing that supply chains are indeed a competitive differentiator, leading manufacturers have invested in upgrading the skill sets of their supply chain personnel, from internal training to college recruitment programs.

2.6 Benefits of Excellence in Supply Chain Management:

- **Improved SCM staff and task productivity** – Automate various SCM tasks – from plan-to-produce, source-to-settle and order-to-cash processes – and improve business processes, leading to increased productivity benefits. Typical productivity improvements include savings in sourcing, supplier management, production planning and analysis, production management, production staff, change order processing and management, quality control and analysis, sales order entry and processing, promotions management, fulfilment, and transportation and logistics.
- **Inventory and inventory carry cost** – More accurately forecast and source the amount of inventory needed, leading to an increase in inventory turns and reduction in days in inventory. This leads to a one time inventory reduction and ongoing carry cost reduction on the saved inventory.
- **Reduced days sales outstanding (days in accounts receivable reduction)** – Reduce accounts receivable collections with better visibility into the AR process, aging and extension of credit, helping to reduce days sales outstanding.
- **Reduced inventory scrap** – Reduce scrap write-downs with better quality control and planning/forecasting.
- **Improved net fixed asset (NFA) utilization, avoiding net fixed asset additions**– More effectively utilize current net fixed assets such as plants and equipment, and potentially avoid planned investments to handle growth.

- **Reduced cost of goods sold (COGS)** – Reduce cost of goods sold with various improvements such as more effective sourcing of raw materials, tracking of work-in-process, and reductions in production quality, issues and planning, increases in production efficiency and reduction in production overhead.
- **Improved strategic sourcing** – Strategically source direct and indirect materials and better manage vendors, leading to material cost savings.
- **Improved purchase order, invoice and payment productivity** – Automate purchase order forms and processing, improving the process and productivity of contract and vendor managers, purchasing agents, employees and managers on purchase order requests and approvals.
- **Reduced maverick spending** – Manage purchase order requests and approvals more effectively to help reduce maverick spending, while increasing strategic sourcing and resultant discounts.
- **Improved production exception handling** – Better plan and manage production, helping to reduce exceptions and the associated resolution costs.
- **Reduced accounts receivable, bad debt write-downs and disputes** – Better manage accounts receivables to eliminate extending credit in error, recognize collection issues sooner and managing them more effectively, and reducing disputes and related costs.
- **Reduced transportation duties and taxes and increase rebates and incentives** – Optimize production and shipping to reduce transportation duties and taxes, and increase rebates and incentives.
- **Reduced transportation error costs** – Reduce transportation errors, eliminating error-related costs to resend or reroute shipments,
- **Improved customer retention and increase customer loyalty** – Improve customer satisfaction via improvements like streamlining and reducing errors in the invoicing process, eliminating backorders, reducing errors, improving quality, reducing time to receipt.
- **Consolidated current SCM solutions** – Avoid current spending on systems, support and maintenance contracts, application development and integration, systems administration and support via consolidation to a newer consolidated platform.

2.7 Summary

Manufacturers are facing increasingly challenging markets today. Survival demands that they consider new business models and operational strategies that will distinguish them from the crowd. They have to become preferred suppliers and establish strategic

partnerships with their customers to preserve and expand their market positions. Manufacturers that achieve preferred status recognize what is really important to their customers and focus on consistently doing these things better than their competitors. They reduce their costs while simultaneously improving their performance by eliminating activities that bring no value to their customers. And recognizing that preferred relationships can be picky, they implement continuous improvement programs to keep them ahead of their competitors. Operational Excellence of supply chain supports these goals and should be considered by all manufacturers. But implementing operational excellence can be challenging for even the most advanced organizations. The use of latest technology in supply chain will certainly help organizations make this transition and achieve the competitive advantage. Besides, they also need to keep in mind the principles of excellence in supply chain for the better gains.

2.8 Self Assessment Questions:

- Define excellence in SCM. Discuss the dimensions of excellence in any SCM.
- Explain in detail the benefits of excellence in SCM.
- How can you enhance the efficiency of any SCM? Discuss in detail.
- Elaborate the common beliefs of excellence in supply chain that are followed by the manufacturers.
- How can you improving performance of supply chain on the effective frontier?

2.9 Key Terms:

- ✓ **Operational excellence:** It is an element of organizational leadership and organizational intelligence that focuses on meeting customer expectation, all while stressing the application of a variety of principles, systems, and tools toward the sustainable improvement of key performance metrics.

- ✓ **Agility:** refers to distinct qualities that allow organizations to respond rapidly to changes in the internal and external environment without losing momentum or vision. Adaptability, flexibility and balance are three qualities essential to long-term agility.

- ✓ **Logistics:** is the part of supply chain management that plans, implements, and controls the efficient, effective forward, and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customer's requirements.

- ✓ **Customer Segmentation:** Grouping of customers on the basis of different parameters

- ✓ **Decision Support System:** a set of related computer programs and the data required to assist with analysis and decision-making within an organization

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Subject: Supply Chain Management	
Course Code: POM-323	Author: Prof (Dr) Hemant Sharma
Lesson No.: 3	Vetter:
Vendor Relationship	

Structure:

3.0 Objectives

After reading this lesson, students would be able

- To understand the significance of suppliers/ vendors for the manufacturers
- To examine the single versus multiple sources of supplies
- To understand the process of vendor development and relationship with vendors
- Define each and every aspect concerned to vendor relationship like its rating, its selection etc.
- To evaluate multiple vendors on the basis of various parameters

3.1 Introduction

In today's global economy there are so many factors to consider when choosing and managing a supplier, that it can quickly become overwhelming. Luckily, now we have latest technology that can help us to automate and simplify the process of vendor selection and managing good relations with them. Now we can make more informed decisions pertaining to our suppliers. Results witness that the companies which focused on vendor relation lead their peers five to one in terms of value derived from their supply base. For any organization, purchasing is a window to the outside world.

The prime function of purchasing is that of being sensitive to the external supply market situation and also of feeding back this information to the other functions other organization. So, in purchasing and selling of products one of the major roles is played by the vendors; they can be in form of suppliers as well as distributers. In any organization it is very important for the purchasing department to keep a close check on the relationship with these parties. In other words any organization dealing with purchasing and selling of products should always focus on having good vendor relationship.

Before taking the issue of vendor relationship, it would be good to appreciate the decision pertaining to single or multiple sources of supply. Needless to mention that the trust is the major element in the relationship between the members of a supply chain, usually there is only one supplier for any item or category of items. Supply chain would cease to be a chain if at every point in it there were multiple links. It believes in a single link. Or else, it will become too complex and will start having all negativities of the traditional approach to business.

As we know that the traditional business houses believe in multiple sources of supply as they believe that the supplying firm would not be able to deliver the required material in the required time, quality and quantity. Therefore, they protect themselves from supply failures by having multiple sources for the same items. It makes the business volume per transaction very less for the suppliers. As a result, supplier is also not sure whether he should invest its time and efforts for a customer who may withdraw the business from him any time. It is really a vicious cycle. For a better understanding, it would be good to have a glance on the advantages and disadvantages on single and multiple sources of supply in the following table:

Parameters	Single supplier	Multiple Suppliers
Trust	Full trust between supplier and customer	Lake of trust between both parties. Customer is suspicious of the intention of suppliers and suppliers are also doubtful about customers
Volume of Business for Suppliers	Customer gives entire requirement of any item to him, thus very high volume	Customer gives order for a particular item to number of suppliers, thus reducing business volume per supplier
Economies of scale	Benefit of economies of scale due to high business volume	No benefit of economies of scale
Special Attention	Suppliers may pay full attention to customers' requirement being the single supplier	Suppliers would not like to focus on the requirement of every single customer due to future uncertainty and less business volume
Quality	Supplier would deliver the best quality	Suppliers are not taking care of quality for any specific customer
Variability in quality	Very less variation in the quality of order placed by customer	High variations in quality due to supply to multiple customers
Control over suppliers	High control being single supplier	Diluted control over suppliers being many suppliers

Keeping in mind the above points, one may take a decision related to single or multiple sources of supply.

3.2 Need for improving Vendor Relationship

It goes without saying that good relationship between vendor and customer is the lubricant for any supply chain. Therefore, it would be wise here to mention few reasons to start cultivating meaningful vendor relationships:

- The focus is on the relationship: In today's world, managing the supply base is about strengthening relationships that can make or break your business. Earning your suppliers' trust with honest communication, listening to their concerns and involving them in your processes ultimately make them a vested partner in your business.

- Expectations are changing: Procurement is expected to know where they are vulnerable and bolster their teams for success. Teams that put a greater emphasis on qualitative and quantitative supplier data analysis will be able to quickly and succinctly identify weak spots, risks and opportunities in the global supply chain - improving the strategies and plans needed to manage the suppliers, and ultimately both businesses, for continued success.
- Its' mutually beneficial: If you are aligned with your suppliers and treat them as partners, both businesses will experience higher success rates, decreased risks and enhanced collaboration and innovation. Studies have found the top procurement teams that have successfully aligned with their key suppliers have improved supplier capabilities of innovation, quality, reliability and costs/price reductions and agility to reduce risk factors. Greater value can be achieved for both businesses, something that would be difficult to achieve if operating independently.
- It delivers big opportunities: Successful vendor relationship yields a faster time to market, transactional efficiency, competitiveness, risk management, and large financial gains - all of which not only contribute to your bottom line, but also allow you to deliver a quality and cutting edge product, putting you ahead of the market.
- Technology can simplify the process: The key to effective vendor relationship is having a system in place that makes it easy to view your suppliers and analyze all of the risk factors. Using vendor relationship technology provides you with full and unparalleled visibility into your supplier base, giving you a detailed picture of what is impacting your supply chain and making it easy to mitigate the risk.

It has been quoted that 20-30% of a company's profit can come from savings generated in the purchasing department and one of the important objective of the purchasing management is that of maintaining good relation with vendors.

A vendor who supplies the proper quality material in proper amounts in proper time is not very easy to find. There are many situations where materials are required in hurry. There are situations where materials are in shortage in the supply market. In all situations, good relations with vendors pay additional dividends. This may entail personal relationship, professional relationship:

A) By helping the vendor in times of stress and strain with financial aid, technical aid, by providing management skills if necessary

B) Maintaining a healthy professional relationship by fair negotiations, fair evaluations and fair compensation

The modern management theory and world class manufacturing call for a long term, almost a lifetime, association with the vendors. This also means that there will be fewer vendors but these will be dedicated vendors almost as a part of the organizational family

3.3 Selection of Vendors

We now know the importance of vendors for any organization and how much they contribute to the profits of any successful business enterprise, now the question arises what are the important points that should be kept in mind while deciding the vendors for the business enterprise. Selecting a vendor is probably one of the most nerve wracking but crucial activities a business must undertake. Your vendors will be delivering your direct purchases – those that you use to produce the products you sell and your indirect purchases – those that keep your business running effectively.

When you are selecting a potential vendor, you are selecting a partner in your business and you will trust them to work with you in a professional and profitable manner. It is important that you chose a company that can supply your requirements now and for the near future.

(1) Analyze the Business Requirements/Needs:

Before you begin to gather data or perform interviews, assemble a team of people who have a vested interest in this particular vendor selection process. The first task that the vendor selection team needs accomplish is to define, in writing, the product, material or service that you are searching for a vendor. Next define the technical and business requirements. Also, define the vendor requirements. Finally, publish your document to the areas relevant to this vendor selection process and seek their input. Have the team analyze the comments and create a final document. In nutshell:

- Assemble an Evaluation Team
- Define the Product, Material or Service
- Define the Technical and business requirements
- Define the Vendor Requirements

- Publish a Requirements Document for Approval

(2) Vendor Search

Now when you have agreement on the business and vendor requirements, the team now must start to search for possible vendors that will be able to deliver the material, product or service. The larger the scope of the vendor selection process the more vendors you should put on the table. Of course, not all vendors will meet your minimum requirements and the team will have to decide which vendors you will seek more information from. Next write a Request for Information (RFI) and send it to the selected vendors. Finally, evaluate their responses and select a small number of vendors that will make the short list" and move on to the next round. In summary:

- Compile a List of Possible Vendors
- Select vendors to Request More Information From
- Write a Request for Information (RFI)
- Evaluate Responses and Create a "Short List" of Vendors

(3) Request for Proposal (RFP) Request for Quotations (RFQ)

The business requirements are defined and you have a short list of vendors that you want to evaluate. It is now time to write request for proposal or request for quotations Which ever format you decide, your RFP or RFQ should contain the following sections:

- Submission Details
- Introduction and Executive Summary
- Business Overview & Background
- Detailed Specifications
- Assumptions & Constraints
- Terms and Conditions
- Selection Criteria

(4) Proposal Evaluation and Vendor Selection

The main objective of this phase is to minimize human emotion and political positioning in order to arrive at a decision that is in the best interest of the company. Be thorough in your investigation, seek input from all stakeholders and use the following methodology to lead the team to a unified vendor selection decision:

- Preliminary Review of All Vendor Proposals
- Record Business Requirements and Vendor Requirements
- Assign Importance Value for Each Requirement
- Assign a Performance Value for Each Requirement
- Calculate a Total Performance Score
- Select a the Winning Vendor

(5) Contract Negotiation Strategies

The final stage in the vendor selection process is developing a contract negotiation strategy. Remember, you want to "partner" with your vendor and not "take them to the cleaners." Review your objectives for your contract negotiation and plan for the negotiations are covering the following items:

- List Rank Your Priorities Along With Alternatives
- Know the Difference Between What You Need and What You Want
- Know Your bottom line So You Know When to Walk Away
- Define Any Time Constraints and Benchmarks
- Assess Potential Liabilities and Risks
- Confidentiality, non-compete, dispute resolution, changes in requirements
- Do the Same for Your Vendor (i.e. Walk a Mile in Their Shoes)

(6) Contract Negotiation Mistake

The smallest mistake can kill an otherwise productive contract negotiation process. Avoid these ten contract negotiation mistakes and avoid jeopardizing an otherwise productive contract negotiation process.

As you can see there a considerable amount of criteria to consider when selecting a vendor but then it is an important undertaking that will make a considerable impact on the success of your business.

3.4 Vendor Rating or Performance Monitoring

Vendor rating is a result of a formal vendor evaluation system. Vendors or suppliers are given standing, status, or title according to their attainment of some level of performance,

such as delivery, lead time, quality, price, or some combination of variables. The motivation for the establishment of such a rating system is part of the efforts of manufacturers and service firms to ensure that the desired characteristics of a purchased product or service is built in and not determined later by some after-the-fact indicator.

Most firms want vendors that will produce the entire products and services defect free and deliver them just in time. Some type of vehicle is needed to determine which supplying firms are capable of coming satisfactorily close to this and thus be retained as current suppliers. One such vehicle is vendor rating.

In order to accomplish the rating of vendors, some sort of review process must take place. The process begins with the identification of vendors who not only can supply the needed product or service but is a strategic match for the buying firm. Then important factors to be used as criteria for vendor evaluation are determined. These are usually variables that add value to the process through increased service or decreased cost. After determining which factors are critical, a method is devised that allows the vendor to be judged or rated on each individual factor.

- **Criteria for Evaluation**

Vendor performance is usually evaluated in the areas of pricing, quality, delivery, and service. Each area has a number of factors that some firms deem critical to successful vendor performance.

1) ***Pricing factors include the following:***

- Competitive pricing. The prices paid should be comparable to those of vendors providing similar product and services. Quote requests should compare favorably to other vendors.
- Price stability. Prices should be reasonably stable over time.
- Price accuracy. There should be a low number of variances from purchase-order prices on invoiced received.

2) Quality factors include:

- Compliance with purchase order. The vendor should comply with terms and conditions as stated in the purchase order

- Conformity to specifications. The product or service must conform to the specifications identified in the request for proposal and purchase order.
- Warranty. The length and provisions of warranty protection offered should be reasonable. Are warranty problems resolved in a timely manner?

3) ***Delivery factors include the followings:***

- ***Time*****:** Does the vendor deliver products and services on time; is the actual receipt date on or close to the promised date? Does the promised date correspond to the vendor's published lead times? Also, are requests for information, proposals, and quotes swiftly answered?
- ***Quantity:*** Does the vendor deliver the correct items or services in the contracted quantity?
- ***Packaging:*** Packaging should be sturdy, suitable, properly marked, and undamaged. Pallets should be the proper size with no overhang.
- ***Lead time:*** Is the average time for delivery comparable to that of other vendors for similar products and services?

4) **Finally, these are service factors to consider:**

- **Inside sales:** Inside sales should display knowledge of buying firms' needs. It should also be helpful with customer inquiries involving order confirmation, shipping schedules, shipping discrepancies, and invoice errors.
- **Technical support:** Does the vendor provide technical support for maintenance, repair, and installation situations? Does it provide technical instructions, documentation, and general information? Are support personnel courteous, professional, and knowledgeable? The vendor should provide training on the effective use of its products or services.
- **Emergency support:** Does the vendor provide emergency support for repair or replacement of a failed product.
- **Problem resolution:** The vendor should respond in a timely manner to resolve problems. An excellent vendor provides follow-up on status of problem correction.

Here, it is important to mention that while pricing, quality, delivery, and service are suitable for supplies that are not essential to the continued success of the buying firm, a more comprehensive approach is needed for suppliers that are critical to the success of the

firm's strategy or competitive advantage. For firms that fall into the latter category performance may need to be measured by the following 7 C's:

- Competency—managerial, technical, administrative, and professional competence of the supplying firm.
- Capacity—supplier's ability to meet physical, intellectual and financial requirements.
- Commitment—supplier's willingness to commit physical, intellectual and financial resources.
- Control—effective management control and information systems.
- Cash resources—financial resources and stability of the supplier. Profit, ROI, ROE, asset-turnover ratio.
- Cost—total acquisition cost, not just price.
- Consistency—supplier's ability to exhibit quality and reliability over time.

If two or more firms supply the same or similar products or services, a standard set of criteria can apply to the vendor's performance evaluation. However, for different types of firms or firms supplying different products or services, standardized evaluation criteria may not be valid. In this case, the buying firm will have to adjust its criteria for the individual vendor. For example, Honda of America adjusts its performance criteria to account for the impact of supplier problems on consumer satisfaction or safety. A supplier of brakes would be held to a stricter standard than a supplier of radio knobs.

- **Awards and Certifications:**

Many buying firms utilize awards and certification programs to rate vendors. Attainment of certification status or an award serves as an indicator of supplier excellence. Certification and awards-program recognition represents a final step in an intense journey that involves rigorous data collection under the total-quality-management-rubric as well as multitudes of meetings with suppliers and purchasing internal customers. Serious buying firms view these programs as an integral part of their overall efforts to improve the total value of the company.

The attainment of a supplier award usually serves as an indication that the vendor has been rated as excellent. Intel awards their best suppliers the Supplier Continuous Quality Improvement Award (SCQI). Other firms may utilize a hierarchy of awards to indicate varying degrees of performance from satisfactory to excellent. DaimlerChrysler awards its best suppliers the Gold Pent star Award. Several hundred vending firms receive this award per year. However, only a handful (less than a dozen) of DaimlerChrysler's vendors is good enough to garner the Platinum Pent star Award.

For other firms, supplier certification is desirable. Supplier certification can be defined as a process for ensuring that suppliers maintain specific levels of performance in the areas of price, quality, delivery, and service. Certification implies that participating firms have reached a level of excellence that other firms were unable or unwilling to achieve. For example a quality certified firm maintains a level of quality such that customer-receiving inspection may be utilized with decreasing frequency up to the point where it is eliminated altogether. Theoretically, this will ensure that all of the supplier's products meet the customer's product specifications. In this case, the goal of supplier certification is quality at the source.

While it is uncertain whether individual firms are consistent in the manner in which they certify vendors, a quality certification would likely require that the vending firm be part of a formal education program, utilize statistical process control (SPC), and have a quality assurance plan (set written procedures).

- **Benefits of Vendor Rating System:**

The main benefits of vendor rating systems mainly include as below:

- Helping minimize subjectivity in judgment and make it possible to consider all relevant criteria in assessing suppliers.
- Providing feedback from all areas in one package.
- Facilitating better communication with vendors.
- Providing overall control of the vendor base.
- Requiring specific action to correct identified performance weaknesses.
- Establishing continuous review standards for vendors, thus ensuring continuous improvement of vendor performance.
- Building vendor partnerships, especially with suppliers having strategic links.

Vendor ratings systems provide a process for measuring those factors that add value to the buying firm through value addition or decreased cost. The process will continually evolve and the criteria will change to meet current issues and concerns.

For example, some feel that supplier evaluation must now reflect the strategic direction of the buying company's environmental initiatives. As a result, some firms have recently developed supplier evaluation systems that place significant weight on environmental criteria. It would seem that the concept will remain valid for some time.

Just like other outside services provided to your company, you should re-evaluate your vendors from time to time to see if you're getting the best deal. Once vendor relationships are established, make your vendor reps work for you by suggesting items for your business. When it's time to re-evaluate your vendors, ask some of your loyal customers in advance what they'd like to see for sale at your business. Customer input can be very valuable in determining what you need to stock and what you should avoid or quit selling..

Good vendors will work with you on inventory control by helping you understand your day's supply of inventory or providing software to keep track of your inventory in and outs. Take advantage of the areas where your vendor can be of assistance and turn advice into real profits. Finally, attend trade shows when you can. Not only will you learn about new and upcoming items you might want to sell, but trade show discounts can be obtained or negotiated.

The vendor selection process doesn't have to be difficult if you take the time to determine what you need, compare vendor pricing, and sign effective agreements that will benefit both you and your vendors.

3.5 Vendor Development

Vendor development is the process of working with certain suppliers on a one-to-one basis to improve their performance for the benefit of the buying organization. It is closely associated with supplier relationship management and partnering - two separate subjects. Reasons For vendor Development

Purchasing and supply management professionals should be able to identify sound reasons for embarking on supplier development process such as

- improving supplier performance

- reducing costs
- resolving serious quality issues
- developing new routes to supply
- improving business alignment between the supplier and the buying organization
- developing a product or service not currently available in the marketplace
- generating competition for a high price product or service dominating the marketplace Supplier development should lead to improvements in the total added value from the supplier in question in terms of product or service offering, business processes and performance, improvements in lead times and delivery for instance

There is no single approach to supplier development. Purchasing and supply management professionals must select the most appropriate approach to suit their relationship with the supplier that they have selected for development. There are different types of, and approaches to, supplier development that are appropriate for different supply markets. Supplier development involves embracing supplier expertise and aligning it to the buying organization's business need, and, where appropriate, vice versa.

The objectives for development can be relatively minor such as slight adjustments in staffing levels or very substantial such as the appraisal and re-launch of an entire range of critical products. A supplier development project might involve developing a supplier's business such as helping the supplier to evaluate and redesign their corporate strategy. The purpose of this might be to align the supplier very closely and on a long-term basis with the buying organization in a strategic alliance or joint venture. Equally, there may be circumstances where it is more appropriate for the buying organization to align its corporate strategy to that of the supplier.

Whatever the form of the alignment, this process may be a highly resource intensive exercise and involve for example, a steering group and various action teams each with action plans for allocated projects and formal reporting procedures against time-scales. Both organizations' must share a mutual understanding, appreciation and desire to achieve the objectives of the supplier development project. Such a project would involve the principles of change management and require visible commitment from both parties' top management teams with identifiable sponsors and champions of change. It is critical to involve people with vision, imagination and commitment; to keep these involved and to ensure the project is not damaged by a change in personnel.

It is also important to ensure that there is a smooth decision-making process and that, where appropriate, those involved in the supplier development project from both organizations are empowered to make decisions. Value management, in particular value analysis, is a key part of supplier development. Value analysis can be used to reduce the cost of a product or service without diminishing the operational value; other objectives might include reducing time to market, improving environmental performance or improving quality. Value engineering is another aspect of value management used in supplier development projects and is similar to value analysis but it takes place before a new product is finalized. Another approach to supplier development is 'Reverse Marketing'; one example of which is where a buying organisation encourages a supplier(s) to enter a new market. This might, for instance, involve the supplier developing its operation or introducing a new range of products.

- **Pre-Requisites to Supplier Development:**

A fundamental pre-requisite to supplier development, and indeed the development of any purchasing and supply management strategy, is that purchasing and supply management professionals analyze, evaluate and appreciate their own organization's corporate objectives and business needs. The supplier development projects which are undertaken must be in support of the purchasing and supply management strategy which, in turn, supports the organizational strategy.

Supplier development requires key technical purchasing skills as well as contract management and project management skills. It also demands excellent interpersonal skills as it is an effective way of opening up communication between the buying organisation and the supplier. Interpersonal skills are necessary in order to "sell" the idea behind the development project both internally with colleagues and to the supplier, and then to work effectively with all those involved irrespective of their status in either organisation. Influencing skills are therefore of fundamental importance.

One of the key interpersonal skills required is empathy i.e. the ability to appreciate others' perspectives. For example, the buying organisation must appreciate the supplier's position and the impact on their business of this development. In some cases, their other customers might perceive that they are being neglected as a consequence of so much resource being channeled into a supplier development programmed of another customer, which may also be one of their competitors.

- **Selecting Suppliers for Development**

Studying the supply base and evaluating the extent to which it meets the needs of the organisation. Suppliers of key supplies and services should be rated according to their current performance and their ideal, or preferred, performance as well as compared to other suppliers. This evaluation should also cover the relationship between the two parties e.g. the style of relationship and how this compares to the preferred type of relationship. These processes will encourage competition between suppliers especially if it leads to a supplier accreditation such as 'Best of Breed'. It would be ideal if the relationship between these suppliers and the buying organization was managed on a key account basis i.e. an individual is given responsibility to manage a number of contracts.

Those suppliers being developed should be encouraged and supported to 'rate' their relationship with the buying organization and to develop it appropriately. Before selecting suppliers for development, the purchasing and supply management professional must first have identified a reason and an understanding of why supplier development should be undertaken and what it involves. The selection of suppliers for development should be dependent on:

- category strategy
- scale of value/improvement opportunity
- cost, complexity and duration of value attainment
- supplier co-operation

There are a number of methodologies for prioritizing which suppliers are most suitable for development including a range of portfolio analysis techniques. A reasonable way to begin would be to identify those products, goods and services which are procured from critical and strategic suppliers and to decide how these should be improved. It may simply be a case of re-sourcing or re-tendering a new contract or moving those goods into another market. Selecting the best supplier for development may not always be the automatic choice; frequently it is the 'less than best' suppliers which are most appropriate for development. Supplier development is normally undertaken with existing suppliers that can be, and agree to being, improved.

The supplier's performance against agreed criteria must be measured in order to identify the scope for development at the outset and, once the development process has started, to monitor and manage improvement. As supplier development can be a resource-intensive process, it should be undertaken only with selected suppliers. It should only be undertaken with those suppliers from which real business benefit can be derived. Supplier

development can be a one-off project as well as ongoing activity that may take some years to come to fruition. Suppliers can be categorized in respect of supplier development in three ways; they are:

- being developed
- on hold as a potential for development or
- identified as not being worth the investment of development Supplier development is a two-way process in that it should be thought of as joint buyer/supplier development activity

Purchasing and supply management professionals should always be aware of the way in which a key supplier positions their buying organization. Incentives need to be given to suppliers to encourage their commitment to supplier development, such as a reward of shared benefits or 'preferred supplier' status. In many cases, the development of the supplier will be of benefit to the supplier's other customers, some of which may be the buying organization’s competition.

This in itself may be an incentive for the supplier to participate in a supplier development project i.e. they can improve relationships with all their customers as a consequence. This may not matter if the development is in terms of improved service, greater quality, value add and management information for instance. However, where for example, the supplier's product has been developed to meet a particular competitive advantage of the buying organization, the purchasing and supply management professional should consider the implications of this at the outset.

The purchasing and supply management professional should develop a chart which can be used by the buying organization and the supplier selected for development in order to identify the extent of the development project. The chart could be as simple or as complex as required; the purpose is to identify what has been agreed in terms of outputs or deliverables; which party is responsible for doing what (ideally with an accountable person identified) and when; and an appropriate apportionment of effort, risk and reward. It is useful to identify the risks in advance and allocate these appropriately.

The chart could then be used to monitor progress and manage the project. Equally, a chart could be developed to assist the buying organization in deciding whether or not a particular supplier should be developed and might comprise a simple yes/no checklist or list of facts to be completed. For example: such a chart might include the level of

expenditure (top 20% of expenditure yes/no); level of risk (high/ medium/low) and so on, as deemed appropriate

Purchasing and supply management professionals should determine when the process of developing a supplier can be brought to an end as objectives and targets have been delivered and measured. In many cases, the results of the development may be simply a 'quick fix' or at the other extreme it may involve continual improvement and step change. Whatever approach to supplier development is employed, purchasing and supply management professionals should ensure quantifiable and measurable results that lead to business benefits. Supplier development is, therefore, a significant opportunity to raise the profile of purchasing and supply management in an organization and should be utilized by all purchasing and supply management professionals.

- **Vendor Development Review**

Vendor development reviews are a key step within the vendor development process. Reviews are carried out to:

- Review business issues/ problems
- Ensure performance is aligned with requirements
- Monitor ongoing projects/initiatives
- Share information and business strategy

3.6 How Vendor Management Requirements Differ Among Types of Organizations

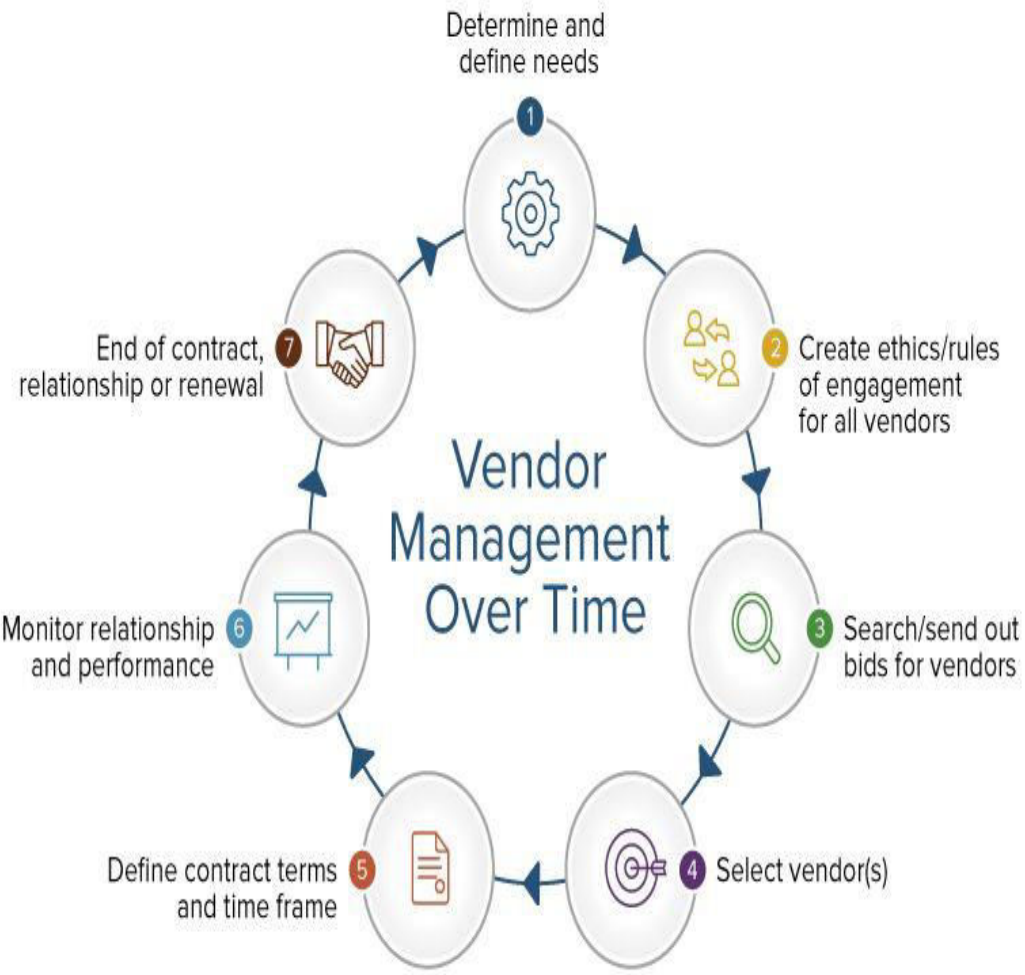
Different types of organizations may have differing - and sometimes quite stringent - requirements for vendor relationships and vendor management. Governmental bodies must often follow strict bidding processes to acquire new vendors. For example, vendors who work with the military may need to follow additional requirements and screenings, like taking drug tests or passing a thorough background check.

Businesses have more freedom in selecting and managing vendors, but for optimal performance, their processes should be as fair and transparent as possible. Some vendors partner with an organization for years, but not all vendor relationships last (or need to last) a long time. Often, organizations will have a one-time need, so a vendor will provide

a good or service for a short time period. However, both long- and short-term vendors need efficient, constructive, transparent management.

The lifecycle of a vendor relationship can be portrayed by the following figure:

While the vendor relationship lifecycle often has a distinct beginning and end, it can also be cyclical: the "end" can sometimes invite a contract revisit or renewal if the company has more work for the vendor. There is no "normal" length for a vendor relationship - the time frame could be anywhere from a week (or less) to many years, with many contract renewals.



3.7 Summary

A vendor is in the context of business projects and goals can provide a small, one-time need for a single project, or can be an ongoing business partner. Some examples of vendors are:

- ✓ A seller in the supply chain of a specific piece of equipment that a company needs. For example, an aircraft manufacturer might employ a company that makes ball bearings as a vendor.
- ✓ An individual who sells his or her services to a company (for a one-time or ongoing need). For example, a copywriter might contract with an advertising agency to write copy for website pages for a fixed amount of money as a one-time project.
- ✓ Anyone who provides a good or service to an organization. This can be those who provide office supplies, legal services, employee benefits, consulting, and any number of other hard or soft goods or services.

Vendor relationship is an important aspect of supply chain management. Vendors can be both suppliers and distributors and they play the most crucial rule in the success of any supply chain as they provide not only raw material but also serve as the link between any organisation and customer. In today's fast pacing world if any organization wants to grow and flourish and make profits then it should have good relations with its' vendors. Now organizations have started taking utmost care in the selection of their suppliers. They also take the necessary steps time to time in order to inculcate confidence among their suppliers so that they continue to supply the material of desired quality and quantity at desired time at the best competitive price.

In the present competitive scenario, no organization can survive if it is not able to procure the necessary raw material and other required inputs at the least possible price at the required time and required place. Organizations are also awarding vendors to keep them motivated. It is a great challenge for the organizations to make and deliver the goods/ services of the desired quality at the desired place at desired time. Vendors play a critical role in this profit making activity of any organization. Thus, it goes without saying that every manufacturer needs to develop cordial relationship with its suppliers in order to achieve the highest efficiency and effectiveness of its supply chain.

Vendor management is the system of overseeing the entire vendor relationship - from acquiring them through the delivery of the required goods and services. Afterwards, there is typically a final evaluation to see whether the relationship was beneficial to both parties. The person in an organization who oversees these relationships is called a vendor manager, and can reside in any segment of the business from Human Resources to Supply Chain, though others in the organization may manage a relationship more directly on a day-to-day basis.

A vendor management plan is a timeline and/or milestone check-in plan that ensures that vendors are achieving mutually agreed upon goals. A vendor communications plan can help large companies who manage a multitude of vendors stay in regular touch with their vendors.

3.8 Self Assessment Questions

- In selecting suppliers, other than the criterion of price what should a company look for?
- Describe the process of vendor selection for supplying a particular item in the company.
- Define vendor development. Explain the significance of vendor development for the success of any company.
- What do you mean by vendor rating system? How is it beneficial for the companies?
- "For different types of organizations, different types of approaches of vendor's selection are used". Comment logically along with suitable examples.
- Being the purchase manager of a company, you will prefer to have single source or multiple sources of supply of any specific item in your company. Answer critically.
- Visit ancillary industries of a large organization. What is their operational relationship with parent organization? Present a management report including your recommendations for operational improvements.
- Study the purchasing function in a manufacturing or service industry. Present a report on enhancing the competitiveness of that industry through changes/improvements in its purchasing operations.

3.9 Key Terms

- ***Vendors/ suppliers:*** is a supply chain management term that means anyone who provides goods or services to a company or individuals. A vendor often manufactures inventorable items, and sells those items to a customer
- ***Procurement:*** the action of obtaining or procuring something.
- ***Performance measurement:*** is generally defined as regular measurement of outcomes and results, which generates reliable data on the effectiveness and efficiency of

programs. Input resources (human resources, employee time, funding) used to conduct activities and provide services.

- ***Vendor development:*** is one of the popular techniques of strategic sourcing, which improves the value we receive from suppliers. It can be defined as any activity that a buying firm undertakes to improve a Supplier's performance and capabilities to meet the buying firms' supply needs.
- ***Vendor rating:*** is the result of a formal vendor evaluation system. Vendors or suppliers are given standing, status, or title according to their attainment of some level of performance, such as delivery, lead time, quality, price, or some combination of variables.

3.10 References/ Suggested Readings:

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Subject: Supply Chain Management	
Course Code: POM-323	Author: Prof (Dr) Hemant Sharma
Lesson No.: 4	Vetter:
Supply Chain Strategy & Network Design	

Structure:

4.0 Objectives

After reading this lesson, the students would be able:

- To understand the concept of supply chain strategy & network design and its significance in procurement of raw material and delivering the finished products to end users
- To examine the factors affecting the supply chain strategy & network design
- To understand the role of network design in supply chain
- To understand the necessary framework for network design decisions
- To understand the complete methodology of supply chain strategy & network design and associated risks

4.1 Introduction

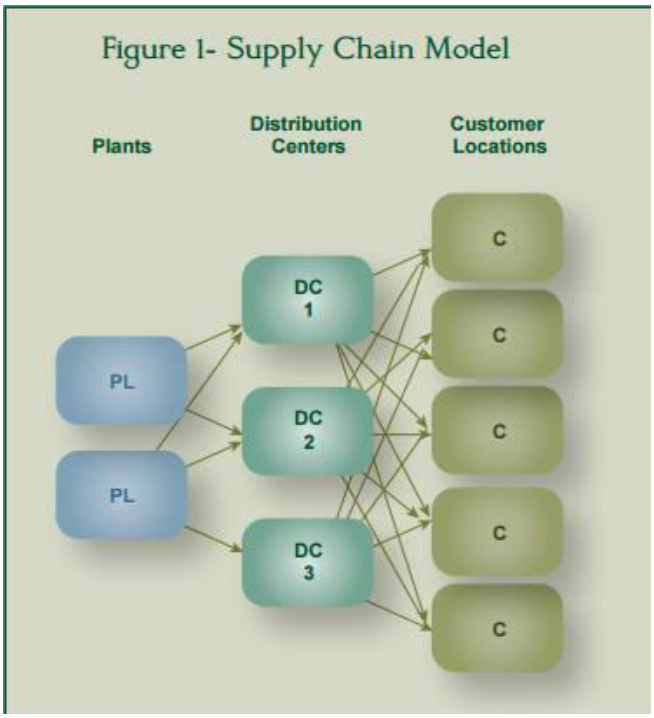
As we know that a firm's supply chain allows it to move products from one point to another point and ultimately to the point of end use/ final consumption. A supply chain consists of suppliers, plants, warehouses and flows of products from each product's origin to the final customer. The number and locations of these facilities is a critical factor in the success of any supply chain. For any business to be successful the organization should recognize the network design and pay significant emphasis on strategic planning by determining the best facility locations and product flows. The discipline used to determine the optimal location and size of facilities and the flow through the facilities is called supply chain network design. The basic purpose of studying supply chain network design is to understand the importance of having a suitable supply chain that is necessary for the procurement of raw materials as well as delivery of final products to end users.

Sometimes it is referred to as network modeling because we need to build a mathematical model of the supply chain before the actual chain exists. This model is then solved using optimization techniques and then analyzed to pick the best solution. Specifically, the focus of such kind of supply chain modeling is to determine the optimal location of facilities (warehouses, plants, lines within the plants, and the suppliers) and the best flow of products through this facility network structure.

Network design decision is the most critical factor that affects any supply chain's responsiveness and cost concerns and it is typically a strategic decision. When in any supply chain network (SCN), market demand is rapidly varying and fluctuating (unpredictable), at that time the most important issue is to find the network configuration that can simultaneously achieve the objectives of minimizing the total cost (comprised of the costs of manufacturers and distributors), and maximization of retailer's service level. Supply Chain Management (SCM) is the process of planning, implementing and controlling the operations of the supply chain efficiently. SCM spans all movements and storage of raw materials, work-in-process inventory, and finished goods from the point-of-origin to the point-of-consumption. Part of the planning processes in SCM aim at finding the best possible supply chain configuration so that all operations can be performed in an efficient way. This entails integrating facility location with other important functions of the supply chain such as procurement, production, inventory, distribution, and routing.

The terms network design and supply chain network design (SCND) are often employed as synonyms of strategic supply chain planning. Although typically no location decisions are made on the tactical or even operational level, a number of issues are strongly related to them such as inventory control policies, the choice of transportation modes and capacities, warehouse layout and management, and vehicle routing. In today's competitive market, a company's distribution network must meet service goals at the lowest possible cost. In some instances, a company may be able to save millions of dollars in logistics costs and simultaneously improve service levels by redesigning its distribution network. To achieve this, an ideal network must have the optimum number, size, and location of warehouses to support the inventory replenishment activities of its retailers. This calls for sophisticated facility location models to determine the best supply chain configuration. Moreover, it underlines the interrelation between the strategic and the tactical/operational planning levels.

Designing a supply chain network (SCN) consists of determining the network structure and dealing with various decisions from strategic decisions on location and capacities of facilities to operational and tactical concerns about transportation or inventory management policies. The structure of a SCN has a great influence on its future performance and costs and therefore, network design is a critical concern in supply chain management (SCM). Traditionally, most studies in the area of supply chain network design (SCND) mainly focus on monetary objectives. They seek designing a SCN with the aim of minimizing total costs of network or maximizing its overall profit. Nevertheless, recently various new paradigms have emerged in SCM field. In order to guarantee profitability and sustaining in today's market, a SCN not only has to minimize the overall costs but also should be flexible and responsive to the environmental changes while considering different concerns such as environmental and social factors rather than economical ones.



As a result, designing a profitable

SCN requires a broader view which takes such primary concerns in to account. The concern is emphasized and different paradigms in SCM with particular focus on network design have been addressed in this lesson.

In the supply chain model depicted (fig. 1), a product may be sourced from either of two plants and flow through three different distribution centers to reach any given customer. Even in this fairly simple model, the complexity grows quickly when one considers any meaningful number of products on top of the various sourcing options, transportation modes, capacity constraints, leads times and costs that must be considered. Supply chain network design models provide the most effective and efficient way to solve such problems. These models provide powerful decision support functionality to understand and evaluate complex supply chain relationships.

4.2 Concept of supply chain strategy & network design

Supply Chain Strategy, and the closely-related concept of Network Design, refers to how the firm chooses to structure its supply chain in support of its business strategy. This typically involves the following strategic decisions:

- Number, location, and size of factories and distribution centers
- Choice, number and locations of suppliers
- Modes of transportation used
- Location and size of inventory buffers
- Location of the push/pull boundary
- Routings: Assignment of products to plants, plants to distribution centers and distribution centers to customers, etc.

A further complication is that the “right” supply chain structure can differ markedly by product and/ or customer segment, or can change over the course of the product lifecycle. And the right supply chain structure for an individual product may itself be a portfolio of multiple supply chains. (like fashion retailers who sometimes combine a low-cost, long lead-time source in the Far East with a higher-cost but more responsive domestic source.)

A network design project can answer many types of questions such as these:

- How many warehouses should we have, where should they be, how large should they be, what products will they distribute and how will we serve our different types of customers?
- How many plants or manufacturing sites should we have, where should they be, how large should they be, how many production lines should we have and what products should they make, and which warehouses should they service?
- Which products should we make internally and which should we source from outside firms?
- If we source from outside firms, which suppliers should we use?
- What is the trade-off between the number of facilities and overall costs?
- What is the trade-off between the number of facilities and the service level?
- How much does it cost to improve the service level?
- What is the impact of changes in demand, labor cost, and commodity pricing on the network?
- When should we make product to best manage and plan for seasonality in the business?
- How do we ensure the proper capacity and flexibility within the network? To meet demand growth, do we need to expand our existing plants or build new plants? When do we need to add this capacity?
- How can we reduce the overall supply chain costs?

Being able to answer these questions in the optimal manner is important to the overall efficiency and effectiveness of any firm. Companies that have not evaluated their supply chain in several years or those that have a new supply chain through acquisitions can expect to reduce long-term transportation, warehousing, and other supply chain costs from 5% to 15%. Many of these firms also see an improvement in their service level and ability to meet the strategic direction of their company.

Although firms are happy to find 5% to 15% reduction in cost, it does highlight that your supply chain might have already missed out on significant savings, you would have possibly realized, had you done the study a year ago (or two or more years ago). Some firms have realized this and now run this type of analysis on a more frequent basis (say, quarterly). This allows them to readjust their supply chain over time and keep their supply chain continually running in an optimal state while preventing costs from drifting upward. The frequency of these studies depends on several factors.

Historically, it has been customary to complete these analyses once every several years per business unit, because it was usual for business demographics and characteristics to change over this period of time. For some industries such as high-tech, the frequency is even higher because there is higher volatility in customer demand, thereby requiring periodic reevaluation of the network. Any major events, such as mergers, acquisitions, or divestitures, should also trigger a network reevaluation study. The savings from the optimization of the revised network typically represent a significant part of the savings that justify the merger or divestiture. Business demographics and characteristics are changing faster.

In addition, the growth of the global supply chain is driving firms to cycle through studies as they go from region to region around the world. Also, firms are running the same models more frequently to stay on top of changes in their business by adjusting the supply chain. Some firms update these models several times throughout the year. Determining the right supply chain design involves a lot of quantitative data as well as some non-quantitative.

Role of Network Design in the Supply Chain

Network design decisions affect the following decisions to be taken for the smooth and uninterrupted functioning of supply chain:

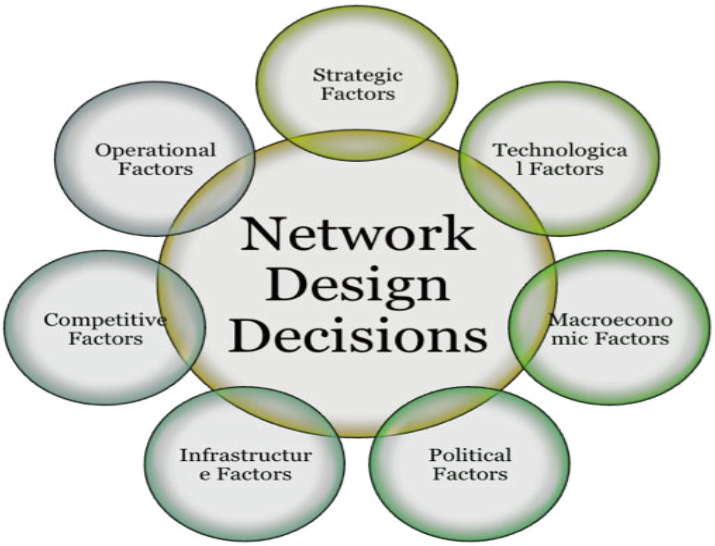
- Facility role: What role should each facility play and what processes are performed at each facility?
- Facility Location: Where should facilities be located?
- Capacity Allocation: how much capacity should be allocated to each facility?
- Market and Supply Allocation: What markets should each facility serve? Which supply sources should feed each facility?

4.3 Factors influencing supply chain strategy & network design

The important factors which are likely to affect supply chain and network design decisions have been shown in the following figure:

(1) ***Strategic Factors***- a firm's competitive strategy is a significant decision within the supply chain. Firms that focus on cost leadership, tend to find the lowest cost location for their manufacturing facilities, even if that means locating very far from the

markets they serve. Firms that focus on responsiveness tend to locate facilities closer to the market and may select a high cost location if this choice allows the firm to react quickly to changing market needs.



(2) ***Technological Factors***- If production technology displays significant economies of scale; a few high capacity locations are most effective. If facilities have lower fixed costs, many local facilities are preferred because this helps lower transportation costs. If the fixed cost of setting up facility is high, 'less facility locations' is a feasible option if setting up fixed cost is low, more numbers of facilities should be established.

(3) ***Infrastructure Factors***- Key infrastructure elements to be considered during network design include availability of sites, labor availability, proximity to transportation terminals, rail service, proximity to airports and seaports, highway access, congestion and local utilities.

(4) ***Political Factors-*** Companies prefer to locate facilities in politically stable countries where the rules of commerce and ownership are well defined. Countries with independent and clear legal systems allow firms to feel that they have recourse in the courts should they need it.

(5) ***Competitive factors-*** Companies must consider competitor's strategy, size and location when designing their supply chain networks. Positive externalities are instances where the collocation of multiple firms benefits all of them. It leads to competitors locating close to each other. For example: gas stations and retail stores

tend to locate close to each other because doing so increases the overall demand, thus benefiting all parties. In malls, retailers are located close to each other, thus providing convenience to the customers and benefitted themselves by increase in sales.

(6) ***Macroeconomic Factors-*** Factors such as tariffs and tax incentives, exchange rate and demand risk. Companies must also take into account fluctuations in demand caused by changes in economies of different countries. For example: firms with little production flexibility experienced unutilized capacity in Indian plants when Indian economies showed slowed down between 2008 and 2009. Firms with greater flexibility in their manufacturing facilities were able to use the extra capacity in their Indian plants to meet the needs of other countries where demand was high.

The factor affecting supply chain and network design decisions may be classified in two categories as:

(1) Quantifiable factors
(2) Non-quantifiable factors

Now, we will discuss these factors in detail.

4.3.1 Quantifiable Factors affecting SCND

4.3.1.1 Geographical Factors

Decisions about the location of the facilities impact many aspects of the business and require making trade-offs among those aspects. Specifically, geography drives the following:

- ***Transportation Cost***- There is a need to move product from its original source to its final destination. The location of a facility determines the distance needed to move product, which directly impacts the amount spent on transportation. But, also, the location of a facility determines your access to transportation infrastructure such as highways, airports, railheads, and ports. Finally, because of supply and demand, different locations may have different transportation rates.

- ***Service Level***- Where you locate relative to your customers impacts the time it takes to get product to your customers. For some products, you can negate great distances by using overnight air freight. But this usually comes at a premium cost.

- ***Risk-*** The number and location of your facilities impacts risk. If you have just one location for a critical activity, there is always the risk that a fire, flood, some other natural disaster, a strike, or legal issues will shut down your operation. There is also political risk to consider. Your facility could get confiscated or shut down for political reasons, or the borders may shut down, isolating your facility.

- ***Local Labor, Skills, Materials, and Utilities-*** The location of your facilities also determines what you pay for labor, your ability to find the needed skills, the cost of locally procured materials (which is often directly related to the local labor costs), and the cost of your utilities.

- ***Taxes-*** Your facilities may be directly taxed depending on where they are located and the type of operations being performed. In addition, you also need to consider the tax implication of shipping product to and from your locations. In some industries, taxes are more expensive than transportation costs.

- ***Carbon Emissions-*** Locating facilities to minimize the distance traveled or the transportation costs often has the side benefit of reducing carbon emissions. In addition, if your facilities consume a lot of electricity, you can reduce your emissions by locating near low-emission power plants.

As the list highlights, geography matters. What makes this challenging is that the geography often pushes the solution in different directions at the same time. For example, it would be desirable to have a facility close to all the demand. However, demand is typically where people live. And it is usually very expensive, if not impossible, to locate a plant or warehouse in the middle of a major metropolitan area. So the desire to be close to customers pushes locations close to cities. The desire for cheap land and labor (and welcoming neighbors) pushes the best locations further from the city center. In global supply chains these decisions become even more extreme.

4.3.1.2 Warehouses

A warehouse represents a facility where firms store product or a location where product simply passes through from one vehicle to another. It can be called a distribution center, a mixing center, a cross dock, a plant-attached warehouse, a forward warehouse, a hub or central warehouse, a spoke or regional warehouse, or a host of other terms.

Warehouses are an integral part of supply chain for following reasons:

- ***Consolidation of Products***- Often, you will need to deliver a mix of different products to your customers and these products may come from various sources. A warehouse serves the useful function of bringing these products together so that you can then make a single shipment to a customer. This will be cheaper than having the products ship to the customers directly from each individual source of supply.

- ***Buffer Lead Time-*** In many cases, you will need to ship to your customers with lead time that is shorter than that which can be offered by shipping directly from the plant or supplier location. For example, you may promise to ship products to your customers the next day but your plants or suppliers may have a lead time of several weeks before they are able to make the product available to the customer. In this case, the warehouse holds product at a location closer to the customers in order to provide the next day transport promised each time an order is placed.

- ***Service Levels-*** Where you store the product and its proximity to the market where it will be consumed is also a measure of the service level the company can provide. The need to be close to customers can create the need for multiple warehouses. Overall cost versus service level is one of the most classic trade-offs in supply chain network design.

- ***Production Lot Sizes***- Setting up and starting the production of a single product or group of similar products on a line can have a significant fixed cost associated with it. Therefore, production plans attempt to maximize the number of units of product made during each run. (This production amount is called a lot size.) Understandably, these lot sizes normally do not match the exact demand from the market at the time. This requires the extra units to be "stored" in warehouses until future demand requires them. Production lot sizes versus inventory storage costs is also a common supply chain design trade-off.

- ***Inventory Pre-Build-*** Some industries see huge spikes in the supply of raw materials (seasonal food harvests) or in the demand of finished goods (holiday retail shopping). In the case of raw material supply spikes, some firms must store these abundant raw materials until the time they will be needed for steady monthly production cycles. Other firms must immediately use these raw materials to produce finished goods that are not yet demanded.

These additional finished goods must then be stored until demand in future time periods requires them. In the case of demand spikes, companies find themselves with insufficient production capacity to fulfill all orders during peak periods of demand. As a result, they must use their additional capacity during off-peak time periods to make finished-good units to be stored awaiting their use to fulfill the upcoming spikes in demand. The use of costly overtime production versus inventory storage costs is another common supply chain design trade-off.

- ***Transportation Mode Trade-offs***- Having warehouses often allows you to take advantage of economies of scale in transportation. A warehouse can help reduce costs by allowing the shipment of products a long distance with an efficient (and lower cost) mode of transportation and then facilitating the changeover to a less efficient (and usually more expensive) mode of transportation for a shorter trip to the final destination (as opposed to shipping the entire distance on the less efficient mode).

It is also important to match up the preceding list of reasons for warehouses with the types of warehouses in the supply chain. A supply chain may have many types of warehouses to meet many different needs. Here are some common types of warehouses:

(a) ***Distribution Center***- Typically refers to a warehouse where product is stored and from which customer orders are fulfilled. This is the most common and traditional definition of a warehouse. When a customer places an order, the distribution center will pick the items from their inventory and ship them to the customers. These types of facilities are also called mixing centers because they "mix" products from many locations so that your customers can place and receive an order from a single location. If a manufacturing company does not have this type of warehouse in the supply chain, customers may have to place several orders or receive several shipments from different locations depending on where each product they want is made.

(b) ***Cross-Dock-*** Usually refers to a warehouse that is simply a meeting place for products to move from inbound trucks to outbound trucks. The term simply means that products pass (or cross) from one loading dock (for inbound trucks) to another loading dock (for the outbound trucks). For example, in the case of a produce retailer with 50 stores, they may have a full truck of fresh peaches arriving at the inbound docks from a single supplier. The peaches are then removed from the truck and some

are placed in each of the 50 waiting trucks on the outbound side, according to the relevant store demand.

This happens for peaches as well as a host of other produce items. Basically full trucks arrive from a single supplier on the inbound side of the facility, and then transferred to multiple trucks on the outbound side of the facility resulting in fully loaded truckloads with a mix of product from each of the suppliers quickly sent on their way. The best-run cross-dock systems have all the inbound trucks arriving at approximately the same time so that product stays at the cross-dock for only a short period of time.

(c) ***Plant-Attached Warehouse-*** Refers to a warehouse that is attached to a manufacturing plant. Almost all plants have some sort of product storage as part of their operations. For some, it may simply be a small space at the end of the line where product is staged prior to being loaded onto a truck for shipment. In other cases, the warehouse can act as a storage point for product made at the plant or for products made at other plants. In this case, this warehouse acts like a distribution center co-located with the manufacturing facility. A major benefit of a plant-attached warehouse is the reduction of transportation costs because a product does not have to be shipped to another location immediately after it comes off the end of the line. When you have plant-attached warehouses, sometimes the standalone warehouses are called forward warehouses, meaning they are placed "forward" or out closer to customers.

(d) ***Hub Warehouse or Central Warehouse-*** Refers to a warehouse that consolidates products to be shipped to other warehouses in the system before moving on to customers. Different from cross-docks, the products are normally stored in these locations for longer periods of time before being used to fulfill demand. The other warehouses in the network are then typically called spokes or regional warehouses.

4.3.1.3 Multiple Plants

A plant could be a manufacturing plant that produces raw material, components, or finished goods, or just does assembly. The location of the plant is primarily driven by the need to have skills in the right place or the need to be next to the corporate headquarters. However, in most cases, there are choices for plant locations. An even more interesting choice is to determine whether you should locate multiple plants to make the same

product—even when a single plant could easily handle all the demand. When you have choices for where to put your plants or the option to have several plants, you must consider some of the same questions we did when locating warehouses. For example, factors that would drive you to have multiple plants making the same product include:

- ✓ ***Service Levels-*** If you need your plants to be close to customers, this will drive the need for multiple plants making the same product. This becomes especially important if your business does not use warehouses. In this case, your plants face the customer and their location can drive service levels.

- ✓ ***Transportation Costs-*** For producers of heavy or bulky products that easily fill up truckload capacities, you will want to be as close to your markets as possible. This may also drive the need for multiple warehouses.

- ✓ ***Economies of Scale-*** As a counterbalance to the benefits of transportation, you also want to factor in the economies of scale within production. The lower the production cost per unit. This is driven by a reduction in production line setup time and costs and the benefit of being able to create a more focused manufacturing process. So while it may be ideal to have many production locations to minimize transportation cost, economies of scale in manufacturing suggest that fewer plants will be better.
- ✓ ***Taxes-*** In a global supply chain, it is often important to consider the tax implications of producing and distributing product from multiple or different locations.

4.3.2 Non Quantifiable Factors affecting SCND

There are other factors that need also to be considered while making a final decision pertaining to network design. Some of these factors cannot be quantified and considered directly within the optimization runs. It is important to run the optimization with as much quantifiable information as needed but it is equally important to understand the non quantifiable factors as well, as a little miscalculation can cost an organization's fortune. Some of the non-quantifiable factors you might then want to consider include the following:

- ***Firm's Strategy***- Your firm may value cost more than service or vice versa. For example, your firm may have a strategy of servicing the top customers at any expense or be committed to a local manufacturing strategy.

- ***Risk***- For global supply chains, you need to worry about placing sites in politically unstable locations, port closures, and the added risk of extra distance between origins and destinations. There is also a risk when you have just a single location to make a given product or you have a supply chain that is currently at capacity and is not equipped to handle any unexpected extra demand.
- ***Disruption Cost***- Firms realize that changes could cause significant disruption, leading to other costs like attrition, lost productivity, and unmet demand.
- ***Willingness to Change***- Some firms may be more willing to change than others. This can impact the range of solutions you might want to implement. For example, for a firm that is not willing to change, they may be happy to give up savings in exchange for a minimal number of changes.
- ***Public Relations and Branding***- This is especially important for firms with a highly visible brand. If one of these firms opens or closes a new facility (especially a manufacturing location), it can often make the news. These firms need to consider the public reaction and the impact on their brand.
- ***Competitors***- A firm's supply chain can be impacted by the competition. Sometimes it makes sense to be exactly where the competition is, and in other cases it makes sense to be where they are not.
- ***Tax Rebates***- Although taxes can be modeled directly as a cost (as product crosses borders or tax jurisdictions), there can also be rebates for locating a facility in a particular location. This can be hard to quantify during the analysis, but it can be used for negotiating with the local tax authorities.

Except from the above stated factors an organization can have internal non quantifiable factors which can affect the supply chain and the network design. The first challenge, aside from merely gathering all these people into the same room at the same time, is to understand and start to balance the different objectives that each group may have. As you can imagine, each of these groups operates with its own specific goals and these may directly conflict with each other.

The second challenge you have is collecting and validating data from all these different parts of the organization. The sales group must produce the appropriate historical demand data as well as dependable forecasts of sales in the future. The operations group will be needed to explain the costs, capabilities, and capacities of all the production and storage assets, as well as any related overhead and labor costs. The logistics group is also needed to provide not only current transportation rates but estimates of rates for new potential

lanes resulting from a reorganized network. The finance department is depended on for comparing the output costs from the model to the costs within their financial statements for the same span of time.

Doing this provides a validated starting point for the model and a baseline to which we can compare all future model scenarios and output. This data may lie in different systems as well, which only adds to your challenges and often requires IT help to sort out. Data challenges also come when you are attempting to estimate data for the new potential locations and product flow paths. (Even though this data may be difficult to collect, this is often the whole point of a study—to consider new alternatives.) Transportation rates for new lanes, potential site costs, capacity, and capabilities, as well as the cost to shut down existing sites, must all be researched and calculated for consideration when we ask the model to make the best decision.

The third and final challenge comes after the modeling is done and you have to take the final decision. The final step of actually implementing the results can be a major challenge in and of itself. People in any company become very comfortable with a certain way of doing things. As a result, it is not always easy to get them to see the "big picture" and the value these changes will bring. Proper involvement from all of the previously mentioned teams within an organization throughout the entire project can assist with this, however, as each team understands the rules and constraints that they ensured were adhered to within the recommended solution. There are many great resources for you to learn about how to implement change like this in an organization, but this topic is beyond the scope of the syllabus. Making changes to a supply chain may also cause a temporary state of disruption. A supply chain cannot just stop at a moment in time and take on a new structure. It is often important to implement changes over a period of time to minimize the downtime and inconvenience that switching over operations may cause.

4.4 Necessary Framework for Network Design Decisions

As it is apparent from the following figure, the framework required for the network design decisions may be understood better in terms of different phases; described as below:

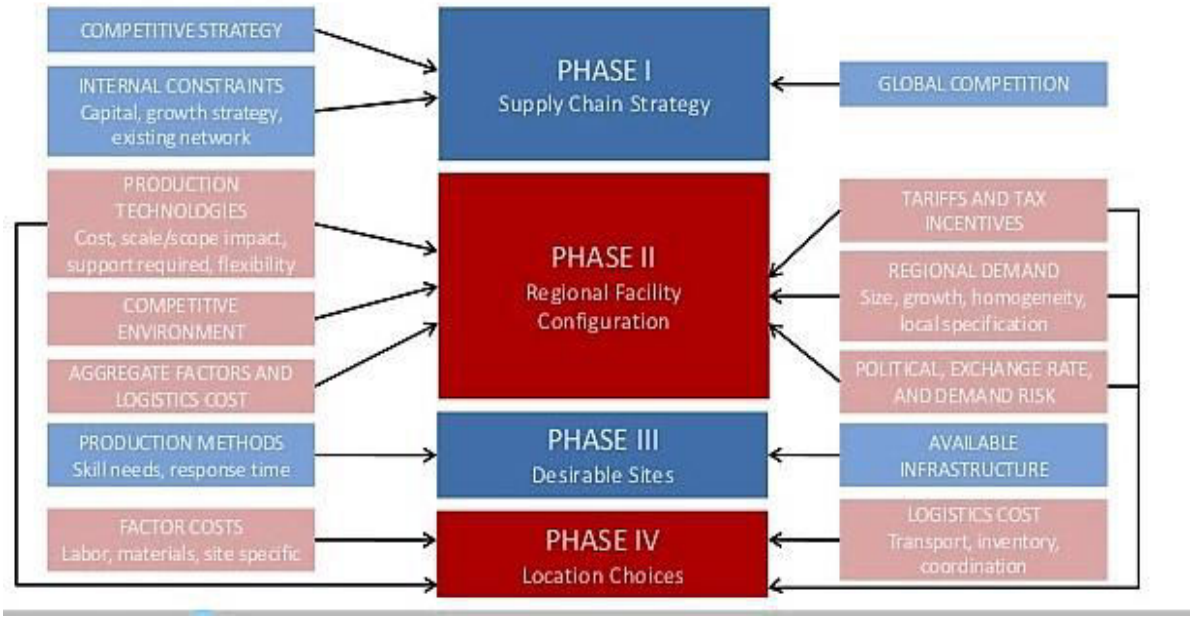
- *Phase 1: Design a Supply Chain Strategy*

First, one must have a clear understanding of the competitive strategy of firm, expressed in terms of its customers' needs; which supply chain aims to satisfy. Manager must

forecast the likely evolution of global competition and whether competitors in each market will be local or global players. Firms also need to have a eye on the constraints on available capital and whether growth will be accomplished by acquiring existing facilities, building new facilities or partnering etc.

- *Phase 2: Define the Regional Facility Configuration*

Demand forecasts made by countries not only indicate the size of demand but also help in determining whether the customer requirements are homogenous or varying across different countries. Homogenous requirements favor large consolidated facilities whereas requirements that vary across countries favor smaller localized facilities. If economies of scale are significant in reducing costs, it may be better to have few facilities serving many markets. If economies of scale are not significant, it may be better for each market to have its own facility. They must identify demand risk, exchange rate risk, political risk, tax incentives and regional tariffs for local production. They must also decide whether a facility needs to be located close to or far from competitor's facility.



- *Phase 3: Select a Set of Desirable Potential Sites*

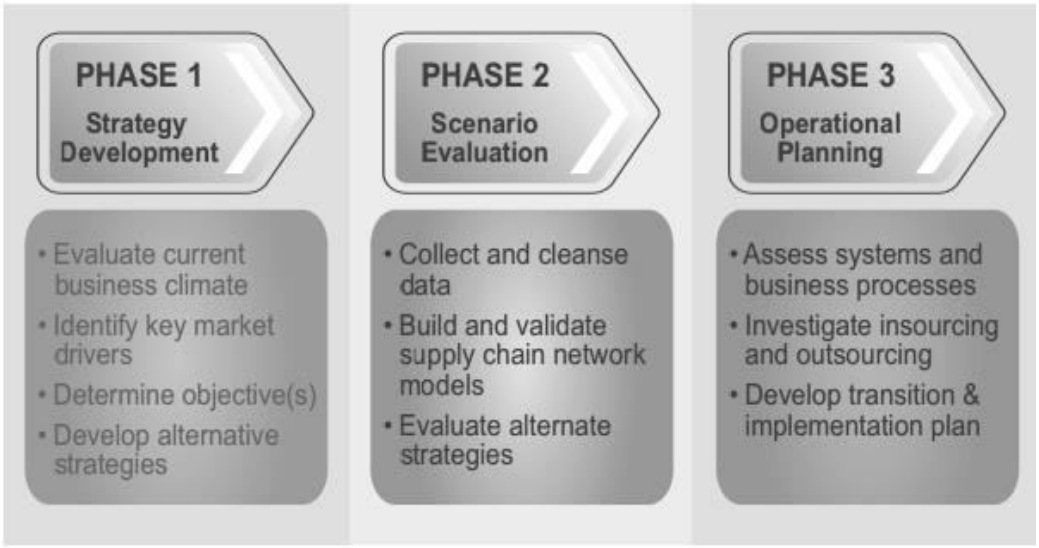
Hard infrastructure requirements include the availability of suppliers, transportation services, communication, utilities and warehousing infrastructure. Soft infrastructure facilities include the availability of skilled workforce, workforce turnover and the community receptivity to business and industry.

- *Phase 4: Location Choices*

Maximize total profits taking into account the expected margin and demand in each market, various logistics and facility costs and the taxes and tariffs at each location.

4.5 Methodology of Supply Chain Network Design

The Spinnaker's approach is most widely used while executing a supply chain network design assessment. It considers the understanding of strategic business objectives, defining and analyzing the multiple strategies to achieve these objectives, evaluating the options and trade-offs involved and developing the implementation plans required to translate decisions into reality. The graphic below illustrates the different steps in this assessment process.



Phase 1: Strategy Development

The development and communication of an overall supply chain strategy is the responsibility of corporate management. The role of the project team is to research and suggest potential strategies, and assist in the evaluation and detailed analysis of the strategic alternatives presented. Models help to visualize and communicate ideas, capture complex relationships and study the impact of various decisions, but they do not create strategy. With this in mind, there are several key issues to keep in mind when developing a corporate supply chain strategy.

Strategy development is both an art and a science. "Art" is required in the evaluation of market trends, forecasting competitive drivers and creating an effective organizational structure. Science is applied in the effective use of modeling tools to develop and evaluate potential strategies (though the effective and creative use of models is often an art itself). During the initial phase of strategy development, it is important to remove oneself from

the numbers and think conceptually. There will be adequate time later to get into detailed analysis. The primary focus at this point should be at developing a list of critical issues and identifying how each will change over next 3-5 years. Some questions to guide the process are listed below:

- Who are our customers? What do they expect from us? How well do we meet their Z expectations?
- What are our deficiencies?
- What do our competitors have and/or do that we don't?
- What do we have and/or do that our competitors don't?
- What functions/roles/services are crucial to our business and should be kept in-house?
- What functions/roles/services could potentially be outsourced?

Discussion starts with a review of the current market trends, competitive and financial pressures and operating environment. Then develop a vision of estimated future market needs and the operating environment necessary to meet those needs. The strategy to be developed must close the "gap" between current and future operating environments. Issues identified at this stage drive the development of an integrated strategy. Note that this strategy is not carved in stone. It must be updated annually as current events re-shape the future. A good strategy evolves over time. The most important goal is to lay a foundation of processes and culture so that strategic planning becomes an integral part of the business.

Phase 2: Scenario Evaluation

Once a set of potential strategies has been developed, these alternatives must be evaluated according to an objective and measurable set of key factors. These values will be used to determine the relative "goodness" of each solution. Since one alternative is to do nothing, the first step is to collect operational and costs data on the current network. These baseline costs and service measures will be used as the benchmark against which all other options will be compared. It is important to closely evaluate the use of averages within the model. Markets, product mixes and logistics costs change over time and from region to region. Averages may bias the models for or against a particular solution. However, high-level averages are still useful for comparing one solution to another. Typical data requirements for a modeling effort will include:

- Demand (as indicated by customer demand for each particular product group)
- Supply (as indicated by supplier and/or manufacturing capabilities and capacities)

- Facility capacity (maximum units of production/flow per day)
- Costs (fixed and variable manufacturing, material handling and transportation costs)

The next step is to build and validate high-level models that will be used to test each alternative and calculate the appropriate cost and service measures. Focusing first on the baseline solution, we create a network model, verify that the model behaves as we expect it to and validate the model output against known cost and flow measurements. Note that the more precise a model must be, the greater the amount of data need to be collected, the greater the accuracy required of that data and the more difficult it will be to solve the model. We make every effort to create flexible, reusable models that may be re-applied for future studies and strategic planning. Because we are evaluating long-term strategy, the models typically focus on annual demand, not short-term figures. Depending on the complexity of the network, it may be necessary to partition or regionalize the network along natural geographic or business divisions. Each long-term strategy being evaluated may potentially be accomplished through millions of possible combinations of facility locations, transportation plans and stocking policies.

The goal of network optimization is to rapidly evaluate this multitude of alternatives and select a few top contenders for further analysis. After the baseline model has been approved, then we can build and evaluate alternative strategies using the same core assumptions used to build the baseline. Our goal at this stage is to optimize a given network to meet market needs. The primary components of a solution are the number, location, size and inventory stocking policies of each facility and the associated transportation plan. The primary measure of each solution is its net operating cost. For each contender selected, it is important to adjust key assumptions to determine the sensitivity of the solution. This sensitivity analysis is useful for evaluating the robustness of the solution to changing market forces, as well as for identifying key factors that must be tightly controlled.

The total cost of a supply chain strategy is not completely captured within a high-level network model. After a solution has been identified as a contender, it must be evaluated within the broader environment of information systems, inventory policies, personnel and operating procedures. This involves a more detailed look at routing and transportation assumptions, inventory stocking policies, facility operating procedures, enabling technologies and changing roles for the workforce. Furthermore, regulatory, tax and other economics factors outside of the model's purview are often relevant. A complete evaluation must also incorporate the costs to transition from the current state to the new

solution, such as closing or moving facilities, retraining the workforce and updating computer systems.

Phase 3: Operational Planning

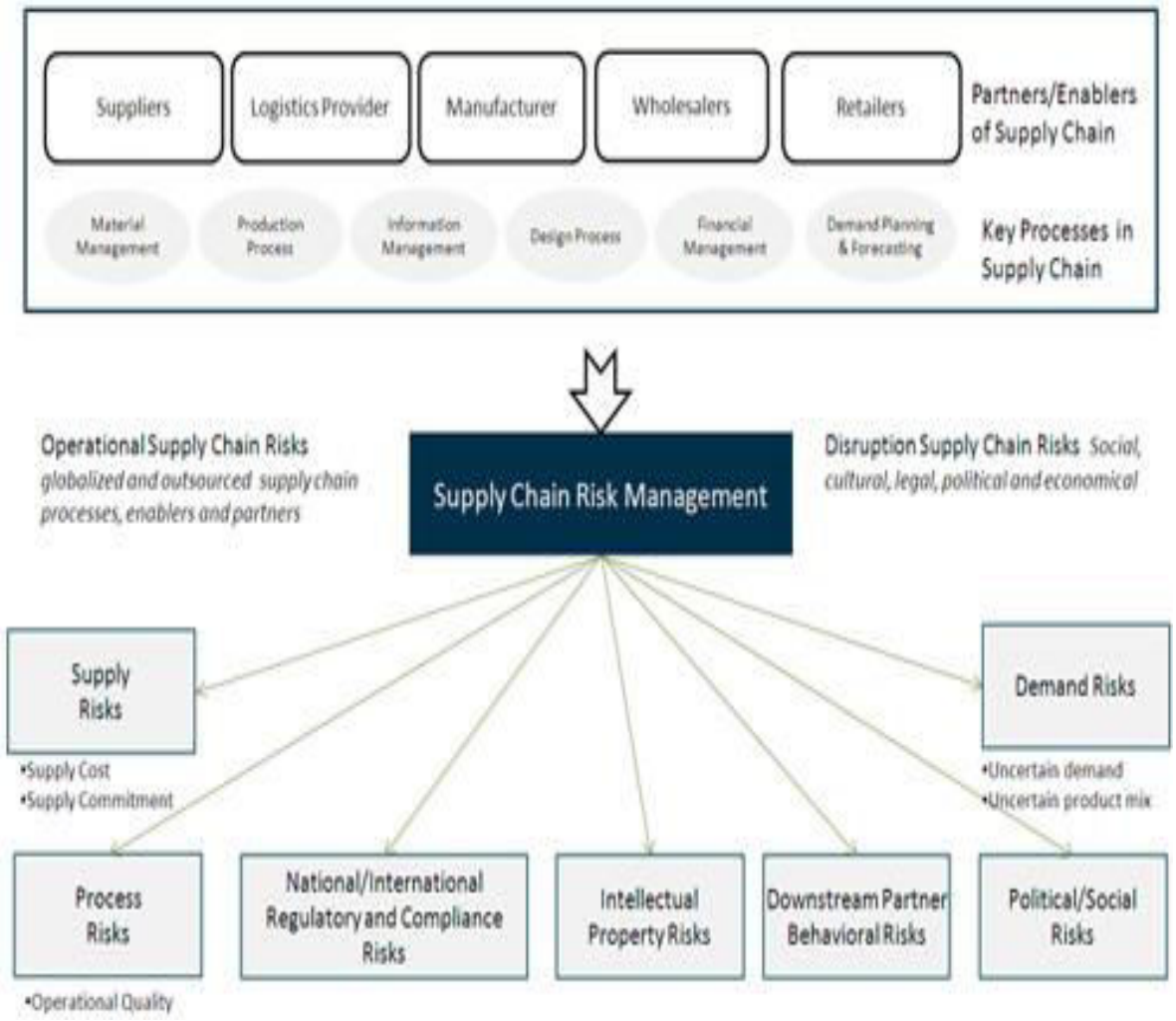
Once a strategy has been selected, it is time to move into detailed planning. Because this stage is very time consuming, it is crucial that only the best strategy (or perhaps 1-2 alternatives that are seriously being considered) be evaluated during this time. Since the network models were solved at an aggregate level of planning, we now must determine how to run the solution on a day-today basis. This includes defining specific operating procedures, material flow policies, inventory stocking policies and load plans. At this point it is important to perform a complete needs analysis covering all components of the supply chain: systems, staffing, facilities, transportation, communication, processes, etc. A fundamental question which must be addressed is the degree to which certain activities or operations will be outsourced to third parties versus being executed in-house. Also occurring at this time is the development of a detailed implementation plan. This plan must define all tasks, dependencies and resources required to transition from the current state to the proposed solution.

4.6 Risk Management in SCND

Risk is usually defined as the probability of an unpleasant event occurrence. Whereas some areas like project management consider both positive and negative risks often negative aspects of risk are highlighted in the literature. Risk management is identification, assessment, prioritization, monitoring, and control of risk and uncertainty.

Some believe that in order to manage risk, we need to consider phases like preparation, prevention, mitigation, etc. In addition, to address the definition of risk it is important to discuss its association with uncertainty.

The figure as below includes various types of risks associated with SCND. There are two different schools of thought, *first* says there are three different strategies to reduce the effects of uncertainties and disruptions in supply chains adapting inventory control system, multi-sourcing and also proactively mitigating risks. The *second* says that associated risks of supply chains may be categorized into eight groups: delay, forecast inaccuracies, procurement failures, disruptions, system breakdowns, intellectual property breaches, capacity, and inventory problems. Among these delay, forecast and disruption



are related to physical flows of material and product throughout the chain. Forecast risks results from the mismatching between the chain's prediction and the actual demand of the markets. Delay risk occurs when a supplier of a chain cannot deliver the orders on time due to inside problems of its system such as overuse of capacities, impairment of facilities, labor dispute and etc. and disruptions occurs when natural or man-made phenomena such as earthquake, flood, inclement weather, war, labor strike and etc. By affecting the production and transportation infrastructure, disrupt the flow of material.

Some factors like market demand, disruption of suppliers in on-time delivery of ordered goods and other designing parameters are considered uncertain. In today's business environment, uncertainty is undeniable. Due to their decentralized nature, supply chains are very vulnerable against uncertainties. As supply chains are important part of today's market, managing their risks has become an integral part of SCM which involves design of a robust SCN structure and management of product flow throughout the network and make it possible to predict, deal with and recover from the disruption.

The labor strike in 2002 results in shutting down of 29 ports in the west coasts of United States and as the result closure of New United Motor Manufacturing production factory. The destructive earthquake in Japan in 2011 made Toyota Motor Company to close 12 assembly plants which results in production loss of 140,000 autos (Talmadge and Kageyama 2011). This problem led to disruption of Toyota's chain's manufacturing subsystem.

Georgiadis (2011) modeled the problem of SCND in case of multi-product production facilities when production resources, warehouses, distribution centers, customer zones and operating are shared while demand is time varied and uncertain. Qi and Shen (2007) introduced unreliable supply in a supply chain. They considered a multi period problem in which the retailers of the chain order a certain good from the existing supplier in each period and the supplier responds to orders via his facilities. Delivered amount of ordered product to the chain's each retailer includes a probabilistic shortage. Because some portion of it is lost, mistakes and damages are possible. They modeled the delivered amount as the ordered amount and a random variable associated with the supplier's facility which serves the retailer. The objective of their model is maximizing the supply chain's profit. They considered the given product retail price, facility location, inventory, and safety stock costs as well as transportation and penalty costs for retailers. They used a bisection search and outer approximation algorithm to solve the model.

Chopra (2007) considered the flow planning throughout a chain with determined network structure. This chain consists of a buyer and two available suppliers. First supplier is cheaper, but prone to disruption and second supplier is completely reliable, but more expensive. They considered supply side uncertainty and highlighted the necessity of decoupling recurrent supply risk and disruption risk. Disruption is modeled by scenario and recurrent supply is considered as a random variable with given distribution function. Yu et al. (2009) considered an order splitting problem in a two tiered SC consists of a manufacturer and two available suppliers with disruption probability. First available supplier has lower price but more prone to disruption and in contrast, the second supplier has higher price but lower disruption probability.

Schmitt and Snyder (2010) considered the optimal ordering and determining the reserve quantities of a two-tiered supply chain which involves a firm and its suppliers. One of these suppliers is prone to disruption and has yield uncertainty whereas the second one is completely reliable and always available but more expensive. They modeled and compared this problem in two cases: single-period and multi-period and discussed about

the advantages of multi period consideration in compare to the other. They also use Branch & Bound technique to solve this problem. There are also works in the literature that consider uncertainty in different parameters of the model. Hwang (2002) considered routing decision in SCND problem with stochastic traveling time.

Lowe et al. (2002) considered risk of exchange rate in SCND problem and solve it by a two-phase multi-screening approach. Alonso-Ayuso et al. (2003) considered a multi-period SCND problem with uncertain product net price, raw material procurement cost, and demand. They solved the problem by a two stage stochastic programming model.

4.7 Summary

The success of an organization is mainly dependent on its supply chain effectiveness and the most innovative business strategies can be derailed by poor alignment with supply chain design. Companies today face shortening product life cycles, lengthening global supply chains, increasing product complexity and rising logistics expenses. Supply chain network is a complex decision making process. The typical inputs to such process consist of a set of customer zones to serve, a set of products to be manufactured and distributed, demand projections, for different customer zones, and information about future conditions, cost (e.g. for transportation and transportation) and resources (e.g. capacities, available raw materials). Given the above inputs, companies have to decide where to locate new service facilities (e.g. plant, warehouses), how to allocate procurement and production activities to the various manufacturing facilities, and how to manage the transportation of products through the supply chain network in order to satisfy customer demands.

Modern supply chain network design methods enable organizations to quickly and efficiently evaluate alternative supply chain strategies and select the one that maximizes shareholder value. The key methodology used to perform supply chain network design is quantitative modeling and optimization. The advantage of models is that they can evaluate the complex relationships and trade-offs of the overall system by tying together large numbers of variables in a conceptual framework that makes it much easier for the user to define relationships. In general, the trade-offs between these different approaches involve speed versus complexity and the need to achieve “good” versus optimal solutions. The typical methodology used by commercial network optimization solutions is to consider a long-term demand forecast, supply chain facilities and capacities, lead times and fixed and variable costs to identify the most cost effective supply chain network.

Utilizing quantitative tools to perform analysis also makes the translation of an operational strategy to a financial business case a much more straightforward task.

4.8 Self-Assessment Questions

- ✓ What are the factors influencing Supply chain Network design?
- ✓ Differentiate between quantifiable and non-quantifiable factors influencing SCND?
- ✓ How does structure of a SCN influence its future performance? Discuss critically
- ✓ Explain the different phases of methodology used in SCND.
- ✓ What are the different risks associated with SCND. How do they affect the efficiency of supply chain?

4.9 Key Words

- **SCND**- Supply chain network design that refers to how a supply chain should be designed
- **SCM-** supply chain management refers to how a supply chain should be managed and understanding the various elements of supply chain.
- **Quantifiable**- Measurable elements i.e. which can be statistically shown
- **Non quantifiable**- Non measurable i.e. which cannot be numerically expressed.
- **Scenario Evaluation**- Understanding the Market needs and demands and acting accordingly.

4.10 References/Suggested Readings

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Subject: Supply Chain Management	
Course Code: POM-323	Author: Prof (Dr) Hemant Sharma
Lesson No.: 5	Vetter:
Inbound Logistics	

Structure:

5.0 Objectives:

After reading this lesson, the students would be able to understand

- The meaning of logistics and its operating objectives
- How logistics are used to earn competitive advantage over competitors
- The different activities of value chain
- Concept of integrated logistics systems
- Various types of logistics systems mainly including inbound logistics
- The forces driving globalization of logistics as well as barriers to global logistics

5.1 Introduction:

According to the Council of Logistics Management (CLM) *"Logistics is the process of planning, implementing and controlling the efficient and effective flow of goods, services and related information from point of origin to point of consumption in order to meet customer requirements".*

- The objective is to plan and coordinate all the activities necessary to achieve desired level of delivered service and quality at lowest possible cost.
- The scope of logistics includes the entire gamut of activities starting from the procurement and management of raw materials through to delivery of final product to the customer.
- The ultimate purpose of any logistics system is to satisfy the customer by establishing linkages of people at all levels in the organization directly or indirectly to the market place.
- As it is getting increasingly difficult to maintain a competitive edge through product alone, customer service has started to provide the distinctive difference between one company's offer and that of its competitors.

The underlying concept is "The process of strategically managing the procurement, movement and storage of materials, parts and finished inventory and the related information flows through the organization and its marketing channels in such a way that the current and future profitability are maximized through the cost effective fulfillment of orders."

Logistics in Today's Indian Business Environment

Liberalization opens our door to competition. Global business has long supply & distribution lines. Rapidly changing preferences of Indian customers, their awareness level, demands and less brand loyalty has posed a great challenge for the producers. Rising competition ensures that product differentiation in terms of quality is difficult. Today, product life cycles are shrinking and our markets are shifting from sellers to buyers. Many consumer products are moving into commodities market.

In India, large distances separate production and consumption centers. Essential commodities have to travel from Food Corporation Warehouses to consumers through

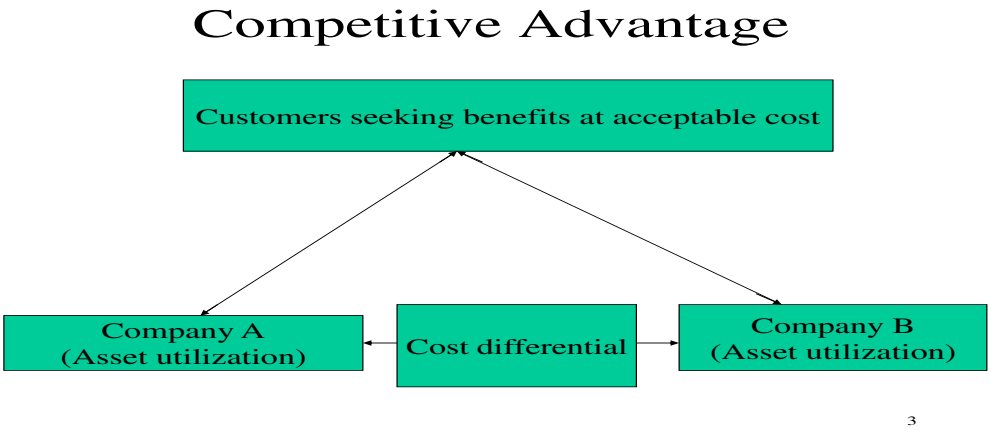
PDS. Still Logistics performance in India has not been impressive – Fruits and vegetables are grown at various places but do not enjoy access to markets located at far.

Operating Objectives of Logistics Management:

1. ***Rapid Response:*** Rapid response is concerned with a firm's ability to satisfy customer's requirement in a timely manner. Instead of stocking the goods and supplying on demand, orders are executed on shipment-to-shipment basis. Here IT helps to postpone the logistical operations to the latest possible time and then execute rapid delivery as when needed by customer.
2. ***Minimum Variance:*** Variance is any unexpected event that disrupts system. Logistical operations are disrupted by events like delays in order receipt, disruption in manufacturing, goods damaged at customer's location and delivery to an incorrect location etc. Traditional solution to deal with variance was to keep safety stock or use high cost transportation. Such practices were expensive and risky and thus have been replaced by information technology to achieve positive logistics control.
3. ***Least Inventory:*** The objective of minimum inventory involves asset commitment and inventory turnover. Asset commitment is the financial value of inventory developed throughout the logical system and inventory turnover is the rate of inventory usage over time. The objective is to reduce the inventory without sacrificing customer satisfaction.
4. ***Movement Consolidation:*** One of the most significant logistical costs is transportation. Transportation cost depends on type of product, size of shipment and distance. Movement consolidation means grouping small shipments together in order to reduce transportation cost.
5. ***Quality Improvement:*** Logistics is a prime part of developing and maintaining continuous TQM improvement. If the quality of product fails, logistics will have to ship the product out of customer's premises and repeat the logistical function again. This adds to cost and customer dissatisfaction.
6. ***Life-Cycle Support:*** Life cycle support is also called cradle-to-cradle logistical support. It means going beyond reverse logistics and recycling to include the possibility of after sale services, product recalls and product disposal. This means that firms must consider how to make a product and its package (cradle) and then how to remake and reuse them (to cradle). E.g. Cold drink industries use their glass bottle again and again whereas the cans are reused in making of paper dishes.

5.2 Logistics to Earn Competitive Advantage over Competitors:

Competitive advantage is the ability of an organization to differentiate itself in the eyes of the customer, from its competitors, and to operate at a lower cost and hence greater profit. Competitive advantage helps organizations to achieve commercial success which mainly depends upon two factors – cost advantage and value advantage.



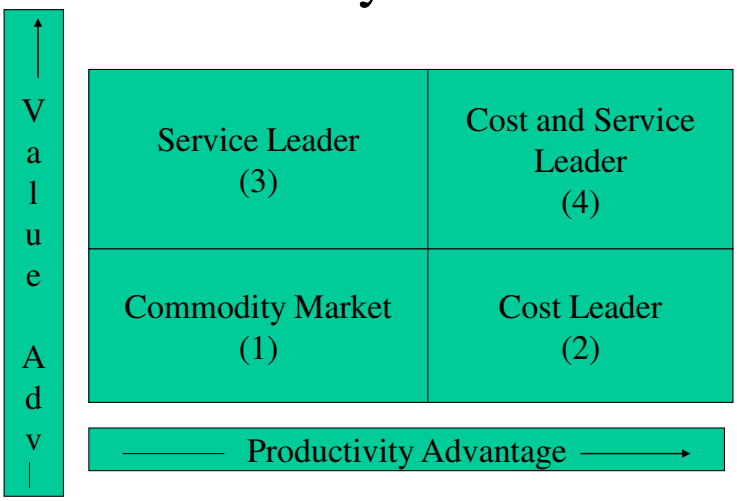
Sources of Competitive Advantages:

An organization may earn competitive advantage over its competitors by:

- Gaining cost advantage or productivity advantage
- Characterized by low cost of production due to greater sales volume, economies of scale enabling fixed costs to be spread over a greater volume and the impact of the 'experience curve'
- Value advantage is in terms of product offering a differential 'plus' over competitive offerings. In the following figure, we can observe productivity and value matrix and evaluate various organizations according to their cost advantages and value advantages.

In the following figure, various types of markets situations are shown. Companies depending upon, market situation try to establish them as cost leader or service leader.

Productivity and Value Matrix



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- For companies in quadrant (1), the market is uncomfortable place as their products cannot be differentiated from their competitors' offerings as they do not have any cost advantage. These are commodity markets.
- Companies in quadrant (2), adopt cost leadership strategies. Traditionally, these are based on economies of scale gained through volume.
- Another route to achieving cost advantage is through logistics management. As logistics constitutes a major proportion of total costs, reengineering logistics processes results into substantial cost reduction.
- Companies in quadrant (3), seek differentiation through service excellence since markets are becoming more and more service sensitive.
- Customers expect greater responsiveness and reliability from the suppliers, reduced lead times, just-in-time delivery, and various other value added services.
- Services strategies can be developed through enhanced logistics management.
- Companies in quadrant (4) are distinctive in value they deliver and are also cost competitive.

- Based on marketing concept that customers that 'customers don't buy products, they buy benefits'
- Benefits may be intangibles and may not relate to specific product features
- It can be an image or reputation or even some functional aspects

- Adding value through differentiation is extremely powerful means of achieving competitive edge in the market
- One of the significant methods of adding value is service
- *Service* helps in developing relationship with the customers through provision of an augmented offer
- *Augmentation* takes many forms such as delivery services, after-sales services, financial packages, technical support etc.

Customer Service:

Customer Service is defined as a process of providing significant value added benefits to the supply chain in a cost-effective way.

Elements of Customer Service

❖ **Availability**

Availability is the capacity to have inventory when it is desired by a customer. The most common practice to achieve availability is to stock inventory in anticipation of customer order. Availability is based on following three performance measures:

(a) ***Stock out Frequency:*** Stock out frequency is a measure of how many times demands for a product exceed its availability. The aggregation of stock outs of all products indicates how well a firm is able to provide basic service commitments.

(b) ***Fill Rate:*** Fill rate measures the magnitude of stock outs over time. E.g. if a customer orders 50 units and only 47 units are available, the order fill rate is 94 % (47/50). Just because a product is out of stock does not mean that a customer requirement is going unsatisfied. Before a stock out affects service performance it is necessary to forecast customer requirements then to identify the product unavailability and to determine how many units customer wanted. Stock out frequency and fill rate are inversely related through order quantity. i.e. if a firm places larger order the stock out frequency will be less and the expected fill rate will be higher.

(c) ***Orders Shipped Complete:*** It is a measure of time when a firm received the entire inventory ordered by a customer. It indicates the potential times that customers will receive perfect orders.

❖ **Operational Performance**

(a) ***Operational Speed:*** Performance speed is the interval between placement of order and shipment arrival. Depending upon the logistical system design, the speed can be as short as a few hours or as long as several weeks. In critical situation service can be performed in a few hours by special delivery or on overnight basis. But every customer does not need maximum speed if it results in increase in logistics cost.

(b) ***Operational Consistency:*** Consistency refers to a firm's ability to perform at the expected delivery time. When a form fails to be consistent it forces customers to carry extra safety stocks to protect against possible late delivery.

(c) ***Operational Flexibility:*** Flexibility refers to a firm's ability to handle extraordinary customer service requests. The events that require flexibility are:

- Modifications in basic service arrangements
- Product modification
- Product introduction
- Product phase out
- Product recall
- Disruption in supply

❖ **Reliability**

Reliability refers to logistics quality i.e. ability of firm to comply with levels of planned inventory availability and operational performance. Reliability also includes firm's capability to provide accurate customer information regarding logistical operations and order status.

Objectives/ Significance of Customer Services:

- ✓ Maintaining customer loyalty and level of satisfaction
- ✓ Receiving repeat orders from customers
- ✓ To win new customers and keep existing customers
- ✓ An edge over competition

Customer Retention:

Once a customer is owned by a company, it must be retained such that customer keep coming again and again. This depends on the Customer Service. For that the company has to motivate employees and to reinforce the service concepts with top management.

Advantage:

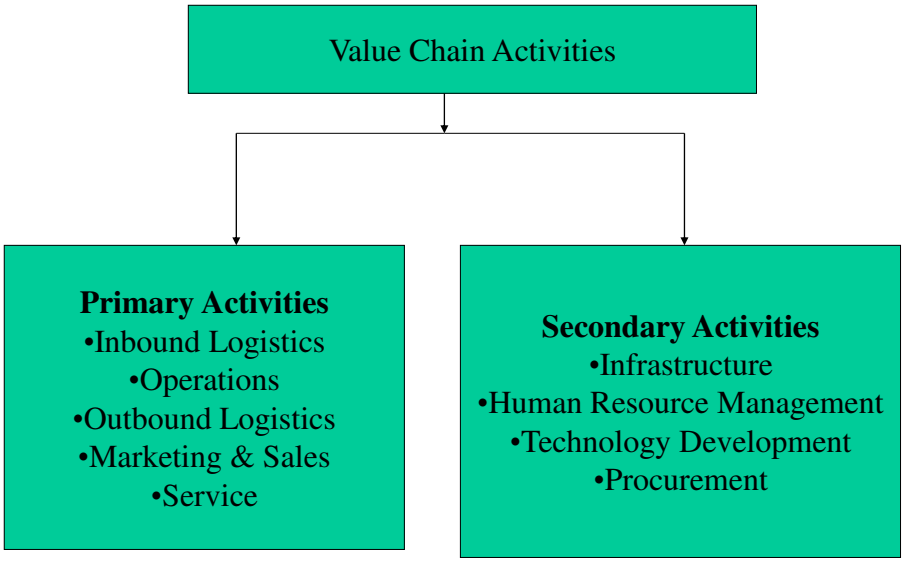
- Retaining more customers result in higher profit
- The cost of retaining customers is much less than to acquire them
- It helps in strengthening and expanding customer base
- If a regular customer were lost, then it would cost very heavily to generate new customer.

Methods:

1. Offer only quality services and products
2. Demonstrate the use of product or services
3. Provide responsive customer service
4. Share testimonials of customers with other potential customers
5. Educate the customer about the market and value of the business
6. Invite customer's opinion and feedback on products or services

5.2.1 Value Chain Activities:

The organizations operating in competition and are willing to increase their profits focus on value chain activities. Competitors find it hard to attack these companies which try to excel in all the value chain activities. You can see the different types of value chain activities which are practiced by successful organizations.

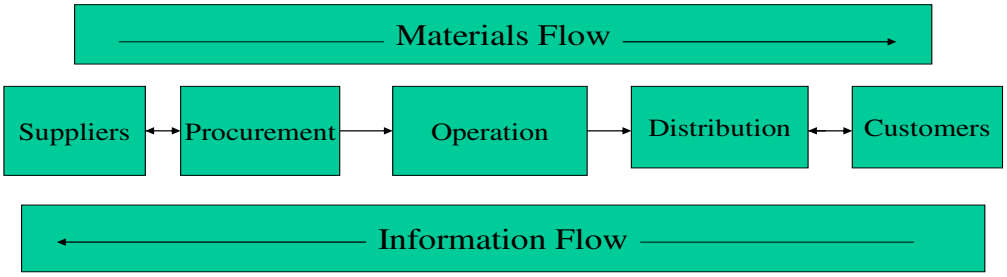


- ❖ Primary activities represent the functional areas like arranging inputs for transforming them into output, and managing distribution, marketing, sales, and services.
- ❖ The secondary activities facilitate the integration of all the functions across the entire organization.
- ❖ The companies can achieve competitive advantage and create differentiation by organizing and performing these activities more efficiently or in a unique manner than their competitors.
- ❖ Factors affecting productivity advantage
  (a) Capacity utilization
  (b) Asset utilization
  (c) Inventory reduction
  (d) Integration with the suppliers.
- ❖ Factors affecting value advantage
  (a) Customized services
  (b) Reliability
  (c) Responsiveness.

The objective of logistics is to link the market place, distribution network, the manufacturing process and procurement activity, so as to provide higher levels of services to the consumers yet at a lower cost.

As far as scope of logistics management is concerned, it encompasses management of raw materials and other inputs through the delivery of the final product.

Underlying Philosophy Behind Logistics Concept

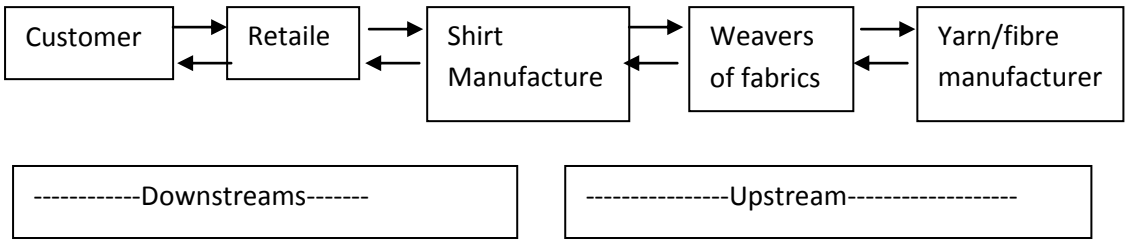


From the above discussion, it is clear now that logistics management:

- A process of satisfying customer needs through coordination of materials and information flows that extend from the market through the firm's operation and beyond that to the suppliers
- A shift to an integrated orientation from the conventional manufacturing or marketing orientation
- Traditionally, manufacturing and marketing have been considered as separate activities each having different priorities
- Manufacturing priorities and objectives are concerned with achieving operating efficiencies based on long production runs, minimized set ups and changeovers, and product standardization
- Marketing priorities and objectives are concerned with achieving competitive advantage based on varieties, high service levels, and frequent product changes
- Customer orientation and cost competitiveness has been integrated by introducing flexible manufacturing systems, practicing inventory management policies based on manufacturing requirement planning and just-in-time inventory policy, laying sustained emphasis on quality and integrating supply side issues in strategic plans.

5.2.2 How do we define supply chain?

- A network of organizations that are having linkages, both upstream and downstream in different processes and activities that produce and deliver value in the form of products and services in the hands of ultimate consumer.



- A shirt manufacturer is a part of supply chain that extends upstream through the weavers of fabrics to the spinners and the manufacturers of fibres, and downstream though distributors and retailers to the final consumers.
- Though each of these organizations are dependent on each other yet traditionally do not closely cooperate with one another.

Is Supply chain management same as vertical integration?

- ✓ SCM is not the same as vertical integration.
- ✓ Vertical integration implies ownership of upstream suppliers and downstream customers.
- ✓ Earlier, vertical integration used to be the desirable strategy but increasingly the companies are focusing on their core business i.e. the activities that they do really well and where they have a differential advantage.
- ✓ Everything else is outsourced.

Implementation of SCM through Logistics Management

- ✓ SCM raises the challenge of integrating and coordinating the flow of materials from multitude of suppliers, including offshore, and similarly managing the distribution of the finished product by way of multitude intermediaries.
- ✓ Transferring costs upstream or downstream leads to logistics myopia as all costs ultimately will make way to the final market place to be reflected in the price paid by the end user.

- ✓ The prime objective of SCM is to reduce or eliminate the buffers of inventory that exists between the organizations in a chain through sharing of information on demand and current stock levels.

How does Logistics differ from SCM?

- ✓ Logistics management is primarily concerned with optimizing flows within the organization.
- ✓ Supply chain management deals with integration of all partners in the value chain.
- ✓ Logistics is essentially a framework that creates a single plan for flow of products and information through a business.
- ✓ Supply chain builds upon this framework and seeks to achieve linkage and coordination between processes of other entities in the pipeline i.e. suppliers and customers, and organization itself.
- ✓ Logistics competency is achieved by coordinating the following functional areas.

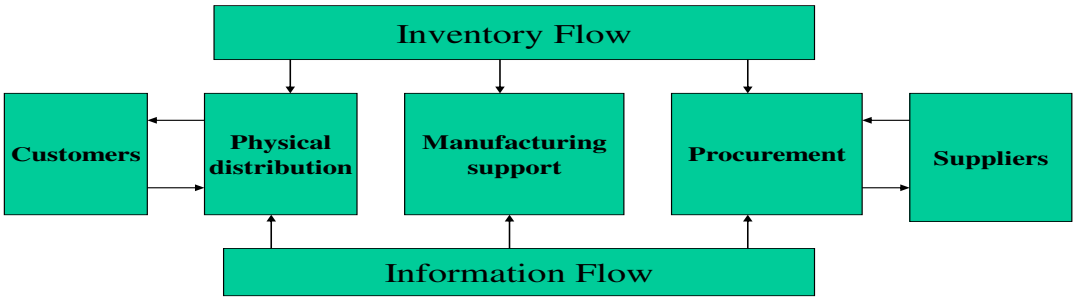
  Network design
  - Information
  - Transportation
  - Inventory
  - Warehousing, material handling and packaging.

5.3 Integrated Logistic System:

Integrated Logistics is a managed service that makes the complex simple. Whatever our product requires, and wherever its' journey begins or ends: we bring it to the market, we take care of it, and we deliver it to end customer. Integrated logistics is designed to help global customers manage their complex, multi-regional supply chains and logistics networks. It is easy to understand integrated logistics in the following figure:

(a) Information from and about customer's flows through the enterprise in the form of sales activity, forecasts and orders.
(b) Information is then translated into manufacturing and purchasing plans.
(c) The materials are then procured; value addition takes place along with the inventory flow ultimately resulting into transfer of ownership of finished products to the customers.

Integrated Logistics



(d) The process of integration is not restricted to manufacturing companies alone, the retailing and wholesaling firms link physical distribution and purchasing since manufacturing is not required.

(e) The entire process of integration can be viewed in terms of two interrelated activities.

- Inventory flow, and
- Information flow

Advantage and Benefits of Integrated Logistics:

(1) Improve Customer Service
   - Visibility on orders, product and stock
   - Reliable service levels and lead times
   - Proactive exception management

(2) Realize Cost Savings
   - Creation of synergies in the network
   - Consolidation and load optimization
   - Efficient utilization of logistics resources

(3) Optimize Logistics Networks
   - Design optimal goods flows
   - Shorter lead times
   - Simplify administration

(4) Standardize Global Logistics Processes
   - Control supply chain execution
   - Best of breed IT-systems and integration

- Uniform KPI's and reporting

Physical Distribution:

(a) Establishes linkage of marketing channel with its customers facilitating the movement of a finished product to the final destination of a marketing channel.
(b) Would need a proper marketing effort resulting into desired assortment being delivered when and where needed.-Outbound logistics.
(c) Fulfills objective of implementation of time and space dimension of customer service as an integral part of marketing.

Manufacturing Support:

(a) Concerned with managing work-in-process inventory as it flows between the stages of manufacturing.
(b) Formulates a master production schedule that subsequently facilitates arranging for timely availability of materials, component parts, and work-in-process inventory.
(c) Is not concerned with *'how'* production occurs but rather *'what,' 'when', 'where'* products will be manufactured.

Difference between Physical distribution and Manufacturing Support

- Physical distribution attempts to serve the desires of the customers and therefore must accommodate the uncertainties of consumer and industrial demand.
- Manufacturing support involves movement requirements that are under the control of manufacturing enterprise.

Procurement (In-Bound Logistics):

- ✓ The procurement operations are identified as inbound logistics
- ✓ Concerned with purchasing and arranging ***in-bound movement*** of materials, parts, and/or finished inventory from suppliers to manufacturing or assembly plants , warehouses, or retail stores thereby ensuring availability of materials/ assortments where and when needed. – (known as inbound logistics).
- ✓ In a given marketing situation, manufacturers' physical distribution is same as retailers' procurement operations.

- ✓ International procurement often requires large shipments necessitating the use of barges, ocean going vessels, trains and multiple truckloads for transportation.
- ✓ The lower value of materials and components as compared to finished product implies greater trade-off between higher cost of maintaining inventory in transit and the use of low cost modes of transport.
- ✓ As the cost of maintaining inventory in the pipeline is less per day than the cost of maintaining finished inventory, there is no benefit for paying higher freight rates for faster inbound transport.
- ✓ Procurement performance cycles are invariably longer excepting in those cases where the value of material or component may justify paying higher freight rates for faster inbound transport.
- ✓ A critical issue in procurement is uncertainty in respect of price change, and/or supply discontinuity.

5.4 TYPES OF LOGISTICS

There are different types of logistics that have been briefly discussed as below:

1. Reverse Logistics

Reverse logistics is also known as Product Recall. It may be defined as a process of moving goods from their place of use, back to their place of manufacture for re-processing, refilling, repair, and recycling or waste disposal.

Reasons for Reverse Logistics

1. Rigid quality standards- it is critical in case of contaminated products, which can cause environmental hazard.
2. Rigid laws prohibiting unscientific disposal of items
3. Rigid laws making recycling mandatory
4. Transit damage – e.g. leaking containers containing hazardous material.
5. Product expiration.
6. Erroneous order processing by supplier
7. Exchange of new product for the old ones.
8. Return for repair or refill.

Drivers in Reverse Logistics

The success of reverse logistics depends upon the efficiency of following subsystems:

1. *Product Location:* For product recall it is necessary to identify the product location in the physical distribution system of the firm. It is difficult in case of consumer goods but easier in case of industrial goods.
2. *Product Collection System:* After the product location is identified, product collection is to be done through company's field force or third party.
3. *Recycling / Disposal Centers:* This may be company's plant, warehouse or any other location. Called back products must be inspected before recycling or disposal etc.
4. *Documentation System:* Proper documents should be maintained at each level, this would help in tracing the product location.

2. Inbound Logistics

The procurement operations are identified as inbound logistics. It is concerned with purchasing and arranging ***in-bound movement*** of materials, parts, and/or finished inventory from suppliers to manufacturing or assembly plants, warehouses, or retail stores thereby ensuring availability of materials/ assortments where and when needed. – (known as inbound logistics).

3. Outbound Logistics

All the activities in which the value added goods are to be made available in the market for customers are called as outbound logistics activities.

- Success of the firm depends upon the supply of products to the customer on time. Supplying the products of firm at marketplace at minimum cost is the essence of Outbound Logistics.
- Activities of distribution performance cycle come under the scope of Outbound Logistics. They are order management, transportation, warehousing, packaging, handling etc.

4. Third-Party Logistics (3PL)

In order to keep the costs of inbound and outbound logistics activities under control, an outside agency appointed to perform these logistics functions is called "Third Party Logistics".

5. Forth-Party Logistics (4PL)

Forth Party Logistics is a complete outsourcing of manufacturing and logistics functions including selection of Third Party service provider.

Need for 4PL:

1. Ever-increasing customer requirements.
2. Competitive and complex market scenario
3. Rising globalization, liberalization and privatization.
4. Rising accessibility of supply chain technology.
5. Inclination of companies to enter into higher margin business.

Services provided by 4PL

1. Procurement and storage of materials.
2. Manufacturing of products.
3. Selection of 3PL companies
4. Transportation and warehousing management
5. Collection of payment and cash flow management
6. Risk management and insurance.
7. Sharing of information, IT solution.

5.5 Inbound Logistics

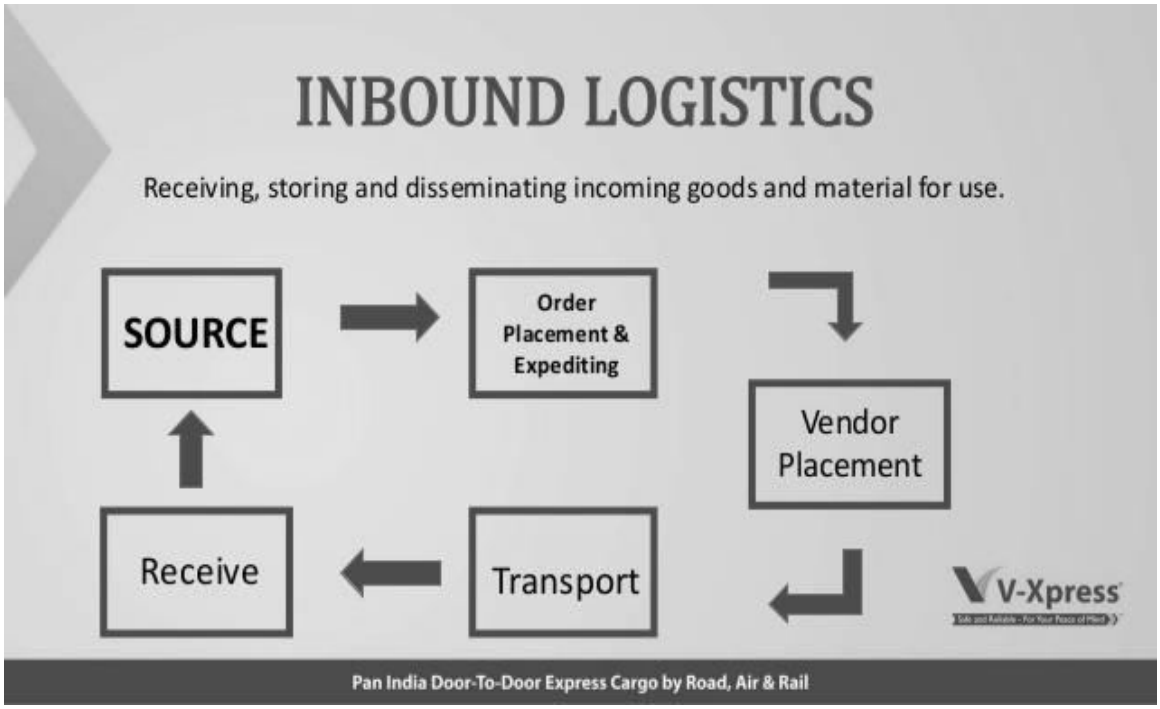
- All the activities related to the material movement till the dispatch of the products out of the factory gate are called as inbound logistics activities.
- Creation of value in the products depends upon availability of inputs on time. Making available these inputs on time at minimum cost is the essence of Inbound Logistics.
- Activities of a procurement performance cycle come under the scope of Inbound Logistics. They are transportation during procurement operation, storage, handling and overall management of inventory of inputs.

Objectives of Inbound Logistics:

The main objectives may be listed as below:

- ❖ To ensure that material received and related information are processed and made available promptly to production, store and other departments
- ❖ To document goods received and returned accurately
- ❖ To accept items only those items that were properly ordered
- ❖ To accept materials that meet the purchase order specification

- To safeguard goods received
- To ensure that vendor, inventory and purchase order information is accurately updated to reflect receipt
- To return rejected items promptly
- To maintain safe working conditions and storage of hazardous materials
- To properly transfer all material requisitioned



5.6 Logistics in Globalization Context

Logistics functions are same domestically and globally but differ in four D's i.e. distance, documents, diversity in culture and demand of customer. In the global logistics distances are longer, documentation is more extensive, and customer's demand varies to satisfy cultural differences within both, countries and regions. Developing strategies to respond to the 4 D environment is the global challenge for logistics management.

There are some factors that facilitate globalization and necessitate global logistics and also some barriers that continue to impede global logistics. Logistics management must balance the cost of overcoming these barriers with the potential benefits of going global.

Forces Driving Globalization of Logistics

- ✓ ***Economic Growth:*** After II world war, there was a growth in industrial sector of developed countries and their manufacturing and logistics productivity increased. This forces the firm to expand their marketing into developing nations. Such expansion requires the integration of global manufacturing with marketing through logistics.
- ✓ ***Supply Chain Perspective:*** Firms traditionally sought logistical control as many essential activities as possible internally, which resulted in private warehouses and transportation. Such privatization increased the capital and assets to support logistics operations resulting in decline of Return on Investment and hence the concept of outsourcing and supply chain emerged during 1980s.
- ✓ ***Regionalization:*** Traditionally trade and transportation across the political borders of countries requires political formalities, which adds to the logistics cost without any value addition to the consumer. Regionalization in the form of trade associations such as EU, NAFTA and SAARC etc. removed such barriers and facilitates global logistics.
- ✓ ***Technology:*** Mass communication and information technology exposed international consumers to foreign products, thus stimulating convergence of global needs and preferences. This promotes global marketing and global logistics.
- ✓ ***Transportation Deregulation:*** Initially there have been restrictions for international transportation ownership and operating rights e.g. foreign carriers could not operate domestically, steamship lines could not own land based transport like motor or rail carriers etc. but such restrictions have been removed in most of the countries.

Barriers to Global Logistics

- ✓ ***Marketing Barriers:*** This includes (i) entry restrictions by placing legal or physical barriers on importing (ii) poor information regarding market size, demographics and competition (iii) pricing fluctuation and tariff barriers.
- ✓ ***Competition:*** Different rules in different countries concerning competitive governance also serve as global logistics barriers.
- ✓ ***Financial Barriers:*** This includes (i) difficulties in forecasting in the global environment (ii) institutional infrastructure barriers result from differences in services offered by banks, insurance firms, legal counselors etc.
- ✓ ***Distribution Channels:*** Lack of infrastructural standardization such as differences in transportation and material handling equipment, warehouse and port facilities, communication system etc. also serves as global logistics barriers.

5.7 Summary:

Logistics is the process of planning, implementing, and controlling procedures for the efficient and effective transportation and storage of goods, including services and related information, from the point of origin to the point of consumption. The goal of logistics is to successfully meet customer requirements. This definition includes inbound, outbound, internal and external movements. On this basis we may categories logistics as inbound logistics, outbound logistics, reverse logistics and third party logistics etc. ***Inbound logistics*** is an integral element of business operations for a manufacturing firm, involving the processes of receiving, storing and distributing raw materials for use in production. Small business manufacturers may not manage as much inventory, but should still optimize **inbound logistics processes**. The inbound flow in a warehouse begins when items arrive in the warehouse of the company location, either received from external sources or from another company location. ... From the receiving dock, warehouse activities are performed at different complexity levels to bring the items into the storage area. Inbound logistics include proper documentation of the materials received and returned. Only those materials are accepted which are exactly as per the specifications of order. Finally, all material requisitioned must be appropriately transferred.

5.8 Assessment Questions:

- Define logistics. Discuss the operating objectives of logistic management.
- How can logistic be a mean of earning competitive advantage over competing firms? Explain with suitable logics.
- Discuss various types of logistics along with appropriate examples.
- Define inbound logistics. Discuss in detail the objectives of inbound logistics.
- Define integrated logistic system. Also explain its advantages
- Discuss in brief the reverse logistics.
- Explain the factors driving the globalization of logistics. Also discuss the barriers to global logistics.

5.9 Key Terms:

- ***Logistics:*** management of inventory in motion and at rest

- ***Logistics management:*** It is the part of supply chain management that plans, implements, and controls the efficient, effective forward, and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customer's requirements.
- ***Inbound logistics:*** Inbound logistics refers to the transport, storage and delivery of goods coming into a business.
- ***Competitive advantage:*** a condition or circumstance that puts a company in a favorable or superior business position over its competitors
- ***Integrated logistics:*** It is process of anticipating customer needs and wants, acquiring the capital, materials, people, technologies and information necessary to meet their needs. It is concerned with optimizing the goods-or-services producing a network to fulfill customer requests and moreover, utilizing the network to fulfill customer request in a timely way.
- ***Reverse logistics:*** is for all operations related to the reuse of products and materials. It is "the process of moving goods from their typical final destination for the purpose of capturing value, or proper disposal.

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Subject: Supply Chain Management	
Course Code: POM-323	Author: Prof (Dr) Hemant Sharma
Lesson No.: 6	Vetter:
Outbound Logistics	

Structure:

6.0 Objectives:

After reading this lesson, the students would be able to understand

- The meaning of logistics and its operating objectives
- The determinants and significance of outbound logistics
- The logistics mission and business functions of logistics
- The concept of integrated logistics systems
- The marketing interface of outbound logistics
- The Business functions of logistics

6.1 INTRODUCTION

What is logistics?

Logistics is concerned with getting the products and services where they are needed and when they are desired. It is difficult to accomplish any marketing or manufacturing without logistical support. It involves the integration of information, transportation, inventory, warehousing, material handling, and packaging. The operating responsibility of logistics is the geographical repositioning of raw materials, work in process, and finished inventories where required at the lowest cost possible.

The formal definition of the word "logistics" as per the perception of Council of Logistics Management is the process of planning, implementing and controlling the efficient, effective flow and storage of goods, services and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements.

Mission of logistics is providing a means by which customer satisfaction is achieved. Art of moving, lodging and supplying troops, supplies and equipment is logistics. Concept of logistics has moved into business to move, lodge and supply inputs and outputs. Logistics is practiced for ages since organized activity began. Without logistics support no activity can be performed to meet defined goal.

The current challenge is to perform logistics scientifically in order to optimize benefits to the organization. Logistics is a planning function of management. Logistics function is concerned with taking products and services where they are needed and when they are needed. Logistics ensures that the required inputs [what] to a value adding process are made available, where they are needed, when they are needed and in the quantities [how much] they are needed. It also ensures that the outputs of the value adding process are made available where they are needed when they are needed and in the quantities [how much?] they are needed.

There are many ways of defining logistics but the underlying concept might be defined as follows: "Logistics is the process of strategically managing the procurement, movement and storage of materials, parts and finished inventory through the organization and its marketing channels in such a way that current and future profitability are maximized through the cost-effective fulfillment of orders".

Genesis of Modern Logistics

Several Modern Management concepts are born or refined in the crucible of II World War. You may remember several OR techniques like Value Analysis & PERT/CPM have their

origin in the II World War. Resources come under pressure in a war, like no other time and one is expected to deliver results in spite of all odds. These trying situations forced the military planners to evolve solutions to their problems. After the war these concepts traveled to business where resource crunch is usual. In business there is no enemy, but there are competitors who pose threat to the organizations survival.

There are several examples where battles are lost due to long & ineffective supply lines. Logistics received great importance in military planning and subsequently became a very important management function in the course of last 40 years. Logistical management includes the design and administration of systems to control the flow of material, work in process and finished inventory to support business unit strategy.

Overview of Logistics Feats

Logistical History of India: India was a maritime power since about 300 BC, trading with several countries of the world bringing prosperity home. Traders of Surat brought riches to the country by extensive maritime trade. Like many of our excellent practices, logistical efficiency also faded away over a period of time. Some important logistical feats in history:

- ✓ Berlin Airlift – 1945: A study in logistics. When the city of Berlin was blockaded by Soviets and all supply lines were cut off, Americans planned and executed a major logistics operation to feed the city from air.
- ✓ Indians in the Gulf countries – 1991: 1n 1991, when gulf war broke out, Indian Government evacuated thousands of Indians from the gulf countries and brought them home in a massive exercise employing Indian airlines planes.
- ✓ Operation Overlord-1945: Allies‟ invasion of Europe and subsequent victory in II World War.
- ✓ American war of Independence: Keeping 12,000 soldiers armed and fed from England was a big task; British lost the American war of independence due to bad logistics.

6.2 IMPORTANCE OF LOGISTICS FOR MANAGEMENT

The important reasons may be listed as followings:

- Impact of logistics on cost of creating and delivering of product to the customer. Logistical costs can be as high as 20% to 25% depending on type of business
- Provides competitive edge to business
- Crucial to survival and prosperity in global trade and business
- Many products have short life cycles
- More & more logistics experts are going up the hierarchical ladder

- Leads to the concept of supply chain management
- Logistics is important in the Indian market due to the ongoing sweeping changes such as Competition: Internal as well as external; Shift from seller‟s market to buyer‟s market; Changing customer; Expanding business, growing exports and Corporate Management's Shift towards modern management concepts like Lean management, Just In Time, Total Quality Management etc.,

6.3 OPERATIONAL OBJECTIVES OF LOGISTICS

There are many operational objectives of logistics as below:

1) **Rapid response:** F-flexibility objective of an organization: Some companies measure this as response time to customer's order. On an average how much time do we need to fulfill one particular type of customer's order in a year? This is a measure of Rapid response. Logistics should ensure that the supplier is able to respond to the change in the demand very fast. Entire production should change from traditional push system to pull system to facilitate rapid response. Instead of stocking the goods and supplying on demand, orders are executed on shipment-to-shipment basis. Information Technology plays an important role here as an enabler. IT helps management in producing and delivering goods when the consumer needs them. This results into reduction of inventory and exposes all operational deficiencies. Now the management resolves these deficiencies and slashes down costs.
2) **Minimum variance:** D-delivery objective of an organization, this can be measured as "On Time Delivery" or OTD. If 100 deliveries are made in a month/quarter/year how many reached as per the commitment made to the customer? This percentage is OTD.
   Any event that disrupts a system is variance. Logistics operations are disrupted by events like delays due to obstacles in information flow, traffic snarls, acts of god, wrong dispatches, damage in transit. Traditional approach is to keep safety stocks and transport the goods by high cost mode. The cost of this approach is huge. Logistics is expected to minimize these events, thereby minimize and improve on OTD
3) **Minimum inventory:** This is component of cost objective of a company. Inventory is associated with a huge baggage of costs. It is termed as a necessary evil. Objective of minimum inventory is measured as Inventory Turns or Inventory Turnover Ratio. Americans call this measure as *turn velocity*. Logistics management increases these turns without sacrificing customer satisfaction. Higher turns ensure effective utilization of assets devoted to stock.
4) **Movement consolidation:** Transportation is the biggest contributor to logistics cost. Transportation cost depends on product type, size, weight, distance to be transported etc. for transporting small shipments just in time [reduction in inventory costs] expensive

transport modes are used which again tend to hike the costs. Movement consolidation is planning several such small shipments together [of different types of shipments] by integrating interests of several players in the supply chain. Generally, large shipment size and long distances reduce transportation cost per unit. Movement consolidation shall result into reduction in transportation costs.

5) **Quality:** If the quality of product fails logistics will have to ship the product out of customer's premises and repeat the logistics operation again. This adds to costs and customer dissatisfaction. Hence logistics should contribute to TQM initiative of management. In fact, commitment to TQM has made the management world over wake up to the significance of logistics function. Logistics can play a significant role in total quality improvement by improving the quality of logistics performance continuously and continually.

6) Life cycle support: Logistics function is expected to provide life cycle support to the product after sale. This includes:

- After sales service: the service support needed by the product once it is sold during its life cycle
- Reverse logistics or Product recall as a result of
    a. Rigid quality standards [critical in case of contaminated products which can cause environmental hazard]
    b. Transit damage [leaking containers containing hazardous material]
    c. Product expiration dating
    d. Rigid laws prohibiting unscientific disposal of items associated with product [packaging]
    e. Rigid laws making recycling mandatory
    f. Erroneous order processing by supplier
    g. Reverse logistics is an important component of logistics planning

6.4 INBOUND AND OUTBOUND LOGISTICS

Inbound Logistics

Creation of value in a conversion process heavily depends on availability of inputs on time. Making available these inputs on time at point of use at minimum cost is the essence of Inbound Logistics. All the activities of a procurement performance cycle come under the scope of Inbound Logistics. Scope of Inbound Logistics covers transportation during procurement operation, storage, handling if any and overall management of inventory of inputs. Several activities or tasks are required to facilitate an orderly flow of materials, parts or finished inventory into a manufacturing complex.

They are sourcing, order placement and expediting, transportation, receiving and storage. *Overall, procurement operations are called inbound logistics*. Inbound logistics have potential avenues for reducing systems costs. Delivery time, size of shipment, method of transport & value of products involved are different from those of physical distribution cycles. Normally delivery time is large as a low cost transportation mode is chosen. As the value of inventory is low size of shipment is large & transit inventory costs are low. As the price of products is lower, tradeoff between cost of maintaining inventory in transit and low cost transport exists to the benefit of the organization.

Outbound Logistics

Value added goods are to be made available in the market for customers to perceive value. Finished goods are to be distributed through the network of warehouses and supply lines to reach the consumer through retailer's shops in the market. During conversion value is added to the raw materials and as a result value of the inventory in this case is very high unlike inputs. Now the size of shipment, modes of transport and delivery time are different as compared to inputs. Activities of distribution performance cycle come under the scope of Outbound Logistics. *They are order management, transportation, warehousing, packaging, handling* etc.

Different attributes of outbound logistics management and need of coordination of different organizational departments with that of logistics

a) Functions of logistics are spread across various stages of value chain.
b) Provides interface between marketing and customers, marketing and operations, operations and supplier
c) Provides competitive edge to business in the current environment
d) Handles flow of information and materials
e) Large avenues for cost reduction.

Need of coordination of different organizational departments with that of logistics. The above features show the complexity and scope of outbound logistics. For such a management function to function effectively various pieces of jigsaw puzzle should fall at correct places which requires coordination of all functional departments.

If we want to solve a jigsaw puzzle, we need to have the complete picture on the box. In the absence of this picture solving the puzzle becomes impossible. Overall coordination of different organizational departments can provide the complete picture. This requires integration of all functions of logistics. If a firm does not consistently satisfy time and place requirement it has nothing to sell in the market, it is simply out of business.

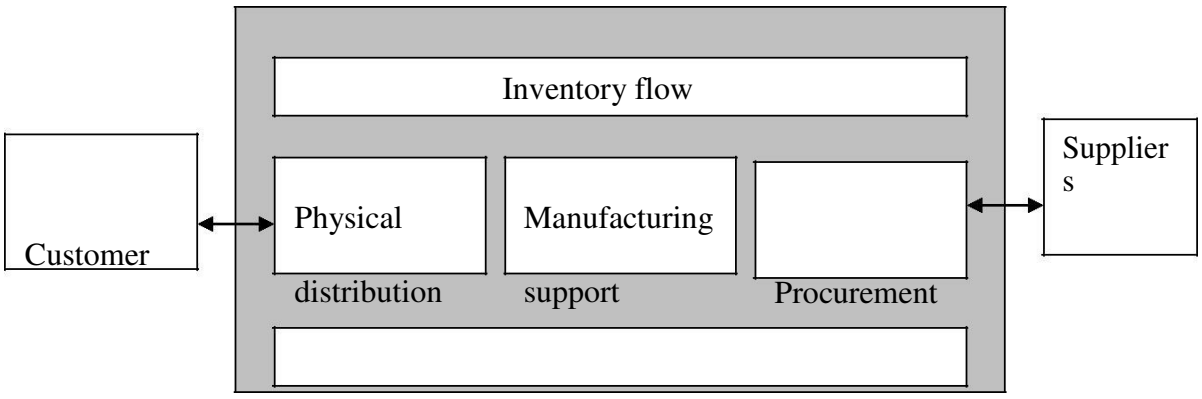
Good logistics alone can enable organizations to do business. To enjoy full benefits of logistics, full range of functional work must be performed on an integrated basis. Excellence in each aspect of functional work is relevant only when it is viewed in terms improving overall efficiency and effectiveness of integrated logistics. This requires that the functional work of logistics be integrated to achieve business unit goals.

What is the concept of Integration in Logistics Operation?

In order to perform various functions of logistics in coordinated fashion bringing all functions of logistics under one operational command is important. Performance of these functions in an isolated fashion is detrimental to the objectives organization. Performance in isolation loses sight of overall picture. It is like trying to solve a jigsaw puzzle without complete picture before you.

What do we integrate? Information flow, inventory flow, procurement, operations support, physical distribution.

Concept of Integration in Logistics Operation



If we view the above graphic we see all internal logistical operations in an organization. We also see their close relationship with each other and the need to perform them in an orchestrated fashion.

Value added Role of Logistics

Various types of economic utilities like form utility, place and time utility and possession utility adds value to a product. In other words make product attractive and trigger purchase.

1) Form Utility is given by Production to a product when conversion process is held. Logistics also adds form utility when warehousing activities like mixing, assembling, processing postponement or unpacking take place.

2) Place and Time Utility is given by logistics functions when a product is moved to a needed place on time to serve the customer
3) Possession Utility: Marketing creates Possession Utility by promoting the product by advertising and or by any other means. But logistics finally possession by customer happen

6.5 COMPONENTS OF OUTBOUND LOGISTICS

1) **Information management:** Management is appreciating importance of information as an element of logistics of late, now. The role of information is vital in order processing. Quality of information is critical as error in composition of information requirement creates potential disturbance in the supply chain. Incorrect order processing due to erroneous information will result into product recall and reshipment if the sales opportunity still exists. Fast and quality information flow from customer to processor results into cost effective logistics. *Forecasting* and *order management* are two areas of logistical work dependent on information.

   Forecasting is an effort to estimate future requirements to position inventory or assets devoted to inventory. As forecasting becomes unreliable in a fast changing environment, control strategies like JIT, Quick Response and Continuous Replenishment came into being. Now it is the task of the logistics function to use information technology to strengthen operation control and forecasting to the best advantage of the organization.

   Leading firms typically have information systems capable of monitoring logistical performance on a real time basis giving them the capability to identify potential operational breakdowns and take corrective actions prior to customer service failure. In situations where timely corrective action is not possible, customers can be notified in advance and thereby taking the surprise out of forthcoming service failures.

2) **Inventory control:** Keeping the stock levels in such a position, so that neither stock out nor stock piling takes place is Inventory control. While formulating inventory policies find out 20% of the products marketed that account for 80% of the profit.

3) **Transportation:** Transportation is the most visible of all elements of logistics and high contributor to logistics expenditure. Costs of transportation are mainly as follows:

   - Movement costs: money paid for moving material across geographical terrain
   - Preservation costs: money spent on preserving the material during transit

- Cost of idle asset: inventory is unavailable for conversion during transit. This results into costs for organization
- Administration costs: money spent on administration

Transportation is accomplished in three ways:

- One‟s own fleet – private carriage
- Contract with specialists on long term basis – contract carriage
- Contract on individual shipment basis – common carriage

Expectations from transportation service are:

- **Minimum cost** – transportation costs are explained earlier
- **Speed**: speed of transport means the speed with which goods reach the destination.
- **Consistency**: consistency in speed is achieving the same speed over a long period of time. Consistency reflects on the reliability of carrier. Any unexpected variance can play havoc with logistics. Modern information technology has made continuous tracking of consignments possible.

  This takes the element of surprise out. IT has helped logistics managers to seek out ways and means to improve speed and consistency. What is becoming important is a combination of speed and consistency.

  Requirement of speed depends on type of industry. In some situations speed may not be important. Then, transportation service offering high speed increases cost. So, logistic managers have to strike a balance between service and cost. Three important aspects of transportation are facility location, transportation cost and consistency. Design of logistics system should consider total costs rather than elemental cost of transportation

4) **Warehousing:** Warehousing is holding material before dispatch after it is produced. Although warehousing is conventionally considered to be a storage facility, it plays a much higher role from logistics viewpoint. It is perceived to be a switching facility rather than a storage facility. Warehouse ownership can be private, public or third party contract. Warehouse provides economic and service benefits to the logistical system. Economic benefits are Movement Consolidation, Break-bulk, Cross-dock, Processing/Postponement & stock piling. Service benefits are spot stocking, assortment, mixing & production support.

5) **Material handling:** Material handling covers receiving, moving, storing, dispatching activities. It has an impact on cost [capital as well as running], quality and safety. One of the principles of material handling is minimum movement. Commonly used material handling equipment are forklifts, EOT Cranes, hoists, pulley blocks, trolleys, railroad cars, conveyers, ropes and slings etc.

6) **Packaging:** Packaging is done to make handling and transporting cost effective. It protects the product in transit and handling. Packing is expected to facilitate lifting and moving by providing easy access to forks or hooks. Packing is also expected to display universal symbols and other instructions for handling. Eg. Pallets and containers, wooden boxes, wrapping etc.

   Types of packaging: consumer packaging and industrial packaging

   Consumer packaging - There is no focus on logistics. Importance is given to marketing appeal and packaging the finished product.

   Industrial packaging - importance is given to logistics considerations handling and moving. Individual parts are packed in cartons or bags and grouped together as master cartons. Master cartons are grouped into units for handling. This concept leads to unitization and subsequently to containerization.

   Analyses of trade off situations between costs of several activities, selection of modes of transport keeping total system cost in mind are fallout of this concept. It can be understood that selection of water as a mode of transport gives low transportation cost that will result into high transit inventory adversely affecting total system cost.

Initially outbound logistics was in focus as value of the finished goods inventory is high. A new management function called Physical Distribution Management emerged integrating various activities on the outbound side like transportation, warehousing, packaging, customer service etc.

Advent of electronic era of 1960s made information a strong component of physical distribution management. Inbound logistics was still considered to be a concern of vendors and did not receive the attention of management. In 1970s strengthened by IT, physical distribution management started looking into some aspects of financial management subsystems.

Monitoring and planning for efficient completion of cash cycle became attached to physical distribution management. Around the same time importance of inbound logistics was appreciated. In 1980s physical distribution management function came to be called logistics management encompassing inbound and outbound logistics. During this time this function started looking closely into logistical operations adopting modern concepts like TQM & TPM to logistical operations.

In 1990, this concept expanded, all upstream and downstream organizations and activities were brought closer for mutual cooperation in order to gain benefits of QCD. This idea of external integration is Supply Chain Management.

Definition: the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole.

Supply Chain Management looks beyond the confines of organizations to deliver value to the end user at minimum cost. Supply chain is visualized as a pipeline through which products from raw materials stage to the end user. Supply Chain Management is ensuring that this flow is smooth and quick.

Idea of supply chain management

Supply Chain Management aims at breaking down organizational barriers:

a) To share sales information on "real time" basis that reduces inventories and need for safety stocks. This is called supply chain compression resulting into inventory reduction and larger inventory turns.
b) Smoothen the flow of information both ways; orders reaching the suppliers, and products reaching the that results into reduced delivery time or reduction of lead-time resulting into shortened cash-flow cycle

The following table distinguishes between logistics management and supply chain management.

Particulars	Logistics management	Supply chain management
Scope	Inbound logistics, in process inventory [movement from one plant to another], outbound Logistics	All players in the supply chain from raw material source to finished product consumer, vendors, their vendors, supplier organization[shipper], Warehouses, service providers, customers, their customers
How is this created in Business?	By internal integration of logistics functions handled by various management functions within organization	By external integration of roles of various players in the supply Chain.
Main Objective	Logistics cost reduction by integrating resources across the pipeline	Supply chain profitability by value creation.
Definition	Logistics is the process of	Management of upstream and

	strategically managing procurement and storage of material , part and finished inventory [and related information flow] through organization and its marketing channels in such a way that current and future profits are maximized through cost effective fulfillment of order	downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole.
Origin	A very old concept in military planning.	As a logical extension of logistics management
Focus	L/M tries to take the product \to the consumer at minimum logistical cost. Hence it is supply driven.	SCM focuses on value creation in the supply chain. Hence this is customer focused or demand driven.

6.6 BUSINESS FUNCTIONS OF LOGISTICS

As discussed earlier logistics is a concept of military planners. But now it has found its way into business.

1. Business logistics is planning, implementing and controlling efficient & effective flow and storage of goods, efficient & effective flow services, and related information from point of origin to point of use or consumption in order to meet customer requirements.
   - Food and agricultural products: We are familiar with warehouses owned by Food Corporation of India. The government in these warehouses stores huge quantities of procured food grains. These stocks are subsequently moved to outlets of Public Distribution System. This is a logistical operation by Govt. of India in Agricultural Products Sector
   - Raw materials and finished engineering, chemical, pharmaceutical goods.
   - Consumer durable goods: Logistical Management is receiving attention in industry as many consumer durable products are moving into commodities market.
2. Business logistics plays the role of facilitator for trade and business. It makes business happen.
3. Logistical mission: Mission of logistics is to achieve business objectives by delivering

desired quality of service at the lowest total cost. This is nothing other than delivering QCD expectations of the customer by planning logistical operations at minimum cost. This can also be called creating customer value at minimum cost. Logistical mission cuts across functional lines to achieve business objectives at minimum cost.

Logistical mission is a set of goals to be achieved at a particular type of market for a particular type of product. Naturally this is responsive to competition. Hence logistical mission is to achieve above goals at minimum system cost. Focus is on mission rather than on isolated functions. Mission of logistics is providing a means by which customer satisfaction is achieved.

4. Role of planning in logistics management

- Role of planning is central to logistics management
- Mission of logistics management is to plan and coordinate all those activities necessary to achieve desired levels of service and quality at lowest possible cost.
- Logistics is fundamentally a planning concept that seeks to create a frame work through which needs of the market place can be translated into a manufacturing strategy and plan
- Logistics makes one plan, integrating various resources of the organization that replaces traditional concept of planning in pockets

5. Outbound Logistics interface with marketing

Interface is a common wall or surface between two objects, concepts or functions. It can also be common area/areas of performance or interest. Outbound logistics plays an important role in selling the product of the company as it moves the product through the distribution system to the customer. Hence it is called the other half of marketing. In several instances making the product available at the right time at the right place itself is the key to successful selling. A student of management very well knows four Ps of marketing. We have already seen the role of logistics as far as "Place" is concerned. It is quite interesting to see the interface with respect to other Ps as well.

Price: Logistics enables marketing to quote a competitive price by providing discount opportunities on account of Transportation cost savings. Logistics Manager can plan the size of the consignment confirming to the most economical schedules published by transportation service providers to save transportation costs. If order size matches with the favored size the benefits are substantial. Logistics Management has to balance inventories to tackle anticipated price-triggered sales.

Product: Inputs of logistics manager are quite important as far as the size and shape of the

product are concerned. Size and shape of the product can make logistics nightmarish, thereby adding huge amount of costs. Weight/volume ratio plays very important role in deciding economics of logistics.

The story of Gillette is well known logistical circle. The low weight, unwieldy floor display proved to be a very expensive logistical operation. While consumer packaging provides sales push in a retailers shop, it can make industrial packaging difficult due to its shape and ability to protect the contents. Product and its packaging is a common area from the point of view of logistics.

Promotion: Logistics Management is required to manage inventory needed to match sales triggered by promotional activities in the market. Marketing management & logistics management need to work closely to decide the promotional strategies for the products. Promotional strategies may be push or pull type. Logistical problems may be faced in either or both, but being aware takes the punch away from the blow!

Place: Marketing decision to distribute the product directly to retailers or through wholesalers has a great impact on logistical operations. Demand placed by wholesalers is more streamlined as compared to retailers. Logistical management of retailers‟ demand often requires time sensitive transportation methods which are expensive.

In addition to the four Ps, customer service is another area where marketing & logistical managements have to work closely to effectively beat the competition.

6.7 SUMMARY

The main objective of outbound logistics is to make the finished products available where they are needed and when they are desired. It is difficult to accomplish any marketing logistical support. It involves the integration of information, transportation, inventory, warehousing, material handling, and packaging. The operating responsibility of logistics is the geographical repositioning of raw materials, work in process, and finished inventories where required at the lowest cost possible.

It may be understood as the process of planning, implementing and controlling the efficient, effective flow and storage of goods, services and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements. Mission of logistics is providing a means by which customer satisfaction is achieved. Logistics is practiced for ages since organized activity began. Without logistics support no activity can be performed to meet defined goal.

The current challenge is to perform logistics scientifically in order to optimize benefits to the organization. Logistics is a planning function of management. Logistics function is concerned with taking products and services where they are needed and when they are needed. Logistics ensures that the required inputs [what] to a value adding process are made available, where they are needed, when they are needed and in the quantities [how much] they are needed. It also ensures that the outputs of the value adding process are made available where they are needed when they are needed and in the quantities [how much?] they are needed.

In brief, we can say that "Outbound logistics is the process of strategically managing the movement and storage of materials, finished inventory through the organization and its marketing channels in such a way that current and future profitability are maximized through the cost-effective fulfillment of orders".

6.8 Self Assessment Questions

- Define outbound logistics. Discuss the operating objectives of outbound logistic.
- How can outbound logistic be a mean of earning competitive advantage over competing firms? Explain with suitable logics.
- Discuss the scope of outbound logistics.
- Discuss the significance of outbound logistics in current scenario.
- Define integrated logistic system. Also explain its advantages
- Explain in detail the components of outbound logistics

6.9 Key Terms:

- ***Logistics:*** management of inventory in motion and at rest
- ***Logistics management:*** It is the part of supply chain management that plans, implements, and controls the efficient, effective forward, and reverses flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customer's requirements.
- ***Outbound logistics:*** Outbound logistics refers to the transport, storage, material and information flow and delivery of finished goods to channel partners and end users
- ***Competitive advantage:*** a condition or circumstance that puts a company in a favorable or superior business position over its competitors

- ***Integrated logistics:*** It is process of anticipating customer needs and wants, acquiring the capital, materials, people, technologies and information necessary to meet their needs. It is concerned with optimizing the goods-or-services producing a network to fulfill customer requests and moreover, utilizing the network to fulfill customer request in a timely way.
- ***Reverse logistics:*** is for all operations related to the reuse of products and materials. It is "the process of moving goods from their typical final destination for the purpose of capturing value, or proper disposal.

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Subject: Supply Chain Management	
Course Code: POM – 323	Author: Prof (Dr) Hemant Sharma
Lesson No.: 7	Vetter:
Warehousing and Distribution Centres	

Structure

7.0 Objectives:

This chapter will help you to understand the:

1) Different issues pertaining to warehouse operations
2) Process of issuing and returning the materials
3) Factors affecting the design and layout of warehouse;
4) Key indicators of the performance of warehouse management
5) Safety and security of warehouse

7.1 Introduction to Warehouse

In the past, warehouses were referred to as cost centers and rarely adding value. But the increasing need for transfer of products across cities, countries and continents resulting from movement of production to the Far East, the growth in e-commerce and increasing demands from end users has seen a change about the perception of warehouses. They are vital components within today's supply chain. They form the Integral part of the supply chain in which they operate, and so trends such as increasing Market volatility, product range proliferation and shortening lead times, all have effect on the roles the warehouse is required to perform. Warehouses are most likely involved In various stages of sourcing, production and distribution of goods, from the handling of raw materials, work-in-progress through to finish products It is therefore apparent that different activities take place at a warehouse and thus, require different nature of facilities, staff as well as equipment to suit each function.

With the vast nature of difference, warehouse operations could easily be the most costly element of the supply chain. The pressure is on warehouse managers to increase productivity and accuracy reduces cost and inventory whilst improving on customer service. The successful management of the warehouse is critical in terms of the level of service provided as well as the cost incurred.

Classification of Warehouses:

The nature of warehouses within the supply chain varies, and can be adopted in various forms of classification, among other things including the following:

- ✓ By the product type: examples include perishable products, frozen foods, explosive items, small spare parts and security items.
- ✓ By the stage in the supply chain: a warehouse could be meant to carry either materials, work-in-progress or finished goods depending on where it is situated in the supply chain.
- ✓ By geographic location: a warehouse is situated to serve only certain geographical area like a region, a whole state or even the whole world.
- ✓ By function: that is whether to just hold inventory or for sorting.
- ✓ By company usage: it could be meant for use by just one company, or shared amongst various users in handling the supply chain.

7.2 Warehouse Operations:

Warehouses are designed to meet specific requirements in the supply chain in which they form a part of. Meanwhile, there are some operations which are common amongst them. Categorize such operations into the following functions:

- ❖ Goods in or receiving. This involves the physical activity of unloading incoming transports, checking deliveries against purchase orders and recording. Depending upon the agreement of both parties, future checks may include quality control. Some or all of the delivered goods are either rejected or accepted at this stage.

  Rejected goods are sent back to the supplier. Discusses pre-receipt, suggesting that the warehouse manager should be involved in specifying and agreeing on the packaging, items per carton as well as any specific labeling required, in addition to the means of transport, so as to ensure that the delivered products are compatible with the storage facility.
- ❖ Put away into the storage area. Depending on the state of goods in the above stage, accepted goods are taken into storage. The storage area of the warehouse is often the largest space, with the spaces divided for the different kinds of goods that come in.
- ❖ Order selection and picking or packing. Goods are stored in the warehouse to be used later when needed. The needs for goods are made when orders are placed for them. When orders are placed, the goods are selected and picked according to their identifiable locations. The goods are then made ready for transportation to the point of need.
- ❖ Goods outward or dispatch. The goods are put together at the dispatch area and loaded onto the outbound vehicles, or picked up for use according to their size and place of need.

Warehouse Processes:

The warehouse processes are:

- Receiving-This is the process of unloading incoming truck, identifying, registering and sometimes repacking.
- Put away- this is when goods are moved from unloading dock to the storage area.
- Storage - in bulk or picks Activities at the warehouse affect goods in storage. For instance, the amount of stocks has to be counted to verify inventory quantities.
- Replenish- If inventory levels of the pick storage drop to certain amounts, it is replenished with stocks from the bulk storage.

- Pick- upon order for need of an item in storage, either full pallet is picked from the bulk area of storage or smaller quantities are picked from the pick area of storage.
- Ship- The picked items are packed, consolidated and staged for shipping.
- Cross-dock- some goods does not make their way into storage. Such goods, upon receipt are transferred to the shipping dock for shipment to point of need.
- Value Added Logistics-There also recognition for the value added by some logistics activities at distribution centers. Such value can be the labeling of goods to the specific customer or country of destination.

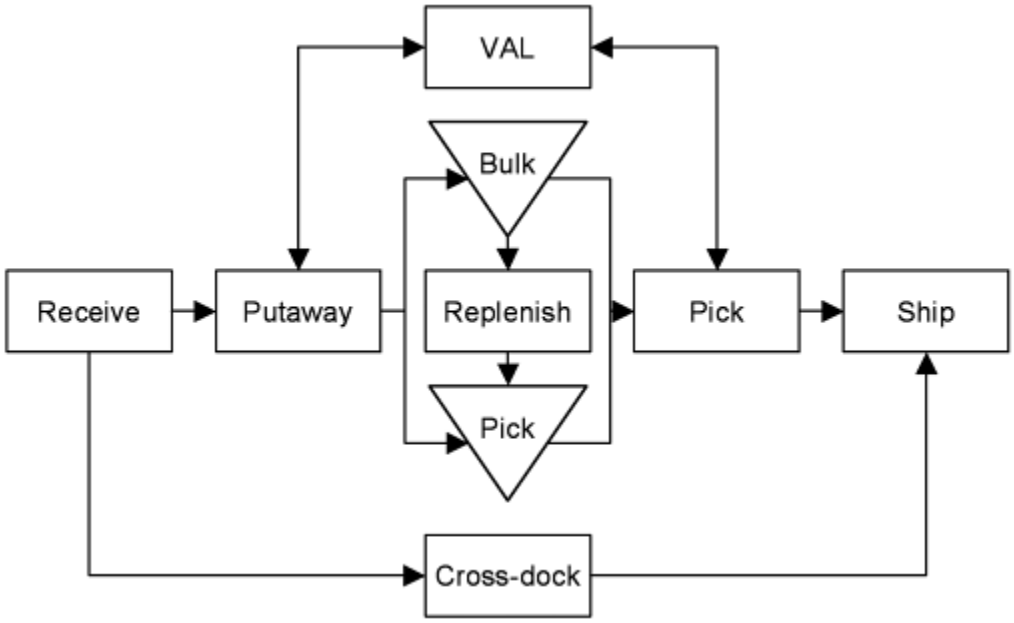

FIGURE - Warehouse processes

7.3 Receipt and Inspection of materials in warehouse

The receipt of stores will mean receipt of all materials against Purchase Orders or stores received against local purchases, gifts, aids etc. All these receipts shall be dealt with in the manner stipulated here in after.

Functions of the Receipt Section

The receipt section shall be located in a suitable place where all incoming supplies shall be received, packing opened, checked and inspected before its storage or use. The functions of the receipt section can be broadly summarized as follows.

- Clear and receive Parcels, Packages, Consignments and all other materials coming in by Rail, Road, Sea, Air, Post, Courier or any other mode. (The SPO of the lab is to decide whether the clearance of import cargo is to remain in Purchase wing or otherwise till competent manpower is available in stores.)

- Check the materials received and arrange for its inspection.
- Notify the indenters and Purchase section about the arrival of the materials by the next day.
- Unpack the packages, parcels & consignments and facilitate its inspection by the Inspecting Officer.
- Intimate the supplier about the excess, shortage, damage, rejected or defective supplies.
- Maintain the following registers.
  - Consignment Clearance Register
  - Daily receipt registers
  - Register for Samples.
  - Register for Gifts.
  - Register for discrepancies.
  - Register for dispatch.
  - Centralized register for local Purchase (Consumables).
- Raise Stores Receipt Voucher (SRV) for all receipts.
- Arrange packing and dispatch of outgoing consignments like samples, rejected materials etc. and forward the dispatch documents to the consignee.
- Arrange Local collection of stores from the vendor as per the terms of the order.
- Maintain and render up to date account of advances taken for clearance of consignments including its adjustment.
- Arrange open delivery of consignments wherever required.
- Lodge necessary claims for non-delivery, shortage or damage wherever required.
- Ensure clearance of consignment immediately so as to avoid payment of demurrage wharf age. In case of its accrual action to get its waiver or sanction for its payment from the competent authority
- Keep all weighing balances calibrated

Procedure for receipt of Items in Warehouse:

- All items that are received directly from the vendor shall be checked with reference to the Purchase Order to find whether the description of the supplied item and received item are same or otherwise. Any discrepancy noticed shall be immediately brought to the notice of SPO/ Dy. SPO and shall be communicated to the firm. The stores shall be as far as possible checked in the presence of the representative of the vendor.
- Once the items are found to be prime facie in order, a receipt will be given to the firm. The receipt furnished to the firm should read as" Received in good condition subject to inspection, counting and final acceptance". Under no circumstances a unconditional

acknowledgement will be forwarded to the vendor as the same may affect the final acceptance of the materials.

- Similarly, all incoming goods from the transporter, railways, airport etc shall be acknowledged. Besides it should be ensured that the packing is in sound condition and there is no apparent damage to the packing boxes.
- The receipt section will arrange for the unpacking of the goods so received. Before any shipment is unpacked, the presence of the Indian Agent for import cargo and the presence of user may be ensured.
- If any shortage/ damage are found even though the boxes are outwardly in order, a discrepancy report shall be prepared and sent to the supplier.
- After the items are received, the same are to be entered in the daily Receipt Register. Besides the copy of the Purchase Order available with the receipt section has to be updated to show whether the full supply has been received or part supply has been received.
- The receipt section has to arrange for inspection of the received material to ensure that the items received are in order. Till such time the items shall be kept separately so as to avoid its mix up with the available stock except the cases where the indenters has to inspect the item at his premises other than the receipt cell.
- Materials received without any document shall be brought to the notice of the Dy. SPO/ SPO for taking into stock through stores receipt voucher. Such entries will be monitored through discrepancy register.

Receipt of other materials:

The receipt cell shall ensure that all accessories, tools etc. received with the machinery and equipment, though not specially detailed in the Purchase order are entered in the receipt voucher with all essential particulars like identification number etc. The Dy. SPO (Stores) shall ensure that these are brought to stock account along with the main equipment.

Daily Receipt Register (DRR)

The daily receipt register is a register for entry of all incoming goods that are received in the Lab in a particular day except local purchases. The register will contain the details about the supplier, order reference, challan no & date, Bill no & date, Bill value, item description, :?quantity dispatched, quantity received, quantity found short/ damage, name of the indentor, inspection report no, rejection cause etc. and will serve as a complete record about the materials including its installation & commissioning. The register can be maintained in a

computer where all such data will be stored and a print out can be forwarded to the user and the Purchase section next day as intimation about the arrival and the need for the inspection. Heavy and large materials will as far as practicable will be unloaded nearer its place of its installation to avoid frequent handling.

Accepted materials:

The store accepted shall be handed over to the respective storekeepers along with Bills, Challan and Stores Receipt voucher for stock entry on the receipt of the materials. It must be ensured here that the stock entry shall be made item wise and no entry as "assorted" will be made in the stock ledgers by clubbing different items. Materials received in excess of quantities ordered for shall be returned to the supplier as per the procedure for rejected materials unless approval of the competent authority for the Procurement is obtained in writing to retain the excess quantity received.

Demurrage Charges Paid

In no case will any amount paid on account of wharf age or demurrage be regarded as a normal charge and every endeavor will be made not to incur such penal charges. However, in unavoidable circumstances, this may become necessary to pay in the first instance. All such cases are to be enquired thoroughly to find out whether there is any lapse on the part of any individual or firm for this loss and ascertain the amount, which is to be recovered. In case of no negligence, the amount paid can be regularized on proper sanction. Free time of clearance varies from case to case from railways to airlines to transport agencies and hence utmost care be taken to ensure that the consignments are cleared immediately on its arrival.

Local Purchases

All materials that are not available in store and needed to be purchased locally either by cash or on credit shall be first produced before the Dy. SPO (Stores)/SPO for physical verification who will sign and mark on the cash memo/ bill as "seen". There after the same shall be got recorded in the local purchase register instead of daily receipt register for stock entry for items purchased out of revenue funds. Stores shall ensure that the stock entry is recorded within a day of its receipt in stores along with proper issue slip. Items purchased out of capital fund shall be posted in their respective stock ledgers as well as in the Personal Inventory Register. Stock entry of the purchases made at the Project site will be done on receipt of a certificate that the items are purchased at the project site and used for the project there.

Inspection of Materials

1) The receipt cell of the laboratory will prepare a stores receipt voucher. The SRV will contain all details of the stores i.e. name & address of the vendor, PO no & Date, Item description, Quantity Dispatched, Quantity Received, Quantity found short/ Damaged, Quantity accepted besides the SRV Number and date. The SRVs will be serially numbered financial year wise for which series has to be allotted in the beginning of the financial year. This will help Purchase and Finance to track receipt of SRVs. The SRV will also have the signature of the Inspecting Officer who has inspected the stores. Payment of bills will be made as per the details of stores received based on the SRV. Similarly, the adjustment of OBs will also be made as per the particulars furnished in the SRV but where any payment is to be made to the firm; corresponding bill will be sent along with SRV details.
2) Stores such as electrical goods, mechanical instruments, refrigeration materials, computers etc. shall be inspected by the persons of technical competence in the line
3) Inspection of scientific and sophisticated instruments etc. shall be carried out by the Indenters himself. He may take the assistance of other experts for inspection of electrical or mechanical portion of the machines and equipments, if necessary in consultation with the Director of Laboratory/Institute.
4) In the absence of the Indenters on account of his being on leave etc. the Head of the Division/Section or the Project Leader shall arrange the inspection which shall not be delayed to avoid late payment to the supplier.
5) If in any particular case, more time is required for final inspection, at least a preliminary visual inspection shall be carried out immediately so that discrepancies/shortage/damage are reported to the Suppliers/Insurances lest the claim becomes time-barred.
6) Till stores are inspected and taken on charge, these shall be kept separately.

Inspection of Stores of General Nature

The stores of general use and repetitive nature e.g. soap, vim, duster, nails, glassware of standard trade mark, stationery items and chemicals from standard companies and of standard make for which indents are placed by the Dy. SPO (Stores)/ SPO shall be inspected by him for acceptance to avoid undue delays. In case of doubt, about the quality, make or specification of an item, the advice of the user department shall be sought before acceptance.

Certificate of Inspection:

When the stores are found acceptable in accordance with the quality, quantity and specifications ordered for, the inspecting officer shall record the following certificate after inspection appending his signatures on the space provided for the purpose: - "Certified that the Stores have been inspected by me and found acceptable in accordance with the quantity, quality and specifications laid down in the purchase order. The equipments/ instruments were installed successfully on _____. *(Please attach the installation report also)*"

The SRV shall be counter-signed by the Head of the Division/Section/Project leader as the case may be. In case of equipments, copy of the installation report submitted by the firm need to be attached with the SRV.

Samples for Inspection:

1) Sample may be called for where necessary, provision for which should normally be made in the rate enquiries/advertisement and these shall be received by the Receipt Section. Samples thus received against supply orders placed by the Purchase Section shall be accounted for in a "Stock Register for Samples".
2) Disposal of samples: The samples shall be placed before the Inspecting Officer, and after the goods have been inspected and approved, the same shall be disposed of on the authority of the SPO, either by returning to the firm through Non-returnable gate pass or to be amalgamate with the incoming supplies or by other suitable measures/advantageous to the Council. Care shall, however, be taken to avoid their unnecessary accumulation, misuse and occupation of valuable space.

Rejection of Materials

All materials received not in conformity with the specifications and requirements ordered for in the purchase order shall be rejected by the inspecting officer, who will record his reason for such a rejection on the Inspection Report. The Purchase Section shall immediately take up the matter with the firm based on the report of the receipt section. The rejected stores shall be suitably labeled and stored in a separate area from the accepted or other stores in the Receipt Section pending their return to the suppliers. These will be handed over to the supplier's representative or dispatched to the firm as the case may be through Non-returnable gate pass. The rejected materials will be accounted for in the "Register for discrepancies" which shall be maintained by the Receipt Section.

All expenditure incurred on this account shall be recovered from the supplier. When the consignee on freight-to-pay basis receives the stores, the supplier shall, at destination, be

liable to pay the freight actually incurred. After dispatch, the receipt cell shall promptly send the relevant documents to the consignee for further action.

A time limit shall be fixed up for the removal of rejected materials by the supplier from the Laboratory/Institute premises, failing which a final notice/reminder by Registered post will be sent for removal within a stipulated period, otherwise ground rent be recovered from them as fixed by the Director of the Laboratory/Institute. The matter will be vigorously pursued till their final removal. In case of failure of any response from the company, appropriate action for their disposal shall be taken through auction or other means with approval of the competent authority.

7.4 Issue and Return of Materials

Issue of Materials:

The following procedure must be adopted while issuing materials from stores.

- Issue of stores shall be made in proper issue slip.
- Issue slip shall be prepared in triplicate by each division/ section separately for each category of stores as outlined in the annexure for (a) Stores Purchased out of revenue grant and (b) Stores purchased out of capital Grant to ensure quick issue and easy accounting.
- Stores purchased out of revenue grants will be issued on pink issue slip and capital items will be issued in White issue slip.
- Stores shall be drawn by an issue slip signed by a person not below the rank of an officer of the division/ section and countersigned by the Head of the Division/ Project Leader. Director of the lab/ Instt may however authorize a person not below the rank of Group C in administration and Group II in Technical to draw stores.
- All stores purchased out of capital funds shall normally be issued to the official indenting the equipment. Each lab shall decide about the mode of maintaining inventory – whether on Personal Inventory basis (PI) or Divisional inventory basis (DI) and get it duly approved by the Management Council of the lab before adoption. Any change to the policy thereafter shall have to be approved by the MC.
- No store shall be issued to the guest/ casual workers who are not on regular establishment unless duly authorized by the Director. But it must be ensured that the items issued to such officials will be taken back at the time of his/her leaving the organization.

- The description of store to be given on the issue slip shall be completed as given in stock ledger/ Bill/ Challan/ Bin Card etc. and shall invariably include identification number, make, type of machine / instrument in case of articles of capital nature.
- All issue slips for items needed for a Project and are made from stores shall bear the project number. The stores shall at the end of every month send a report indicating cost price (under FIFO method) of such issues to the accounts for debiting that project.
- All issues shall be scrutinized and authorized by the Dy. SPO (Stores) / SPO before actual issues are made by the stores assistant and in his absence by the senior most stores assistant. In case of any excess demand the issue may be curtailed where necessary.
- In order to enable the store keeper to post the ledgers, raise indent for new procurement etc. issue timings for issue of materials from store be fixed in each lab.
- Issue slips having mutilations and over writings or incomplete in any respect shall not be accepted for issue of materials and returned to the indenters forth with.
- Stores shall not ordinarily be issued in bulk quantities and the project Leader/ HoDs shall .Ensure that minimum quantities of such materials are permitted to be drawn by them to avoid accumulations, wastage or likely misuse of such articles. Whenever any quantity above the normal consumption is requisitioned, PL/ HoDs may record reasons for such specific requirement.
- Where the date of expiry is indicated on the package, endeavors shall be made to use such materials before the expiry date. In case it is not possible to use the same before the expiry date, the same may be disposed off in the best interest of the council.
- In order to control the issue/ consumption of stores like soap, duster, towels etc to officers & other staff the same shall be issued strictly in accordance with the scale which has to be laid down by the lab/ Instt.
- Issue of some items purchased out of revenue funds like Tube lights, Bulbs, batteries, tiers & tubes, chokes, electric line testers, umbrellas, briefcases, computer cartridges, Floppy disks, CDROMs, CD-RW, brass civil engineering items etc. need to be regulated either by insisting the issue of a fresh one in exchange of the old one or fixing time limit/ fixing quantity of issue as may be decided by the Director.
- The issue slip books shall be kept in safe custody by all drawees and shall be used by him only. Fresh issue slip books will only be issued after it is personally verified by the Dy. SPO (Store) that the all the issue slips of the book is consumed.

Return of Materials:

All returns to stores will be governed by the following procedures:

- Capital items shall be returned to the stores when the same is no longer required in the division but are in working order so as to enable stores to get it issued to other division on demand.
- The user is thus required to obtain a certificate from the inspecting authority to the effect that the stores returned now is in working order.
- Before accepting the return voucher the store assistant will compare the details of item being returned with that of the original issue to ensure correctness of the serial number, make, model etc.
- The receipt of such returned store shall be done by the concerned store assistant and will be countersigned by the Dy. SPO Store, the duplicate copy will be returned to the user and the original copy kept in store. All postings need to be completed immediately on the same day.
- Whenever a new demand arises, the used store shall be issued first vis-à-vis the new one available in stock till a committee declares them as surplus/ obsolete/ unserviceable.
- The position of the returned store shall be reviewed by the dy. SPO/SPO at regular intervals to ensure that the returned stores do not get accumulated. In case no section/ division in the lab need these equipments, the same can be disposed off to the best advantage to the council.
- A number of chemicals and other items that get accumulated in various divisions/sections and lie un-utilized for a pretty long period results in its damage, deterioration in quality, evaporation etc. besides depreciation in cost. In order to effect economy in expenditure on materials the HoDs shall prepare a list of such chemicals that are lying in their respective sections for more than a year without any usage and shall be reviewed by the Director every March so that its transfer to other sister labs could be considered is needed.
- A return control register for return slips will also be maintained in line with that of issue control register.

7.5 Internal Transportation in Warehouse

A warehouse is a building with possibly many dock doors around the various sides, for the receiving, storing and dispatching of goods. Therefore, it is apparent that different types of equipment are needed to make the carriage, and movement and storage of items possible. Both human are machine are deployed to function at warehouses to perform value added services to the goods until they are transported to the next user on the supply chain. For the purpose of this work, the focus is on the internal transportation of goods from point of

receipt to storage, and to dispatch area and the vice versa. The safety of the personnel will be highlighted, and also means to ensure transport safety by using floor strips or paintings and other measures are discussed. Transport activities are very crucial in the successful operations of warehouses. The requirement is for easy and efficient carriage of goods from one point to another in the warehouse.

Transport Equipment

1) Conveyors

This means of transport is mostly used between fixed points. Goods are moved from one point to another fixed point. A conveyor can either be powered to function or be dependent on gravity. Gravity conveyors are used to transport goods within shorter distances. Some examples are chutes and skate-wheel conveyors. Such conveyors normally function with shorter distances. Power conveyors, on the other hand, are used for longer distances. The types of such conveyors include belt conveyor and chain conveyor.

Nevertheless, conveyors are more efficient where an operation has some features as;

- Need for high throughput
- Fixed routes for movement of goods
- Continuous movements of goods
- Uneven warehouse floors.

2) Fork-lift Trucks

The fork-lift trucks as the workhorse of most stores and warehouses. They come in different varieties depending on their lift capacity and lift heights. Consequently, different fork-lift trucks are used in different warehouses depending on the mode of operation Forklift trucks are designed mainly for lifting and transporting pallets, the effective storage of goods in warehouse normally involves the stacking of pallets, and their transportation or movement is made possible by fork-lift trucks

3) Automated Guided Vehicles (AGV)

These transportation machines are powered by battery and are computer-controlled. In other words, they do not require a driver to function. They are normally used for moving pallets and a variety of unit loads. The vehicles are guided to move along a certain designated area by several means. One common means is a wire guidance system. With this method, a wire is buried in the floor of the warehouse and sensors are fixed in the vehicles to detect and follow the magnetic field which is generated by the electric current flowing through the

wire, which steers the vehicle. Other means are burying magnets in the warehouse floors and also lasers are used for laser guidance.

Operational Efficiency

Efficiency is defined as how well an operation is being run, by redesigning operations or processes so that less time, space and materials are need to complete an operation, the process is said to be more efficient. An example is the reduction of travelling distances in the warehouse by storing according to the order of importance or rate of need, as in the ABC classification. Thus, the need for warehouse staff, warehouse space and materials should be as small as possible.

Furthermore, distinguishes three actions that can enhance process efficiency. They are:

- Eliminate activities: this is when certain activities that are redundant or improper are taken out
- Improve activities: here, the same activities are performed but with more efficiency.
- Combine activities to reduce the number of repeating similar activities. The problem of how much inventory should be held is that faced by many inventory managers. Maintaining a huge inventory means a quick response time to demand. Meanwhile, it is expensive to stock in larger quantities. While the goods themselves are costly, it also implies that money is tied up in inventory and cannot be invested elsewhere Efficiency in managing inventories could be a competitive advantage to certain companies in their quest to ensuring profitability and sustainability. Such policies help to minimize the need for keeping large inventories.

7.6 Material Management in Warehouse

Different researchers provide different definitions for material management, therefore different definitions can be found in different references. Basically, material management is concerned with the planning, identification, procuring, storage, receiving and distribution of materials. The purpose of material management is to assure that the right materials are in the right place, in the right quantities when needed. The responsibility of one department (i.e. material management department) for the flow of materials from the time the materials are ordered, received, and stored until they are used is the basis of material management.

Ballot (2006) defines material management as the process of planning, acquiring, storing, moving, and controlling materials to effectively use facilities, personnel, resources and capital.

Tersine and Campbell (2004) define material management as the process to provide the right materials at the right place at the right time in order to maintain a desired level of production at minimum cost. The purpose of material management is to control the flow of Materials effectively.

Beekman-Love (1998) states that a material management structure should be organized in such a way that it allows for integral planning and coordination of the flow of materials, in order to use the resources in an optimal way and to minimize costs.

Bailey and Farmer (2009) define material management as a concept concerned with the management of materials until the materials have been used and converted into the final product. Activities include cooperation with designers, purchasing, receiving, storage, quality control, inventory control, and material control.

Gossom (1999) indicates that a material management system should have standard procedures for planning, expediting, transportation, receipt, and storage to ensure and efficient system for materials control.

Cavinato (1994) states that material management involves the control of the flow of goods in a firm. It is the combination of purchasing with production, distribution, marketing and finance.

Arnold (2001) states that material management is a function that is responsible for planning and controlling of materials flow. He adds that a materials manager should maximize the use of resources of the company.

Stukhart (2007) defines material management as the activities involved to plan, control, purchase, expedite, transport, storage, and issue in order to achieve an efficient flow of materials and that the required materials are bought in the required quantities, at the required time, with the required quality and at an acceptable price.

The typical tasks associated with a material management system are:-

- Procurement and purchasing
- Expediting
- Materials planning
- Materials handling
- Distribution
- Cost control
- Inventory management / Receiving/ Warehousing
- Transportation

Need for Material Management System in Warehouse

The costs associated with material management are hidden in other activities or included as overhead costs. Stukhart (2007) states that studies from the Construction Industry Cost Effectiveness Project (CICEP) concluded that senior management have not recognized the contribution of material management to cost issues in projects, that personnel involved in material management activities do not receive an adequate training, and that the computer systems used by companies are not good sources of information for materials control. Historically managers had paid more attention to the costs associated with personnel, equipment and plant and little attention has been given to materials.

For manufacturing organizations, the costs related to materials have increased and had become the largest expenditure of the organization; therefore more attention has been placed into activities related to materials (Tersine, 2004). The cost of materials has escalated to twice the cost of labour between 1975 and 1980 inducing companies to pay more attention to activities related to materials (Bernold and Treseler, 1991). Traditionally the responsibilities for activities related to materials flow have been divided between different departments.

The activities related to material management are divided between different departments. For example, the finance department is in charge of the purchasing activities while the manufacturing department is in charge of the control of materials during production. This division of responsibilities makes it difficult to coordinate the activities related to materials. In addition, this division can make the control and identification of materials extremely difficult. The integration of the functions related to materials into a single department makes it easier to control and identify all the activities related to material flow and costs, the integrated approach for Material Management. Material Management is designed to coordinate and control the materials needed and activities related to those materials. In a typical organization, the material activities are interrelated (Dobler & Burt, 2009).

Important Elements in Material Management in Warehouse

Purchasing and inventory control are the key elements for efficient material management. Decisions on how much to buy and when to buy cannot be view in isolation; as is being done in many quarters. The provision of safety stock on the other hand is a kind of insurance and is largely influenced by the lead time required to procure the materials. It is obvious that any improvement in the lead time would necessitate a decrease in the volume of safety stock and thereby reduce overall capital lock-up in inventory (Saeed, 2008). Another important issue in material management is the matter of maintaining good systems and procedures and this calls for strict discipline in documentation.

This implies that all related paper work are completed in time so as to generate the basic data and compile timely and reliable information for planning, follow-up and control. This seems mandatory, be it manual or computerized system. The success of the system calls for cooperation and understanding of all that are concerned for providing timely, the necessary data; in order to ensure that the information processed for action reflects the realities of the situation.

According to Nasiri, Davoudpour and Karimi (2010) resource planning and timely information for decision, action and control is possible today with the support of a computer system with the relevant application package and software. An integrated material management system with electronic data processing support avoids many of the common volume data in a short time span and checking the actual against the preset norms, so as to take quick preventive and/or corrective actions.

7.7 Warehouse Design and Layout

While historically a warehouse has been a large box used to store surplus inventory for long periods of time, tomorrow's warehouse facilities are becoming "distribution activity hubs" that add value by processing goods, not storing them. Such value-added services are, by definition, very labour-intensive. This change speaks volumes for the need to focus attention on productivity and operational efficiency. While a warehouse in fact is a large box, the input of experienced operational people, like managers, supervisors and operations managers, can drastically improve the productivity and efficiency of the material handling as well as the use of storage space. Architectural design, construction techniques and warehouse operational know-how are easily compatible if they work together through the initial planning stages. Some important areas in designing a warehouse are as below:

- Location and ventilation of battery changing area
- Building support columns configured for optimal aisle layout
- Adequate doors to handle volume
- Offices and break area locations
- Adequate lighting throughout the facility
- Obstacles that impede the smooth flow of traffic
- Minimal travel distances from receiving docks to storage areas and shipping docks
- Sprinkler requirements, which include high-pressure pumps, reservoirs, in-rack sprinklers, high-density systems
- Aerosol and/or explosion-proof rooms

- Knock-out expansion walls

Demand for Contemporary Warehousing

Warehousing has been called upon by corporate to add value to supply chains while continuing to support traditional economies of scale and customer demand. As discussed, large storage warehouses are utilized to stockpile inventory that is produced, purchased, and transported in quantities large enough to gain competitive and cost-effective economies of manufacturing, procurement, and transportation. Such economies cannot be ignored by contemporary warehouse operators; however, additional factors must be considered when designing the strategy of the warehouse plan.

Anticipatory Inventory

Many times products are produced in anticipation of demand and especially items that have a low cost associated with each unit. Brands associated with long historical demand data and with relatively predictable patterns (little unexpected variations in customer ordering quantities) may be prime candidates for producing in anticipation of the forecasted demand. Items with well-established demand patterns, low cost of goods sold and minimal handling requirements would be kept in stock at levels to meet ordering and service requirements of customers. Although all inventory represents value in terms of dollars, items such as canned vegetables that have relatively steady base demand patterns, strong historical demand data for adjusting forecasts based on other relevant factors, ordered in case and/or pallet quantities, and require little value-added within the warehouse are potential items for anticipatory inventory.

Seasonal Stocking

Red and white, and sometimes varied in coloured, candy canes sold and consumed during the December holiday season represent an extreme case of seasonal stock. Manufacturers of the candy begin production and stock piling inventory well before orders are shipped to wholesalers and retailers. Historically, a southern U.S. candy maker would level production the item by producing candy canes months in advance of demand so that labour and production machinery could more efficiently be utilized. Production strategies like this helped to reduce costs associated with overtime and running equipment near maximum capacity, thereby, risking an equipment breakdown. Producing well in advance of the season also allowed the candy maker to adjust production plans as the season approached. Compared to many other consumer products, candy canes are relatively low in cost per unit, require little handling without the cost of palletizing materials, may be stacked in high-bay

storage, and are less susceptible to theft. As such, warehouse costs are more than offset by the reduction in production and labour costs

7.8 Basic data and key performance indicators of warehouse systems

The planning and design of warehouse and distribution systems is highly complex so that it is nearly impossible to describe all relevant system-related parameters. The major part of such key values has to be defined for a given problem. In the following the most elementary key values which are used in quite a number of systems are described. They are classified into basic data and key values Basic data are also called absolute numbers and directly result from measurements, counts, summations or differences of certain units or they are recorded as master data. At the same time, they also represent the requirements and basic information to be provided by a system. Key values should provide significant and dandified information to evaluate and compare the efficiency of processes and systems. Here, absolute as well as relative numbers, i.e., proportionate values or data are used.

1) Master data

Master data are statically data which are not changed over a longer period of time. The master data contain all important information about the basic characteristics of an article, loading aid, etc. The most important master data in a warehouse are the article master data because all main warehouse functions and control mechanisms are based thereon. The article master contains a description of all articles independent of their current stock. The total number of articles represents the assortment although discontinued or dead articles result in differences to the actual stock.

2) Inventory data

This data group informs about the quantities of articles stored or provided over a longer period of time. The up-to-date and accuracy of this kind of data collection is of special importance to ensure the readiness to deliver and to dimension the warehouse system. Since these data change continuously they are also called dynamical data

3) Movement data

The second group of dynamical data are the movement data which represent all main physical warehouse processes. These are basic processes like goods receipt and issue and warehouse operations as well as order-picking processes and order execution.

4) Other system data

Other elementary system data are among others

– Structural space and room data

– Structural manpower data,

– Cost data

–Unit load and packaging master data, etc

Appropriate actions will have been taken to minimize incidents, accidents, and other hardships to CRS' staff and goods stored at the warehouse.

Warehouse Safety and Security

Housekeeping Guidelines

Food aid programs often take place in economically and physically difficult environments, including conflict zones and sites of man-made and natural disasters. Often, they are areas with extreme heat or high humidity. Food aid commodities are a valuable resource for vulnerable people in these situations. Care must be taken so that the commodities remain healthy and secure. Prevention of incidents and accidents begins with good housekeeping. Good housekeeping leads to a safe warehouse environment. To keep a warehouse safe requires awareness, anticipation and common sense. The warehouse manager should ensure:

Safety:

- ✓ Maintenance of clutter-free environment: walking areas inside the warehouse and its surroundings are free of boxes, materials, electric cords, tools, and equipment against which people may stumble and fall
- ✓ Removal of garbage, debris, dirt, and oily materials that are a potential fire hazard. There should be enough trash cans inside and outside the warehouse for easy disposal of such items.
- ✓ Daily emptying of trash cans in covered outside bins
- ✓ To the extent possible, the warehouse is kept free of rodents and other pests to protect warehouse workers and stored commodities
- ✓ Prohibition of smoking in the warehouse; post no-smoking signs
- ✓ A clean washroom available to all staff and workers should be required to wash their hands before handling commodities, particularly if they are engaged in re-bagging activities

Security:

- ✓ The warehouse is provided with a first aid kit and that assigned employees have a basic knowledge of how to use it
- ✓ The warehouse is equipped with fire extinguisher(s).

- ✓ The warehouse is regularly visited by a safety inspector who provides a written report and that the inspector's recommendations are promptly addressed
- ✓ To the extent possible, each warehouse has multiple exits and that visible exit signs are posted in the warehouse in order for staff to recognize where they can exit in case of emergency
- ✓ Emergency phone numbers are posted and visible to all warehouse staff

7.9 Summary

As an impact of large product varieties and shortened customer response times there is a greater emphasis on the ability of the organizations to establish smooth and efficient logistics operations. In this regard, warehouses play a vital role because they function as nodes that direct the flow of materials within a distribution network. The effects of organizing warehousing activities can directly be seen in customer service levels, lead times, and the cost structure of a company. Hence we can conclude that warehousing influences the performance of an entire supply chain.

With the boom in organized retailing it becomes necessary for the players to continuously improve their process. The retailers have to strive continuously to reduce their costs. Technology being an enabler improved technology has to be incorporated into the current processes. Also the processes have to be designed in such a way that they provide for incorporating changes. The value stream mappings of the current systems showed many bottlenecks that prevail in the system. These bottlenecks restricted the capacity the warehouses could handle. Performance and productivity of the warehouse suffered as the operations were manually carried when it could be more easily and more effectively done using machines. With WMS implementation the cycle time of the process also decreases the study proves WMS to be an enabling factor for performance and productivity improvement. The productivity of a WMS warehouse is way higher than when the operations are manually performed.

7.10 Keywords

1. Stacking- shuffle or arrange
2. logistics- deals with procurement, distribution
3. Infeasible- not possible to do easily, conveniently
4. Contemporary- occurring in the present
5. Divesting- extremely effective

7.11 Self Assessment Questions

Q-1 Explain functions of warehouse management?

Q-2 Explain the layout of warehouse?

Q-3 Explain the procedure of material handling and storage in warehouse.

Q-4 Explain in details with example of stocktaking?

Q-5 What are the various safety, security measures should be taken in warehouse management?

7.12 References

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Subject: Supply Chain Management	
Course Code: POM 323	Author: Dr. Hemant Sharma
Lesson No.: 8	Vetter:
Inventory Management	

Structure

8.0 Objectives:

This chapter will help you to understand the:

1) Basic functions of inventory management;
2) Different types of inventory;
3) Various types of inventory costs;
4) Different approaches to control the inventory level;
5) The concept of safety stocks

8.1 Introduction:

Inventory is basically working capital and that is why control of inventories is very important as part of operations management. Inventories are crucial for proper functioning of manufacturing and retailing organizations. There are many types of inventories like raw material, spare parts or consumables, work-in-progress and finished goods. It is not necessary that every organization needs these resources but should work according to the needs and requirements of the resources depending upon what type of production is taking place.

Various departments within the same organization have a contradictory approach towards these kinds of resources. This is because the functions that are performed in various departments influence the motivation in them. For example, the sales department might need large amount of stocks of materials so that the production systems run very smoothly with any hesitation. On the other hand, the finance department would need a minimum investment in stocks so that the funds could be used elsewhere for even better purposes to enhance the performance of the organization.
There are different inventory systems that determine the when to order and how much to order. In this chapter, we will discuss all of them in detail.

8.2 Types of Inventory:

Inventories are used for many different purposes and by various departments for their respective needs and requirements, but there are generally five types of inventories that every production organization should emphasis on:

1) Movement inventories
2) Buffer inventories
3) Anticipation inventories
4) Decoupling inventories
5) Cycle inventories

1) Movement Inventories:

Everyday resources are being transported to the industries and putting them to use by production organization through various modes of transportation. Movement inventories are also called transit or pipeline inventories. This is basically dealt with transporting the resources from source to destination. For example, coal is transported from coalfields to an industrial township by trains, then the coal, while being transported will not be able to provide any service to the customers for power generation or for burning furnaces etc.

2) Buffer Inventories:

These inventories are basically kept for future needs for the organization in stock because there may a case when more inventories would be needed and therefore every organization keeps an average amount of inventories in stock so that the organization can utilize those resources efficiently and effectively without any delay. This mainly calls for uncertainty in demand, as every organization would need the required amount of stock but what would happen when the stock runs out? Everything would stop mainly the production so it is very important that excess amount of resources should be kept in stock. Similarly, the average time for delivery that is (the time between placing the order of resources and receiving those orders and getting them ready for use in stock, technically known as lead-time).

The idea of keeping buffer stocks is to enhance the level of providing customer service and gradually reducing the number of stock outs and back-orders. Stock out is something when the stock runs out and the needs of customers are not being able to fulfilled but in some situations back ordering is possible that is (the order for goods demanded is fulfilled as soon as the next shipment of stock arrives.) while in others it is not as it looks because the demand might be lost forever which leads to temporary or permanent loss of customer goodwill.
So it is very important to keep buffer stocks as demand may arise at any point of time.

3) Anticipation Inventories:

Anticipation inventories are put under scrutiny for future demands so that when the time arrives, the supply of products flow rapidly. Like producing rain coats before the rainy season, creating crackers before Diwali etc. The idea under this is to smoothen the flow of production process for longer time on an iterative scale instead of operating with excess

overtime in a particular period and then keeping the system idle for long or even shut down the system because of unnecessary demand for another period.

4) Decoupling Inventories:

This type of inventory deals with the work rate of different machines and people because normally machines work at different rates- some slower and some faster. For example, a machine might be producing half the output of the machine on which the item being handled is to be processed the next. Inventories in between the various machines are held in order to disengage the processing on those machines. In absence of those inventories, different machines and people cannot work on a continuous basis. Clearly, therefore the decoupling inventories act as shock absorbers and have a cushioning effect in the face of varying work rates, and machine breakdowns and failures and so on.

5) Cycle Inventories:

Cycle inventories are those when purchases in lots instead in exact amount of stock need in a specific point of time. But yes if all purchases are made as per the exact requirement of stock there would have been no cycle inventories. But then the cost in getting these stocks would be much higher as per the customer needs and requirements. They are also called lot-size inventories and larger the lot-size inventory the greater would be the level of cycle inventory.

8.3 Inventory Decisions:

It is very important and is the top most priority of deciding about the inventories in a production organization as this would decide the future and present performance of the company. In any production organization deciding the inventories according the needs and requirements of it is very important. This can enhance the performance or bring down the efficiency.

So there are specific things any production manager should keep in mind before making decisions. They are:

- How much to order? – This is decided by the manager as to how much quantity to order for optimal performance and effective utilization of resources.

- When to order? – This is the most important aspect the manager should emphasize on because this would decide when should the products be ordered.
- How much stock should be kept in safety? – This indicates how much quantity should be taken under consideration so that the stock can be used safely in the future without any hesitation.

8.4 Types of Inventory Costs:

For deciding the best suitable inventory policy, the top most criteria used is the cost function. This inventory analysis has four major components:

1) Purchase Cost:

This is basically the nominal cost of an inventory. It is the cost incurred in buying from the outside sources, and it would be known as production cost if the items are produced within the organization. The cost is constant for a unit but may vary according to the quantity purchased increases or decreases. For example, the unit price is Rs.20 for up to 100 units and Rs.19.50 for more than 100 units. If a unit cost is constant, the control decisions would not have any affect because whether all the requirements are produced just once or made in installments the total amount of money involved would be the same.

2) Ordering Cost/Set-up Cost:

This occurs whenever the stock replenishes. It associates with the processing and chasing the purchased order, transportation, and inspection for quality. It is also called procurement cost. The parallel of ordering cost when the units are produced within the organization is the set-up cost. It refers to cost incurred in relation to developing production schedules. The ordering cost and set-up cost are taken to be independent to the order size. So the unit ordering/set-up cost decreases as the purchase order increases.

3) Carrying Cost:

Carrying cost is also known as holding cost and it refers to the cost that is associated with storing an item in the inventory. It is proportional to the amount of inventory and the time taken to hold that inventory. The elements of carrying cost include opportunity cost, obsolescence cost, deterioration cost. The carrying cost is expressed in terms of rate per unit or as a percentage of the inventory value.

4) Stockout Cost:

Stock out cost is the cost, which incurs when customers are not being served. These costs imply shortages. If stock out is internal, that means that some production is lost internally also resulting in idle time for man and machines. If stock out were external, it would result in potential sales or loss of customer goodwill. When the new shipment arrives, a customer who was denied earlier would be immediately supplied the goods. But it would involve costs like packaging costs and shipment costs.

8.5 Inventory Management Systems:

There are basically two types of management systems:

- ***Fixed order quantity system:*** Also known as re-order point, when a specific level is reached called the re-order level and the stock level reached this point, an order for a particular number of units is placed;
- ***Periodic Review System:*** This is a system where the stock is replenished over a fixed period of time. In this system, the time after which the order is placed, is fixed, but not the quantity.

Fixed Order Quantity System:

This system also called the Q-System. In this, a re-order point is established and as soon as the stock level reaches this level, new set of orders are placed. This system is taken under consideration of certainty. A couple of models based on different conditions shall be developed to study various operations of the system under deterministic conditions.

Model 1: The Classical EOQ Model

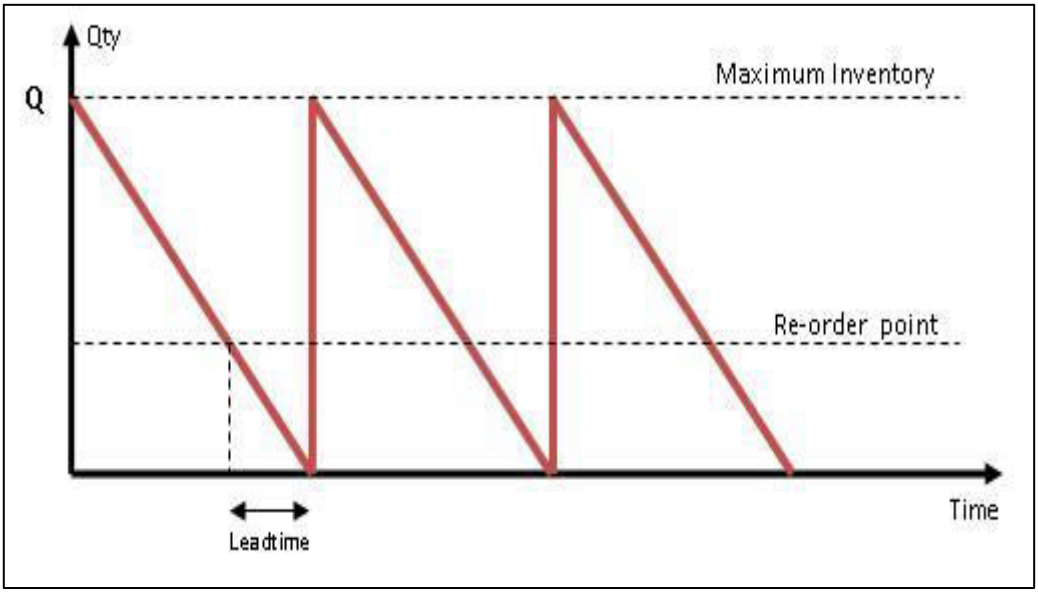
EOQ stands for Economic Order Quantity also known as the Wilson Formulation. It is the most elementary of all the inventory models. For this, a fixed cost model is made and then it is manipulated to form an inventory model.

This model is based on the following assumptions:

1) The demand for the item is continuous, constant and certain over time.
2) The purchase price is constant, and no discount is available on the large lots.
3) The inventory is replenished immediately as the stock level reaches level equal to zero. So there is no shortage or overage.

4) The lead is always known and fixed. When the lead-time is zero, the delivery of item is instantaneous.
5) Within the range of quantities ordered, per unit holding cost and the ordering cost are constant and thus independent of the quantity ordered.

With these assumptions, the inventory level would vary over time as shown in the graph 1 as below:



Graph 1

Now, we begin with a stock of Q on the time zero. This will be consumed at the rate of some units per day. If the stock can be replenished instantaneously (that means lead time is zero), then a new set of orders is made and the inventory is obtained. When this stock is consumed, an order would be made at another time.

The interval between two different points when orders are placed, or the time elapsed in consuming the entire lot of items, is called the inventory cycle. The maximum inventory held would be Q while the minimum be zero, and hence the average inventory level would be equal.

There is no need for maintaining a safety stock because of the first two assumptions. For determining the optimum order quantity, we shall take two types of cost: ordering cost and the holding cost. Since the purchase price is uniform in nature, it does not affect the decision as to the quantity of the item to be ordered for purchase and, hence, is irrelevant for the purpose.

The cost model assuming for a period of one year is:

$$T(Q) = O(Q) + H(Q)$$

Where,

Q = the ordering quantity

T (Q) = total annual inventory cost

O (Q) = total annual ordering cost

H (Q) = total annual holding cost

Example 1:

Samsung Electronics Co produces 2000 TV sets in a year for which it needs an equal number of picture tubes of a certain type. Each tube costs Rs10 and the cost to hold a tube in stock for a year is Rs 2.40. Besides, the cost of placing the order is Rs 150, which is not related to its size.

Now, if an order for 2000 tubes is placed, only one order per annum is required. When 1000 units are ordered, 2 orders in a year are needed, while 500 units are ordered to be supplied, then a total of 4 orders per annum are required. Naturally, as the number of orders placed increases the ordering cost goes up. More orders, however, would also imply smaller order quantity and therefore decreasing holding costs. Thus, we have a trade-off between the ordering and the holding cost. What we attempt in our EOQ model is, then, to find the order size that minimizes the cost function T (Q).

A) *Total Annual Ordering Cost:* This is given by the number of times an order is placed, N, multiplied by ordering cost per order. A.

$$O(Q) = N \times A$$

The value of N itself is independent on the order quantity Q, and the annual demand, D. Here N would be equal to D/Q. Accordingly:

$$O(Q) = D/Q \times A$$

So, When:

N=1, Q=2000 and O (Q) = 1x150 = Rs150

N=2, Q=1000 and O (Q) = 2x150 = Rs300

N=4, Q=500 and O (Q) = 4x150 = Rs600

N=5, Q=400 and O (Q) = 5x150 = Rs750

B) *Total Annual Holding Cost:* The annual holding cost is obtained by multiplying the unit holding cost, h, by the average number of units held in the inventory. As been pointed

out earlier, the average inventory held equals Q/2. Consequently, the total cost of holding inventory, per annum would be:

$$H(Q) = Q/2 \times h$$

So, When:

Q=2000, H (Q) = 2000/2 x 2.40 = Rs 2400

Q=1000, H (Q) = 1000/2 x 2.40 = Rs 1200

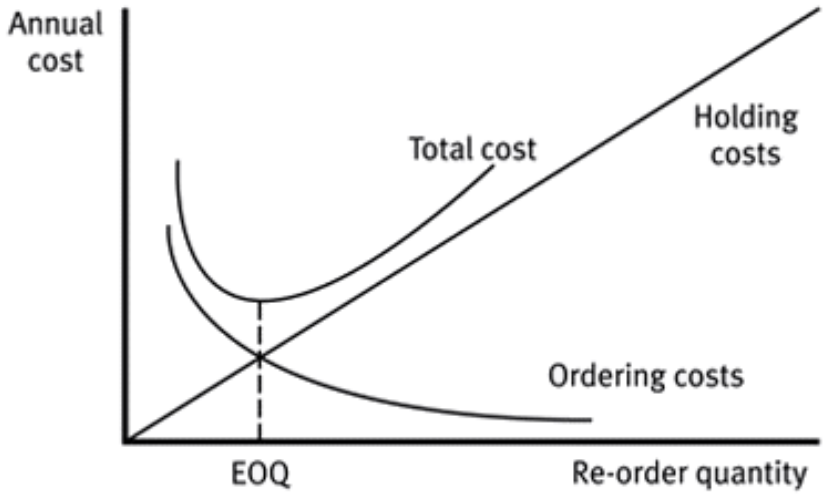
Q=500, H (Q) = 500/2 x 2.40 = Rs 600

Q=400, H (Q) = 400/2 x 2.40 = Rs 480

This may be pointed out that although the cost of holding a unit in an inventory is given in this question, more often the holding cost is expressed as a proportion, or percentage of the value of inventory. It may be stated for example: that the inventory holding costs are 15% per annum of the value of an item. It implies that if an item costs Rs 40, then the holding cost would be 15% of 40 = Rs 6 per unit per year.

C) *Total Annual Inventory Cost:* Both the cost components can now be added up and we can obtain the total cost of inventory.

The total cost curve is obtained by adding two components O (Q) and H (Q). The minimum point on this curve determines the optimal quantity, for which each order is placed each time. This ensures the minimization of total cost.



Graphic Determination Of EOQ

The graphic and tabulation methods of determining the EOQ are cumbersome.

We can obtain this value using the following formulae:

$Q = \sqrt{2AD}/h$

Or, $Q = \sqrt{2AD}/ic$

For example: We have A = Rs 150 per order, h = Rs 2.40 per unit per annum. D = 2000 units. Thus,

Q= $\sqrt{2 \times 150 \times 2000/2.40}$

=$\sqrt{2{,}50{,}000} = 500\ units$

Determination of the Re-order Level:

The re-order level would be known at a point such as: The data below,

No. of working days = 250
Lead time = 15 working days
With this info, the daily demand = 2000/250 = 8 tubes
Demand during lead time = 15 x 8 = 120 tubes
Re-order level=120 tubes

A) Annual Total Variable Inventory Cost: The minimum annual inventory cost can be determined by substituting Q* for Q.

   T (Q*) = D/Q* x A + Q*/2 x h

   It may be noted that when the holding cost is expressed in the proportion form, we have: T (Q*) = $\sqrt{2Adic}$

B) Inventory Cycle: With a uniform and constant demand D, and the economic order quantity Q*, the problem of the optimal interval between the successive orders can be answered easily. If T* represents the optimal interval between any consecutive orders, we have,

   T*=Q*/D

T* is also called the inventory cycle time.

C) Number of Orders: The optimal number of orders placed per year, N*, can also be obtained. It equals the reciprocal of T*. Thus, N* = 1/T*. Thus, when T* = 0.25 = 1/4, N* = 4 orders per year.

D) Rupee value: The monetary value of optimal order quantity and average inventory held can also be determined:

Rupee value of EOQ = Q* x C (where c is the unit price)

= 500 x 10 = 5000

Rupee value of the average inventory = Q* x C/2

= 500 x 10/2 = Rs 2500

In most cases, demand is expressed in money terms instead of units. So in this case, of the unit price is known, the demand may be converted into units by dividing rupee demand by the unit cost price.

Where ever, the cost is not given and then we can determine the economic order quantity in rupee terms. When the demand is given in monetary terms, the holding cost must be expressed as a proportion.

D_m= the annual demand in rupee terms

A= the acquisition cost

I = the holding rate

Example:

Using the following data, obtain the EOQ and the total variable cost associated with the policy if ordering quantities of that size.

Annual Demand = Rs. 20000

Ordering Cost = Rs 150 per order

Inventory carrying cost= 24% of average inventory value

Here,

D_m = Rs20000

A = Rs 150/order

I = 24% = 0.24

$$\text{EOQ (in rupees)} = \frac{\sqrt{2x150x20000}}{0.24}$$

$$= \text{Rs } 5000$$

$$\text{Total Cost, T (Q*)} = \sqrt{2} \times 150 \times 20000 \times 0.24$$

$$= \text{Rs } 1200$$

Violation of Assumptions of EOQ Model:

- In the EOQ model, we assumed that demand of an item is certain, continuous and constant. But however, the demand is more likely to be uncertain, discontinuous and variable.
- Demand is always supplied immediately and there is no availability of shortage. However, even when the demand and lead-time are known and constant, stockouts may be permitted.
- The unit price is the same. The analysis can be extended to cover situations when quantity discounts are available.
- The implicit assumption that the entire quantity ordered for would be received in a single lot may not hold true sometimes. If the supply of goods is gradual, the model needs adjustments.

Model 2: EOQ with Price Breaks

The previously discussed, the classical EOQ model is based on the assumption that the cost of an item under consideration is uniform. But in real life, it is very common to find cost discounts on quantities for which the order is placed. Lower rates are highlighted if the quantity of goods is high. So in cases like these, the quantity ordered should be carefully examined taking into consideration the price levels of different quantity ranges.

When the unit cost price is uniform, the purchasing cost is inadequate to determine the order size. But under the conditions of price break, the item cost, being a function of order quantity, is the incremental cost and must be included in the cost model. As such, the cost model would include the holding cost, ordering cost and the purchasing cost of items.

$$\text{T (Q)} = \frac{D}{Q} \times A + \frac{Q}{2} \times h + ciD$$

This cost model is a step function, and not a continuous like the one given earlier. To understand how optimal order quantity can be determined in such a case, we would take an example:

D = 2000 units per annum

A = Rs 150 per order

h = 2.40 per unit per annum

Suppose now that the supplier informs that if the order size is at least 800 units, he is prepared to supply it at a discounted rate of Rs 9.80 per tube.

With the EOQ = 500 units

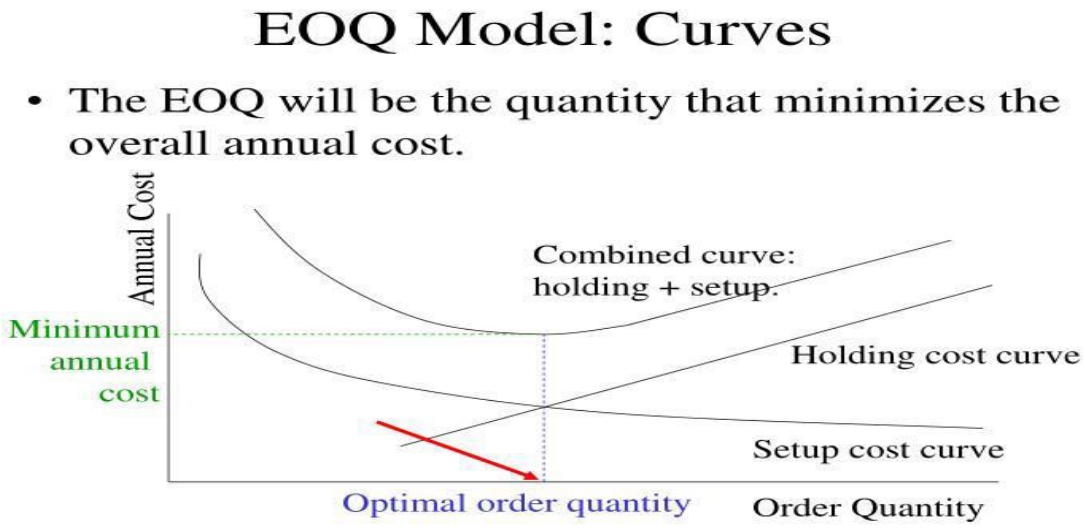
$$T(Q) = \frac{2000}{500} \times 150 + \frac{500}{2} \times 2.40 + 10 \times 2000$$

= Rs 20935

With the EOQ = 800 units

$$T(Q) = \frac{2000}{800} \times 150 + \frac{800}{2} \times 2.40 + 9.80 \times 2000$$

= 750/2 + 960 + 19600 = Rs 20935



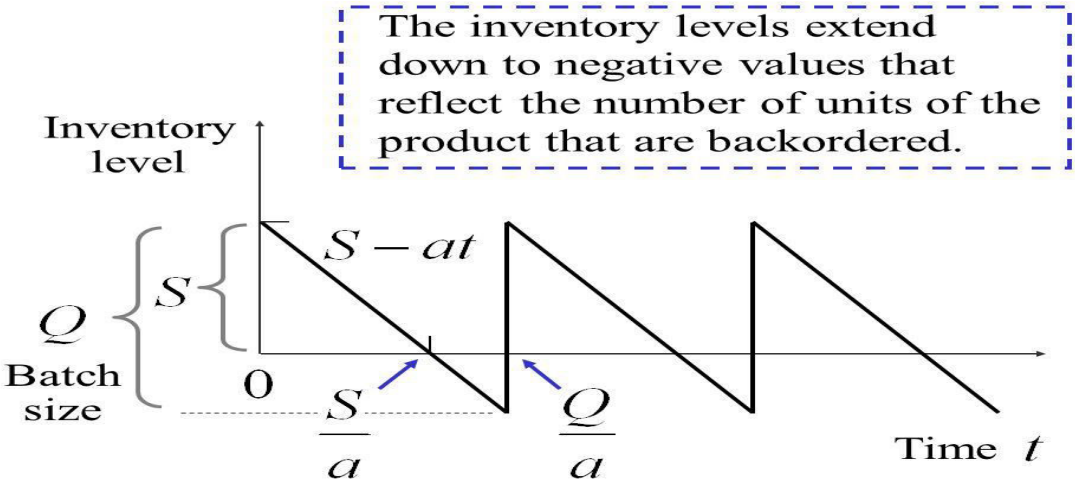
Cost Curve For the Price-Break Model

Clearly, the curve shows a sizeable drop in the cost due to the price discount at a quantity of 800 units. At this level, the total cost is lower than the total cost corresponding to 500 units.

Model 3: Inventory Model with Planned Shortages

In general inventory situations, a shortage is mainly undesirable and should be avoided because shortages can result in loss of customer goodwill, reduction in future orders, it may result in unfavorable changes in the market share etc. and in some situations, customers tend to move from a source to another for different requirements, and also customers may not withdraw the orders and wait until the next shipment arrives. This situation is also called the *back-ordering situation*. The EOQ model assumes that the inventory is replenished precisely when the inventory level falls off to zero. With the assumption of back ordering, Shortages, and therefore, the cost of shortage is not considered in that model. It may be advisable on economic considerations, specially, when the value of the item in question of setting off the cost of shortages against the saving in the holding cost.

Graph below shows negative inventory (zero level) i.e. number of units backordered. As soon as the lot of Q items is received, the customers whose orders are pending would be supplied their needs immediately and as such the maximum inventory level would be Q-S.



The EOQ Model with Planned Shortages

In developing the cost function, we would consider cost of shortages in addition to the holding and the ordering costs. Cost of shortages or the backordering cost is incurred in terms of the labour and special delivery expenses and the loss of customer goodwill.

Total Cost = Ordering Cost + Holding Cost + Shortage Cost

Ordering Cost: As seen before, if the cost of placing an order be A, and the total demand be D, we have,

Annual ordering Cost = D/Q x A

Holding Cost: It is the period in a given inventory cycle when positive inventory is held. Since the maximum inventory, M, is Q-S, the average inventory level equals (Q-S)/2. Thus,

Holding cost during a given cycle T = (Q-S)/ 2 x ht

From the above formulae, we observe that the quantity (Q-S) is sufficient to last a period.

Shortage Cost: We shall now develop expressions for the average number of shortages and the shortage cost with the help of which we shall determine the annual shortage cost. Since S represents the maximum level of shortages, the average level of shortages, during the period when there is a shortage shall be S/2.

From the analysis, the total cost expression would be:

$$T(Q) = \frac{D}{Q}A + (Q-S)^2 h/2Q + bS^2/2Q$$

Derived from the expression, Q* would be:

$$Q^* = \frac{\sqrt{2AD}}{h} \times \left(h + \frac{b}{b}\right)$$

$$= \sqrt{2AhD} + \sqrt{\frac{B}{H} + B}$$

Determination of the re-order level: The optimal shortage being 474 units and the consumption during the lead-time being equal to 8x15=120 units, the re-order level would be established at a point where the shortage reaches 474-120=354 units.

Therefore: Re-order level = -354 units (shortage level of 354 units).

8.6 Economic Manufacturing Batch Size:

The EOQ concept can be further extended to the determination of optimal manufacturing batch size for semi-finished and finished goods. If the batch size is large, then the average level of inventory is also large therefore the carrying costs for the inventory are high. But a few cases like, large batches of would suffice for the annual requirements, the number of set-ups would be low. On the other hand, when batch size is small, the order cost is higher, but at the same time, the average inventory level is smaller thus making the carrying cost lower. Thus, there is clear trade-off between costs involved.

Cost of Setup:

The set-up cost mainly includes the following:

1) Cost of time spent in setting up the equipments and organizing the labour for a manufacturing batch. This is the cost of the idle time of labour and the machinery, which would have otherwise produced goods. This is the opportunity cost of the time lost due to a set-up.
2) Cost due to rejects, scrap, rework generated during a set-up.
3) Variable cost of administrative paper work for a set-up.

Calculation of Economic Batch Quantity:

The Economic Batch Quantity (EBQ) Formula for a single product is:

This expression is similar to that derived for the classical inventory model except for the fact that it takes into consideration production and consumption rates of the product.

Example:

Compute the EBQ for manufacture given the following data:

Monthly demand = 500 units

Daily production rate = 25 units

Days in a month = 25 days

Cost of set–up = Rs. 1,500

Cost of holding inventory = Rs.10 per unit per year

Solution:

Annual Demand A = 500 x 12 = 6000 units per year

The daily consumption rate $r = \frac{\text{Monthly Consumption}}{\text{No.of days in a month}} = \frac{500}{25}$

=20 units per days

The above problem of optimal manufacturing batch size is confined to a case where only one product is being manufactured. In practice, a number of different products may be manufactured on the same plant facility. One might argue that the formula for the single product can be used to determine individually the optimal batch quantities for different products. Although this individual determination of the manufacturing batch sizes would produce most economical results as far as individual products are concerned, it might present some difficulties in a few cases.

When multiple products share the same plant facility, there are chances of interferences and therefore, stock-outs occur. Such interference between different products is experienced sometimes, when the products share the same equipment but the batch quantities are calculated independently. To avoid this kind of problem, it is suggested that the economic batch size of the products using the same plant facility be determined jointly. Therefore, there will be joint cycles of manufacture and in each joint cycle all the products will be manufactured in appropriate quantities. The determination of the economic batch sizes of the different products then amounts to the determination of the optimal number of joint cycles in a year; annual demand for a product divided by the optimal number of joint cycles gives the economic batch quantity for the product.

Since all the products, using the same plant facility, are manufactured, one after another in each optimal joint cycle, there is no question of shortage of any product at any time. The principle to be followed in joint cycle determination is similar to that for the determination of the optimal batch quantity for individual products. Numerical based on joint cycles are beyond the scope of this chapter.

8.7 Safety Stock

The inventory models discussed so far are based on the common assumption of constant and know demand for the item and the lead-time. Therefore, these models are called deterministic models. The models that consider the situation in which the demand and demand and/or lead-time are not known with certainty and they need not be constant is beyond the scope of this chapter. In these models, demand and lead time are taken as

random variables, capable of assuming varying values whose probability distribution may be known.

In the models, the stock is replenished as soon as the stock reaches the point of exhaustion, due to the assumption underlying them. Under such idealistic situation, there is no need to maintain any extra stock because the supplies would reach the moments the stock level reduce to zero and there would be no stock outs (unless they are intentionally allowed to occur). However when the demand is varying and so is the lead time, there is a need to provide for the safety or buffer stock in order to meet either or both the lead time, there is a need to provide for the safety or buffer stocks in order to meet either or both the contingencies, viz. that demand rate during the lead time is in excess of what was expected/forecasted and that the delivery of good is delayed. The safety stock, then acts as a cushion against stock-outs caused by random deviations of nature.

The safety stock is an important constituent of the re-order level that is determined as the expected demand of the item during lead time plus the safety stock. If the demand varies about the mean daily demand equal to d with the expected lead time equal to L days, and we set the re-order level R at L units, then we should expected a shortage to occur in about half the lead time periods. To reduces this 50% probability of being out of stock, the safety stock SS would be required to be kept. Thus,

Re-order level, R = L* d +S.S.

We know that in this system, an order is placed as soon as it reaches the re-order level. Therefore, how high or low is the rate of demand before the re-order level reaches is of little consequence. What is significant is the level of demand during the lead-time. Here fresh supplies are received as soon as the stock level reaches the safety level. In this kind of a situation, the average stock held would be exactly equal to SS + Q/2.

The idea of keeping the safety stock is clearly to prevent stock out and it is the amount of stock that the organization would always like preserve for meeting extraordinary situation. In general higher safety stock would be called for in situation where costs of stock out are larger; higher levels of service (i.e. meeting greater proportion of demand) are sought; significant variation are observed in the lead time and/or time demand; and where holdings costs are smaller. Naturally, the higher the level of safety stock the greater the service level and therefore to strike a balance between the two, The optimal safety stock

level is determined where successively declining stock out costs and successively rising holding costs, caused by the successive units added to the safety stock, would balance.

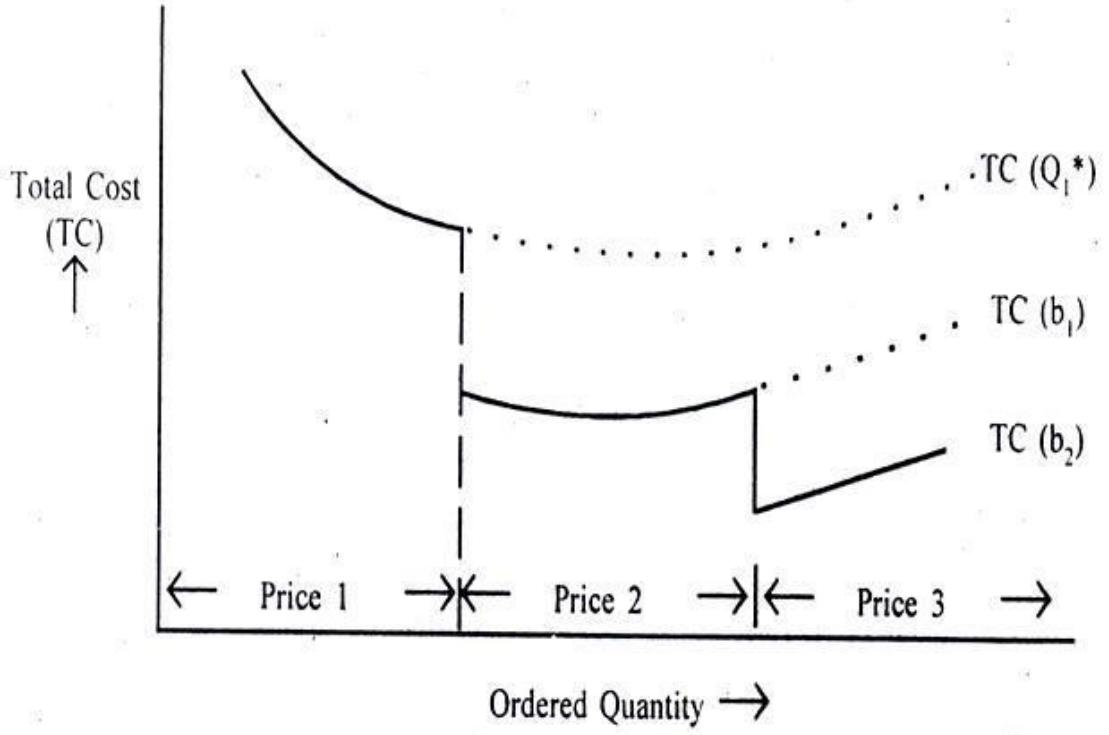
There is no rigid formulation for determining the optimum level of safety. The different approaches available for the purpose are based on the demand, the lead time and the stock out costs. The complexity of the situation is determined by the extent and nature is determined by the extent and nature of information available about these factors.

8.8 Inventory Model with Purchase Discounts:

The classical model for inventory does not take into account, amongst other things, the quantity discounts given by the supplier if material is purchased in bulk. As the discount might be relevant in the inventory analysis, this could be included in the total relevant cost and therefore in this case, the total cost function becomes:

Where is the supply price per unit of the inventory item and f is the carrying cost of the inventory expressed as a fraction of the inventory value.(Other nomenclature remains the same.)

Differentiating the total costs with respect to Q and equating the result to zero, we get the optimal procurement quantity.



At the two different prices (1 and 2) the $Q_{optimal}$ values are different. Which one shall we choose $Q_{optimal}$ for price 1 or $Q_{optimal}$ for price 2 the answer is not straightforward. We shall have to plot the total cost (relevant) with respect to the procurement lost size. For lot

sizes less than b price 1 is operative and we get a total cost curve corresponding to it. For lot sizes equal to or greater than b we get another total cost curve. These curves need not exhibit minima within their zone. Price 1 total cost curve can have a minimum in the zone where price 2 is operating. Conversely. Price 2 total cost curve can have a minimum in zone where price 1 is operating.

It should be noted that due to the earlier given equations, the total cost curve for the second price will always be lower than the total cost curve for the first price, the minimum total cost for the second price will be lower than the minimum total cost for price 1, and the $Q_{optimal}$ for price 2 will always be higher than $Q_{optimal}$ for price 1. In spite of this, the three possibilities arise.

Here again, it is obvious that we choose $Q_{optimal}$ in fact $Q_{optimal}$ does not exit. The lowest of the total cost at price 1 is at price 1 is lot size 'b' and this total cost will have to be higher than the total cost for $Q_{optimal.}$

Here price 2 curve shows a minimum in the price 1 zone and the minimum is therefore imaginary. Hence, the only choice is between $Q_{optimal}$ and the price break quantity (at which the real part of the price 2 curve begins). This can be decided by comparing the total costs corresponding to the two choices.

The determination of the optimal quantity in the case of purchase discounts, therefore, follows the procedure given below:

1. Calculate $Q_{optimal}$ the optimal lost size corresponding to price 2.
2. Find out if the $Q_{optimal}$ falls in its own range. If so, desired optimal order quantity is $Q_{optimal}$ if not, carry out the following procedure.
3. Compare the total cost at $Q_{optimal}$ with the total cost corresponding to the lost size 'b' (price break quantity) at the second price. If the former is less than the latter,

Choose $Q_{optimal}$ Otherwise, the optimal order quantity is equal to the price-break point.

Example: The supply of a special component has the following price schedule.

0 to 99 item: Rs 1000 per unit

100 items and above: Rs 950 per unit

The inventory holding costs are estimated to be 25% of the value of the inventory. The procurement ordering costs are estimated to be Rs. 2,000 per order. If the annual requirement of the special component is 300, compute the economic order for the procurement of these items.

Steps 2 and 3:

Therefore, we have to determine the optimal total cost for the first price and total cost at the price-break point corresponding to the second price, and compare the two.

The total cost (optimal for the first price)

$$=\sqrt{2x2000x1000x0.25x300 + 1000x300}$$

=17,320+300,000=Rs.3,17,320

The total cost for the price-break point (corresponding to the second price):

$$TC=200 \text{ x } \frac{300}{100} + \frac{100}{2} \text{ x } 950 \text{ x } 0.25 + 950 \text{ x } 300$$

=6,000 + 11,875 + 285,000

=3,02,875

This is lower than the total cost corresponding to $Q_{optimal.}$

Therefore, the economic quantity for a procurement lot is 100 units (price-break point).

Consideration of Uncertainties:

In the above given models for the determination of 'normal' inventory consumption rates were assumed to be constant. In actual practice, there are always uncertainties stemming from two basic reasons:

1. Variability in sales, hence variability in the demand for the materials or the consumption of the materials
2. Delay in the supplies of raw materials.

8.9 Summary:

- Inventory serves a useful purpose in the manufacturing organizations. Firms can help minimize the need for inventory by carefully managing those factors that drive inventory levels up
- Inventory items can be divided into two main types: Independent demand and dependent demand items. The systems for managing these two types of demand, inventories differ significantly
- The two classic systems for managing independent demand inventory are periodic review and perpetual review systems
- The economic order quantity (EOQ) is the order quantity that minimizes total holding and ordering costs for the year. Even if all the assumptions don't hold exactly, the EOQ gives us a good indication of whether or not current order quantities are reasonable

- The reorder point formula allows us to determine the safety stock (SS) needed to achieve a certain cycle service level. In general, the longer the lead times are, and the greater the variability of demand and lead times, the more SS we will need
- Inventories are vital to the successful functioning of manufacturing and retailing organizations
- The basic questions to keep in mind before getting any inventory:
  a) How much inventory to keep
  b) When to keep the inventory in the warehouse
- Buffer stock is kept for review period + lead-time
- Maximum inventory on hand is (Normal consumption + Buffer Stock) both for review period plus on order.

8.10 Keywords:

- ***Inventory:*** is working capital and therefore the control of inventories is an important aspect of operations management
- ***Lead Time:*** The time elapsing between placing an order and having goods in stock
- ***Procurement costs:*** associated with processing and chasing of an order, transportation, inspection for quality, expediting overdue orders and so on

8.11 Self-assessment Questions:

1. Define inventory. Discuss various types of inventory costs.
2. Discuss various types of inventories.
3. What are the basic assumptions underlying the classical EOQ model? Also discuss its limitations.
4. What is the set-up cost of manufacture?
5. Discuss economic batch quantity with suitable example.

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Subject: Supply Chain Management	
Course Code: POM – 323	Author: Prof (Dr) Hemant Sharma
Lesson No.: 9	Vetter:
Transportation Infrastructure, Facility Location, Material Handling	

Structure:

9.0 Objective

After reading this chapter, you would be able to understand:

- The factor affecting the location of any facility
- Methods to be used to decide the location of facility
- Significance of material handling
- Transportation infrastructure and logistics

9.1 Introduction

Supply Chain Management (SCM) can be divided into three main areas: purchasing, manufacturing, and transport. From end to end, this includes decisions about which input materials to use, production quantities, inventory levels, distribution network configuration, and transportation for both the input materials as well as for the finished products. Logistics Management is the component of SCM that focuses on how and when to get raw materials, intermediate products, and finished goods from their respective origins to their destinations. Today, international trade is commonplace and increasing market share in emerging markets is highly desirable. It is therefore safe to say goods are rarely consumed where they are produced, and transportation services are the essential trait union between all of the elements of the Supply Chain. Effective, cost efficient Logistics Management can be a real point of competitive differentiation.

The efficient and effective movement of goods from raw material sites to processing facilities, component fabrication plants, finished goods assembly plants, distribution centers, retailers and customers is critical in today's competitive environment. Approximately 10% of the gross domestic product is devoted to supply related activities. Supply chain management entails not only the movement of goods but also decisions about:

(1) Where to produce, what to produce, and how much to produce at each site,

(2) What quantity of goods to hold in inventory at each stage of the process,

(3) How to share information among parties in the process and finally,

(4) Where to locate plants and distribution centers.

Location decisions may be the most critical and most difficult of the decisions needed to realize an efficient supply chain. Transportation and inventory decisions can often be changed on relatively short notice in response to changes in the availability of raw materials, labor costs, component prices, transportation costs, inventory holding costs, exchange rates and tax codes. Information sharing decisions are also relatively flexible and can be altered in response to changes in corporate strategies and alliances. Thus, transportation, inventory, and information sharing decisions can be readily re optimized in response to changes in the underlying conditions of the supply chain. Decisions about production quantities and

locations are, perhaps, less flexible, as many of the costs of production may be fixed in the short term. Labor costs, for example, are often dictated by relatively long-term contracts. Also, plant capacities must often be taken as fixed in the short-term. Nevertheless, production quantities can often be altered in the intermediate term in response to changes in material costs and market demands. Facility location decisions, on the other hand, are often fixed and difficult to change even in the intermediate term. The location of a multibillion-dollar automobile assembly plant cannot be changed as a result of changes in customer demands, transportation costs, or component prices. Modern distribution centers with millions of dollars of material handling equipment are also difficult, if not impossible, to relocate except in the long term. Inefficient locations for production and assembly plants as well as distribution centers will result in excess costs being incurred throughout the lifetime of the facilities, no matter how well the production plans, transportation options, inventory management, and information sharing decisions are optimized in response to changing conditions.

However, the long-term conditions under which production plants and distribution centers will operate is subject to considerable uncertainty at the time these decisions must be made. Transportation costs, inventory carrying costs (which are affected by interest rates and insurance costs), and production costs, for example, are all difficult to predict. Thus, it is critical that planners recognize the inherent uncertainty associated with future conditions when making facility location decisions. Vehicle routing and inventory decisions are generally secondary to facility location in the sense that facilities are expensive to construct and difficult to modify, while routing and inventory decisions can be modified periodically without difficulty. Nevertheless, it has been shown empirically for both location/routing and location/inventory problems that the facility location decisions that would be made in isolation are different from those that would be made taking into account routing or inventory. Similarly, planners are often reluctant to consider robustness and reliability at design time since disruptions may be only occasional; however, large improvements in reliability and robustness can often be attained with only small increases in the cost of the supply chain network.

9.2 Facility Location

Location decisions are a basic determinant of profitability in international logistics. Decisions on where to manufacture, to assemble, to store, to transship and to consolidate can make the difference between profit and loss. Because of international differences in basic factor costs and because of exchange rate movements, location decisions are very important. Also, these decisions involve substantial involvement in fixed assets in the form of facilities and equipment. Location decisions, therefore, can have a continuing impact over time on the company's financial and competitive position. As movement towards global manufacturing increases, organizations should consider location decisions through total cost analysis which includes activity related costs such as manufacturing, transportation and handling as well as inventory holding costs, tariffs, and taxes.

The fixed charge facility location problem is a classical location problem and forms the basis of many of the location models that have been used in supply chain design. The problem can be stated simply as follows. We are given a set of customer locations with known demands and a set of candidate facility locations. If we elect to locate a facility at a candidate site, we incur a known fixed location cost. There is a known unit shipment cost between each candidate site and each customer location. The problem is to find the locations of the facilities and the shipment pattern between the facilities and the customers to minimize the combined facility location and shipment costs subject to a requirement that all customer demands be met.

Once a set of facilities has been built, one or more of them may from time to time become unavailable ñ for example, due to inclement weather, labor actions, natural disasters, or changes in ownership. These facility failures may result in excessive transportation costs as customers previously served by these facilities must now be served by more distant ones. In this section, we discuss models for choosing facility locations to minimize fixed and transportation costs while also hedging against failures within the system. We call the ability of a system to perform well even when parts of the system have failed the reliability of the system. The goal, then, is to choose facility locations that are both inexpensive and reliable.

The problem of facility location is faced by both new and existing businesses, and its solution is critical to a company's eventual success. An important element in designing a company's supply chain is the location of its facilities. Criteria that influence manufacturing plant and warehouse location planning are discussed next.

a.) Proximity to Customers

For example, Japan's NatSteel Electronics has built its two largest plants in Mexico and Hungary to be closer to major markets in the United States and Europe—whose buyers want their goods delivered yesterday. Such proximity also helps ensure that customer needs are incorporated into products being developed and built.

b.) Business Climate

A favorable business climate can include the presence of similar-sized businesses, the presence of companies in the same industry, and, in the case of international locations, and the presence of other foreign companies. Pro-business governmentlegislation and local government intervention to facilitate businesses locating in an area via subsidies, tax abatements, and other support are also factors.

c.) Total Costs

The objective is to select a site with the lowest total cost. This includes regional costs, inbound distribution costs, and outbound distribution costs. Land, construction, labor, taxes, and energy costs make up the regional costs. In addition, there are hidden costs that are difficult to measure. These involve (1) excessive moving of preproduction material between locations before final delivery to the customers and (2) loss of customer responsiveness arising from locating away from the main customer base.

d.) Infrastructure

Adequate road, rail, air, and sea transportation are vital. Energy and telecommunications requirements also must be met. In addition, the local government's willingness to invest in upgrading infrastructure to the levels required may be an incentive to select a specific location.

e.) Quality of Labor

The educational and skill levels of the labor pool must match the company's needs. Even more important are the willingness and ability to learn.

f.) Suppliers

A high-quality and competitive supplier base makes a given location suitable. The proximity of important suppliers'plants also supports lean production methods.

g.) Other Facilities

The location of other plants or distribution centers of the same company may influence a new facility's location in the network. Issues of product mix and capacity are strongly interconnected to the location decision in this context.

h.) Free Trade Zones

A foreign trade zone or a free trade zone is typically a closed facility (under the supervision of the customs department) into which foreign goods can be brought without being subject to the normal customs requirements. There are about 170 such free trade zones in the United States today. Such specialized locations also exist in other countries. Manufacturers in free trade zones can use imported components in the final product and delay payment of customs duties until the product is shipped into the host country.

i.) Political Risk

The fast-changing geopolitical scenes in numerous nations present exciting, challenging opportunities. But the extended phase of transformation that many countries are undergoing makes the decision to locate in those areas extremely difficult. Political risks in both the country of location and the host country influence location decisions.

j.) Government Barriers

Barriers to enter and locate in many countries are being removed today through legislation. Yet many non-legislative and cultural barriers should be considered in location planning.

k.) Trading Blocs

The world of trading blocs gained a new member with the ratification of the North American Free Trade Agreement (NAFTA). Such agreements influence location decisions, both within and outside trading bloc countries. Firms typically locate, or relocate, within a bloc to take advantage of new market opportunities or lower total costs afforded by the trading agreement. Other companies (those outside the trading bloc countries) decide on locations within the bloc so as not to be disqualified from competing in the new market. Examples

include the location of various Japanese auto manufacturing plants in Europe before 1992 as well as recent moves by many communications and financial services companies into Mexico in a post-NAFTA environment.

l.) Environmental Regulation

The environmental regulations that impact a certain industry in a given location should be included in the location decision. Besides measurable cost implications, these regulations influence the relationship with the local community.

9.3 Factors Influencing Factory Location

- Labor availability, Labor cost, Labor Skills;
- Materials Availability, Material cost, material quality;
- Equipment availability, Equipment Cost;
- Land availability, Land suitability, Land cost;
- Energy availability, energy cost;
- Water availability, water quality, water cost.
- Government Stability, Government taxes, Import and Export restrictions.
- Quality of life, Cultural issues,
- Environmental regulations, Transportation availability, Transportation cost
- Availability of Financial Institutions, Strength of Financial Institutions
- And finally, Competitors' size, strength and attitude in that region.

9.4 Location Selection Methods

1. FACTOR Rating System

This consists of a weighted list of factors which company considers the most important and a range of values for each factor.

In factor rating method, first we must identify the Most Important Factors in evaluating alternative sites for the new facility.

Then we should assign a weight between 0 and 100 to each of these factors.Each alternative location will then be rated based on these factor weights.

The most weighted alternative is selected as the best alternative.

Factor-rating systems are perhaps the most widely used of the general location techniques because they provide a mechanism to combine diverse factors in an easy-to-understand format. By way of example, a refinery assigned the following range of point values to major factors affecting a set of possible sites:

Region
Fuels in region 0 to 330
Power availability and reliability 0 to 200
Labor climate 0 to 100
Living conditions 0 to 100
Transportation 0 to 50
Water supply 0 to 10
Climate 0 to 50
Supplies 0 to 60
Tax policies and laws 0 to 20

Each site was then rated against each factor, and a point value was selected from its assigned range. The sums of assigned points for each site were then compared. The site with the most points was selected. A major problem with simple point-rating schemes is that they do not account for the wide range of costs that may occur within each factor. For example, there may be only a few hundred dollars' difference between the best and worst locations on one factor and several thousands of dollars' difference between the best and the worst on another.

The first factor may have the most points available to it but provide little help in making the location decision; the second may have few points available but potentially show a real difference in the value of locations. To deal with this problem, it has been suggested that points possible for each factor be derived using a weighting scale based on standard deviations of costs rather than simply total cost amounts. In this way, relative costs can be considered.

2. Point Rating System

Very similar to previous method. Only difference is that futuristic scope of all important factors is considered.

Locating Service Facilities

Because of the variety of service firms and the relatively low cost of establishing a service facility compared to one for manufacturing, new service facilities are far more common than new factories and warehouses. Indeed, there are few communities in which rapid population growth has not been paralleled by concurrent rapid growth in retail outlets, restaurants, municipal services, and entertainment facilities.

Services typically have multiple sites to maintain close contact with customers. The location decision is closely tied to the market selection decision. If the target market is college-age groups, locations in retirement communities—despite desirability in terms of cost, resource availability, and so forth—are not viable alternatives. Market needs also affect the number of sites to be built and the size and characteristics of the sites. Whereas manufacturing location decisions are often made by minimizing costs, many service location decision techniques maximize the profit potential of various sites.

Facility location decisions are a key element in any firm's overall strategic plan. Dramatic changes in the global geopolitical environment, coupled with rapid advances in technology, have placed a premium on making location decisions in a matter of weeks rather than months, as has been the case in the recent past. As a final comment, much of the location "action" is in deciding where to locate support functions rather than factories or retail outlets. In these situations the need for special capabilities of the workforce is often far more important than other cost factors. For example, IBM Business Consulting Services stated that

a dominant factor in deciding where to locate the software application group of its client, a U.S. investment bank, was the availability of a large pool of multilingual workers.

9.5 Material Handling

Material handling (MH) involves "short-distance movement that usually takes place within the confines of a building such as a plant or a warehouse and between a building and a transportation agency."1 It can be used to create "time and place utility" through the handling, storage, and control of material, as distinct from manufacturing (i.e., fabrication and assembly operations), which creates "form utility" by changing the shape, form, and makeup of material.2 It is often said that MH only adds to the cost of a product, it does not add to the value of a product. Although MH does not provide a product with form utility, the time and place utility provided by MH can add real value to a product, i.e., the value of a product can increase after MH has taken place; for example:

The value (to the customer) added by the overnight delivery of a package (e.g., Federal Express) is greater than or equal to the additional cost of the service as compared to regular mail service—otherwise regular mail would have been used.

The value added by having parts stored next to a bottleneck machine is the savings associated with the increase in machine utilization minus the cost of storing the parts at the machine

Material Handling:

- Moving of goods between incoming transport, storage, processes and outgoing transport
- The set of activities that move production inputs and other goods within plants, warehouses and transportation terminals**.**

Providing the right amount of material:

- in the right condition
- at the right place
- at the right time
- in the right position
- in the right sequence
- for the right cost

- By using the right methods.

Material handling cannot be avoided in logistics, but can certainly be reduced to minimum levels. The productivity potential of logistics can be exploited by selecting the right type of handling equipment. The selection of material handling equipment cannot be done in isolation, without considering the storage system. Investment in the material handling system will be sheer waste if it is not compatible to the warehouse layout plan. The layout will create obstacles for free movement of equipment and goods, resulting in poor equipment productivity. Recent trends indicate preference for automated system with higher logistics productivity to enhance the effectiveness of human energy in material movement.

In the last several years material handling has become a new, complex, and rapidly evolving science. For moving material in and out of warehouse many types of equipment and system are in use, depending on the type of products and volume to be handled. The equipment is used, in loading and unloading operations, for movement of goods over short distances. The handling of material in warehouse is restricted to unitized forms, which require smaller size equipment. However, for bulk handling of material at logistics nodes such as shipyards, ports and airports different type of equipment is used. In warehouses, material handling operation is performed at the following stages:

• Unloading the incoming material from transport vehicle.

• Moving the unloaded material to assigned storage place in warehouses.

• Lifting the material from its storage place during order picking.

• Moving the material for inspection and packing.

• Loading packages/boxes/cartons on to transport vehicles.

The efficiency of material handling equipments adds to the performance level of the warehouse. The internal movement of goods has a direct bearing on the order picking and fulfillment cycle. The warehouse, wherein the material handling equipments is in use, is more sensitive to labor productivity than the manufacturing center as material handling is more labor intensive. There is a scope for reducing labor and enhancing productivity by emerging technology in material handling. A good material handling system will enhance the speed and throughput of material movement through the supply chain.

9.6 Design & Principles of Material Handling

A common approach to the design of MH systems (MHSs) is to consider MH as a cost to be minimized. This approach may be the most appropriate in many situations because, while MH can add real value to a product, it is usually difficult to identify and quantify the benefits associated with MH; it is much easier to identify and quantify the costs of MH (e.g., the cost of MH equipment, the cost of indirect MH labor, etc.). Once the design of a production process (exclusive of MH considerations) is completed, alternate MHS designs are generated, each of which satisfies the MH requirements of the production process. The least cost MHS design is then selected.

The appropriateness of the use of MHS cost as the sole criterion to select a MHS design depends on the degree to which the other aspects of the production process are able to be changed. If a completely new facility and production process is being designed, then the total cost of production is the most appropriate criterion to use in selecting a MHS—the lowest cost MHS may not result in the lowest total cost of production. If it is too costly to even consider changing the basic layout of a facility and the production process, then MHS cost is the only criterion that need be considered. In practice, it is difficult to consider all of the components of total production cost simultaneously, even if a new facility and production process is being designed. Aspects of the design that have the largest impact on total cost are at some point fixed and become constraints with respect to the remaining aspects of the design.

Principles

Although there are no definite "rules" that can be followed when designing an effective MHS, the following "Ten Principles of Material Handling,"3 as compiled by the College-Industry Council on Material Handling Education (CIC-MHE) in cooperation with the Material Handling Institute (MHI), represent the distillation of many years of accumulated experience and knowledge of many practitioners and students of material handling:

- Planning Principle: All MH should be the result of a deliberate plan where the needs, performance objectives, and functional specification of the proposed methods are completely defined at the outset.

- Standardization Principle: MH methods, equipment, controls and software should be standardized within the limits of achieving overall performance objectives and without sacrificing needed flexibility, modularity, and throughput.
- Work Principle: MH work (defined as material flow multiplied by the distance moved) should be minimized without sacrificing productivity or the level of service required of the operation.
- Ergonomic Principle: Human capabilities and limitations must be recognized and respected in the design of MH tasks and equipment to ensure safe and effective operations.
- Unit Load Principle: Unit loads shall be appropriately sized and configured in a way that achieves the material flow and inventory objectives at each stage in the supply chain.
- Space Utilization Principle: Effective and efficient use must be made of all available (cubic) space.
- System Principle: Material movement and storage activities should be fully integrated to form a coordinated, operational system which spans receiving, inspection, storage, production, assembly, packaging, unitizing, order selection, shipping, and transportation, and the handling of returns.
- Automation Principle: MH operations should be mechanized and/or automated where feasible to improve operational efficiency, increase responsiveness, improve consistency and predictability, decrease operating costs, and to eliminate repetitive or potentially unsafe manual labor.
- Environmental Principle: Environmental impact and energy consumption should be considered as criteria when designing or selecting alternative equipment and MHS.
- Life Cycle Cost Principle: A thorough economic analysis should account for the entire life cycle of all MHE and resulting systems.

9.7 Material Handling System Types

Materials handling systems provide transportation and storage of materials, components and assemblies. Material handling activities start with unloading of goods from delivery transportation, the goods then pass into storage, onto machining, assembly, testing, storage, packaging, storage, and finally loading onto transport. Each of these stages of the production process requires a slightly different design of handling equipment, and some processes

require integration of multiple items of handling equipment. Design or selection of the right material handling system is one of the most important decisions that a manager can make, because of the effects on the rest of the manufacturing plant. It affects the material flow and the factory layout.

Apart from the initial capital cost for a new system, the consequences of any misjudgment in material handling will have considerable and long-term effects on operations. In recent years computer based simulation tools have been developed to simulate material handling systems and their effect on the manufacturing process. Loading equipment is aimed at providing the capability to load and unload vehicles; it is also referred to as loading bay equipment.

The category can be divided into products that provide access from the loading bay to the vehicle and equipment that moves the product from the loading bay to the vehicle and vice versa. Equipment that falls into the access category are scissor lifts, goods lifts, dock levelers, loading ramps, doors, dock seals and vehicle restraints, and equipment that falls into the movement category are pallet trucks, conveyors and fork lift trucks.

- Lifting and Transport Equipment: Lifting and transport equipment is used to move product around the production facility, from loading bay to storage, from storage to production, around production, from production to storage, and from storage to loading bay. Equipment that falls into this category are fork lift trucks, order picking trucks, overhead cranes, tower cranes and belt, chain and overhead conveyors.
- Storage Equipment Storage equipment: As the name suggests is used to store materials, components and assemblies. The level of complexity of this type of equipment is wide ranging, from a welded cantilever steel rack to hold lengths of stock materials to a powered vertical carousel system. Also within this category are pallet racks, mobile shelf units, and plastic, wood and steel containers.
- Automated Handling Equipment: Manufacturers of automated handling equipment produce automated guide vehicles, storage and retrieval equipment, conveying systems and product sortation equipment. The level of automation varies depending on the handling requirements. Fully automated handling systems ensure that the materials/components/assemblies are delivered to the production line when required without significant manual intervention. Semi-automatic handling systems provide less

advanced solutions that deliver materials/components/assemblies to the production line with some manual intervention.

- Automated Guided Vehicles (AGVs): An AGV is a material handling device that is used to move parts between machines or WorkCentre. They are small, independently powered vehicles that are usually guided by cables that are buried in the floor or they use an optical guidance system. They are controlled by receiving instructions either from a central computer or from their own on-board computer. In some applications they can be used as mobile workstations to replace the more traditional conveyor system.
- Robotics: Robotics was first introduced 30 years ago. Since then their applications and versatility have increased dramatically. The basic robotics technology is similar to CNC technology but most robots have more degrees of freedom. In manufacturing applications, robots can be used for assembly work, process such as painting, welding, etc. and for material handling. More recently robots are equipped with sensory feedback through vision and tactile sense. The main advantage of robots is that they can be used for repetitive, monotonous, mundane tasks that need precision. They can also be used in hazardous environments that are not suitable for human operators.

9.8 Summary

Location decisions are the strategic decisions that require large financial investments and they are irreversible in nature. A number of factors like market related factors, tangible or cost factors and intangible or qualitative factors affect and are affected by the location choice. Models and techniques such as break-even analysis, factor rating technique, transportation method of linear programming, centre of gravity method, and analytical Delphi method help managers in making location decisions. Since these models work on quantitative basis; therefore the influence of qualitative factors should be considered by managers to decide the location choice

The physical disposition of the facilities of a plant is referred to as the plant layout. The basic types of layouts are: process layout, product layout, fixed-position layout, cellular manufacturing layout and hybrid layout. Material handling is the movement, protection, storage and control of materials and products throughout manufacturing, warehousing, distribution, consumption and disposal. As a process, material handling incorporates a wide

range of manual, semi-automated and automated equipment and systems that support logistics and make the supply chain work. A company's material handling system and processes are put in place to improve customer service, reduce inventory, shorten delivery time, and lower overall handling costs in manufacturing, distribution and transportation.

9.9 Keywords

Transportation
Facility Location
Material handling
Pallet trucks
Platform truck
Stacker Crane

9.10 Self Assessment Questions

1) What do you think about the significance of material handling in service industry? How is it different than that of manufacturing organizations?
2) Explain the factors to be considered while selecting a suitable material handling equipments.
3) Discuss in detail the factors to be considered while deciding a suitable location of the facility.
4) Discuss the various means of transportations.

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Subject: Supply Chain Management	
Course Code: POM – 323	Author:
Lesson No.: 10	Vetter:
Strategic Considerations in Supply Chain & Effectiveness of Supply Chain Management	

Structure

10.0 Objectives:

This chapter will help you to understand the:

1) Basic functions of Supply Chain;
2) Critical success factors in a Supply Chain;
3) Globalization of supply chain;
4) Different approaches to control the inventory level;
5) The concept of safety stocks

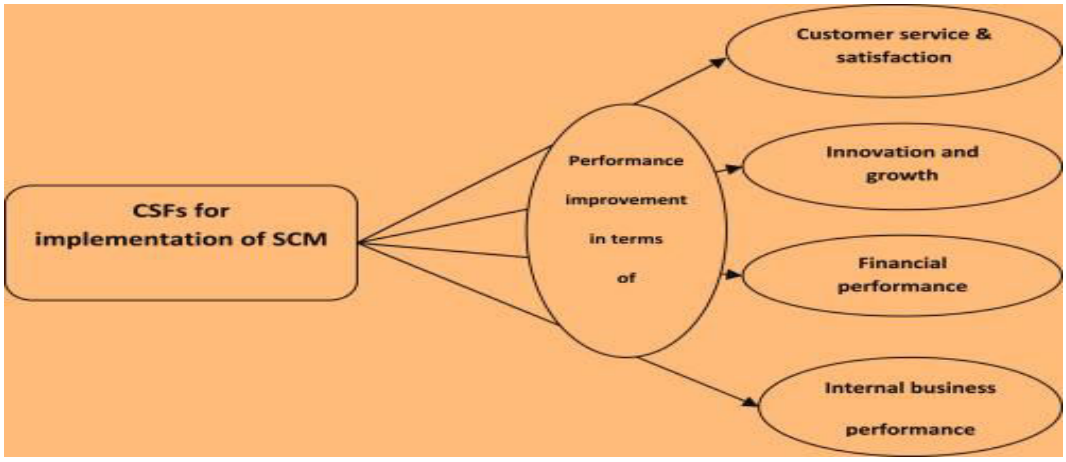
10.1 Introduction:

Supply chain effectiveness is very important for commercial success and in order to stand out from the rest. To effectively compete in the global market, all organizations should focus on improving the effectiveness of operational functions with effective supply chain management. In other words, successful implementation of supply chain management (SCM) can give companies an edge over their competitors. Effective supply chain management along with technology are a must have for any organization but effectiveness of supply chain requires meeting two main challenges - a strategic challenge and an integration challenge. Deciding what to outsource and when to partner is important for strategic decisions, whereas the capability to align interests, develop partnership networks and manage complexity and risks across the extended enterprise is vital for integration.

But it's easier said than done; problems in SCM implementation occur due to lack of resources and direction. Commitment of the Top management, development of effective SCM strategy, devoted resources for supply chain, logistics synchronization, information sharing with supply chain members, use of modern technologies, forecasting of demand based on point of sales (POS), developing just in time (JIT) capabilities in the system, development of reliable suppliers, higher flexibility in production system, focus on core strengths, and long-term vision for survival and growth are some critical factors(CSFs) which contribute towards the success of any supply chain. These factors represent a wide variety of strategies dedicated to improving operational efficiency and competitiveness of companies.

10.2 Critical Success Factors (CSFs) in a Supply Chain:

CSFs of SCM implementation lead to performance improvement of a company on different categories, which ultimately lead to the success of the company.



Let’s discuss each of the CSFs in detail here

1) Commitment of the Top Management

The main responsibility of the top management is to provide sufficient financial support and adequate resources for building a successful system. Further, the support of the top management will be required to ensure that SCM implementation has high priority within the organization and that it will receive the necessary resources and attention. Apart from such primary support, psychological support is also important for the smooth implementation of SCM. top management support is very much necessary for cross-functional training, integration of departments within the organization and vendor development for a responsive supply chain.

2) Information sharing with supply chain members:

Keeping the chain members informed is of utmost importance in order to generate trust among supply chain partners and have better coordination between them. Trust is required for flow of information in the supply chain. Risk and reward sharing influence an individual supply chain member's behavior and his interaction with other supply chain members. Conflicts of interest can occur when one supply chain member gets more benefits when compared to other members from an existing risk and reward sharing process. Use of information technology(IT) such as internet, intranet, software applications packages and decision support systems can be applied to facilitate the information flow within the supply chain, between the members of the supply chain.

Collaborative decision making by supply chain members results in better forecasting of demand, trust between the supply chain members, and flow of information.

3) Use of modern technologies:

Lack of awareness of the technologies and their benefits has lead to inefficiencies in supply chain as a result of time lag in various processes. Information sharing means sharing of the inventory data, demand data, and product quality data. Periodic ordering in large batches between the manufacturer and retailer could distort original demand information due to large variance.

Information technology (IT) has gained a lot of importance in SCM implementation in recent years. Increasingly, supply chain operations are changing from electronic data interchange systems and enterprise resource planning systems to internet/intranet to support SCM. Use of modern technologies in SCM can lead to advantages such as cost saving, quality improvement, delivery and support, and greater competitive advantage.

4) Trust among supply chain members

Trust among supply chain members is another vital aspect for improving coordination between the partners. Trust is a favorable attitude that exists when one supply chain member has confidence in other supply chain members. It is required for flow of information in the supply chain. Collaborative decision making by supply chain members results in better forecasting of demand, increases trust between the supply chain members, and smoothens flow of information.

5) Risk and reward sharing

Risk and reward sharing influence a supply chain member's behavior and his interaction with other supply chain members. Conflicts of interest tends to occur when one supply chain member gets more benefits than what other members get from an existing risk and reward sharing process. Hence trust and commitment are essential for enhancing performance.

6) Forecasting of demand on point of sale (POS)

Availability of point of sales (POS) data is important in an effective supply chain. Since companies are under strong pressure to decrease cost, an appropriate inventory management system at every point of the supply chain reduces the inventory at supply chain nodes.

Hence effectiveness of a supply chain can be improved if focus is on product customization, waste reduction, and IT applications to reduce time lag in various processes.

10.3 Globalization of Supply Chain

In recent years, the pressure to find consumer responsive and cost efficient solution to supply chain issues in a market has forced closer partnership between retailers and manufacturers in order to fight the challenges that result from different information and

the bullwhip effect. Many firms can no longer afford to have their supply chain located in a single country. If they do, they run the risk of becoming less competitive and delivering less value than they are actually capable of delivering. The main reason is that the location at which a firm chooses to get its raw materials from, to hire its labor, to locate its manufacturing facilities and to fulfill the demand can greatly influence a firm's cost-benefit measures and its investment decisions.

While designing an effective global supply chain is a challenge, it can be a fruitful one because it can create more valuable products/services that a firm delivers. This growing concern has created a motivation for more effective and efficient design of supply chains and of management in utilizing consumer response. In a global market, supply chain management is more complicated since suppliers and partners are located in different countries and the traditional logistics of facility location, sourcing, and distributions are greatly influenced by political and economic factors. Varying taxes and customs rules, production expenses, multiple currencies and numerous transportation problems are among the challenges of linking a global supply chain. not to ignore the cultural and social challenges that the firm faces when they begin to establish their foothold in a new socio-cultural environment in a different county. the various decisions the company has to make while expanding into new market. The strategy that they will adopt, as discussed in the next section 4.3, whether they want to start organically by expanding their own business in the new location or inorganically by merger or acquisitions, is the question to start with.

All said globalization of supply chain provides a flexibility which also enhances the supply chain design capability. Reduced costs of logistics across the globe have added to globalization of businesses.

10.4 Strategic considerations in Supply Chain:

There are various strategies used by the marketer to cope with the changing market conditions. Those companies who adopt the change in the market demand, change in the market conditions and change in the consumer preferences will survive the market. Therefore, it is important for all the companies to have good market research department and have regular and immediate information system to provide relevant necessary change in the supply chain according to the change in the market conditions, change in the consumer preferences, change in the competitor's strategies etc. The major strategies followed by companies are:

1. Using a wide mix of operational approaches to provide supply chain initiative to emerging market initiatives
2. Pairing a low cost structure with a focus on quality and market knowledge to access the new market and provide differentiation
3. Taking advantage of technology extensively to increasing efficiency, improve flexibility and augment decision making
4. Investing aggressively in supply chain operations to keep pace with changing market dynamics.
5. Investing heavily on R&D to encourage innovation and growth, and always have a competitive edge over competitors.

As the change in the market forces the change in the market demand there is change in the supply chain management. Also as the customer preferences change, there is change in the supply chain. Growing complexities of market promotes innovation required in the supply chain management which is a major challenge in the current market condition. The diversity of growing market condition becomes a growing concern for the marketer to how to design their supply chain according to the market and its changing scenario.

Introduction of new products with shorter life spans, intense competition in today's global markets, and the higher expectations of customers have contributed to the development of new approaches to supply chain management. Traditionally, raw materials are acquired and items are produced at one or more factories, shipped to warehouses for storage, and then shipped to retailers or customers. Therefore, in order to reduce costs and improve service levels, effective supply chain strategies must take the exchanges at various levels of the supply chain into consideration.

10.5 Effectiveness of Supply Chain Management

In order to make the supply chain effective certain points have to be kept in mind:

1. The direction, alignment, and capabilities of the supply chain must be clear to all employees.
2. Selected parts of the strategy need to be shared with strategic suppliers and business customers.
3. Customers need to understand how the company will serve them.
4. Capital and operating expenses need to be planned.

The supply chain or operations strategy is mission critical for enabling business strategies. Its development should be multi-functional, inclusive, collaborative, and adopted. Its implementation should be integrated with other company processes, strategic suppliers, and selected customers. Also its implementation should be tracked, checked, and adjusted as appropriate.

Below are some important steps required to develop an effective supply chain strategy:

1. Take a complete view:

Supply chain management requires more than just sales and inventory information. Forecasting techniques have become much more reliable and coarse. Forecasting tools supported by high-performance computing resources can generate reliable forecasts based on sales data as well as demographic data, geographic trends, and even weather forecasts. The supply chain strategy must involve integrating the flow of information both upstream and downstream so that all stakeholders can respond to these demand signals in a timely manner.

2. Pay attention to industry trends:

Each industry has its own set of demand drivers, industry standards, and supply chain management code of conduct, which change over time. While one can't reconfigure the supply chain strategy in response to every temporary technology fad, it's not too difficult to see which way to go when it comes to major shifts.

If a number of suppliers start to demand certain types of information or are shifting to just-in-time supply models, or coming together around a particular data standard, the company should at least prepare to change its supply chain strategy so that they are ready to adapt to the changes when it is required. A worse strategy is to be inflexible and resists to technology investments. If a company winds up on the exterior of what has become an industry standard, it could cost them a lot more as business will be lost in the long term.

3. Understand your company's unique value proposal: Knowing the firm's competitive positioning within the supply chain, the minimum requirements that will make the firm an option for customers, and the elements can differentiate the product or service from competitors in the supply chain - the firm's strategy should focus on that differentiation, and the added value that the product can provide through the supply chain.

4. Incorporate risk management: Identify the risks to optimal performance, both internal and external; Important steps in doing that are - knowing the weakest links in the supply chain and ways to mitigate those risks, coming up with action plans, identifying alternate suppliers or transportation resources, and assigning team members for specific response actions when there is a breakdown in the supply chain.

Implement the supply chain strategy in such a way that the firm can continuously monitor performance and adjust accordingly to enable improvement. By implementing a continuous improvement process, the supply chain strategy can quickly adapt and respond to changes in the market, customers and suppliers demands.

10.6 Summary:

Supply chain management is a frequently encountered phrase these days, as managers strive to improve factory performance. The trouble is that all too often the real meaning is lost. Instead, a casual observer might interpret the activities at the factory as evidence of an intensive effort to improve supplier management. Good supplier management, while praiseworthy, does not constitute good supply chain management without a concurrent effort to manage the rest of the aspects of delivering products to customers. A

manufacturing operation must be able to better manage its supply chain, ultimately improving customer satisfaction levels while reducing overall costs. Organizations need to identify and improve its process for manufacturing and delivering products to customers as profit margins suffered pressure from increasing competition. Other factors have contributed to a renewed focus, namely: more instances of multisite manufacturing, where several independent entities are involved in the production and delivery process; increasingly cut-throat marketing channels, such as independent computer dealers; the maturation of the world economy, with heightening demand for "local" products; competitive pressures to provide exceptional customer service, including quick, reliable delivery.

10.7 Keywords:

Supply Chain management

Efficiency and effectiveness

Strategic consideration

10.8 Self-assessment Questions:

1. What is the meaning of supply chain strategy?
2. What is an efficient supply chain?
3. What is the process of supply chain management?
4. Why Supply Chain Management is necessary for an organization?
5. What do you mean by critical success factor of a supply chain?

10.9 References:

- Operations and Supply Management by Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Nicholas J. Aquilano - 12th Edition
- Supply Chain Management Strategy, Planning and Operations by Sunil Chopra, Peter Meindl and D.V.Kalra – 3rd Edition

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Subject: Supply Chain Management	
Course Code: POM – 323	Author: Prof (Dr) Hemant Sharma
Lesson No.: 11	Vetter:
Porter's Industry Analysis and Value-Chain Models	

Structure

Objectives:

This chapter will help you to understand the:

1) Porter's five forces model and its importance;
2) Different forces to analyze level of competition;
3) Various factors affecting forces;
4) Porter's value chain model;
5) Activities and advantages of value chain

11.0 Introduction:

Concept of value chain was first introduced by Michael E.Porter. Harvard Business School's Michael E.Porter, who had also developed the Five Forces Model that many companies and businesses used to figure out how well they can perform in the existing marketplace.

Porter's industry analysis was like a framework that tried to analyze the level of competition present within the industry and business strategy development.

Value Chain analysis basically relied on the economic principle of advantage i.e. businesses are best served by operating in areas/sectors where they can have a relative productive advantage over their competitor companies. At the same time, businesses should also ask themselves where they can provide best value to their customers.

11.1 Porter's Industry Analysis - Five Forces Model:

In year 1979, Harvard Business School's Michael E.Porter identified five key forces that determined the long term fundamental attractiveness of a market or market sector. This was later recognized as Porter's Five Forces Analysis and it provided the model that enables the companies to analyze their industry in way that takes your competitors' activities in to the account. For Creating Strategies this was the vital part and it is very important that managers understand its working and how to contribute to it.

Organization's ability to define its market properly is one of the most crucial aspects of using this technique. Porter's analysis technique is often regarded as credible and practical approach as it looks at the forces that your competitors can exert on the market and how this could affect long term success of your organization. Porter's technique of analysis has become very popular with business and strategy analysts.

For analyzing organizations industry structure in strategic processes, 'Five Forces Tool' has become an important method. Porter's model is basically based on the insight that a corporate strategy should meet the threat and opportunities in the organizations external environment. Competitive strategy should be based on the understanding of the industry structures and the way they can change.

Five competitive forces were identified by Porter that shape each and every industry and attractiveness of the industry. Objectives of Corporate Strategy is to modify the competitive forces in such a way that it improves the organization's position. Five Forces

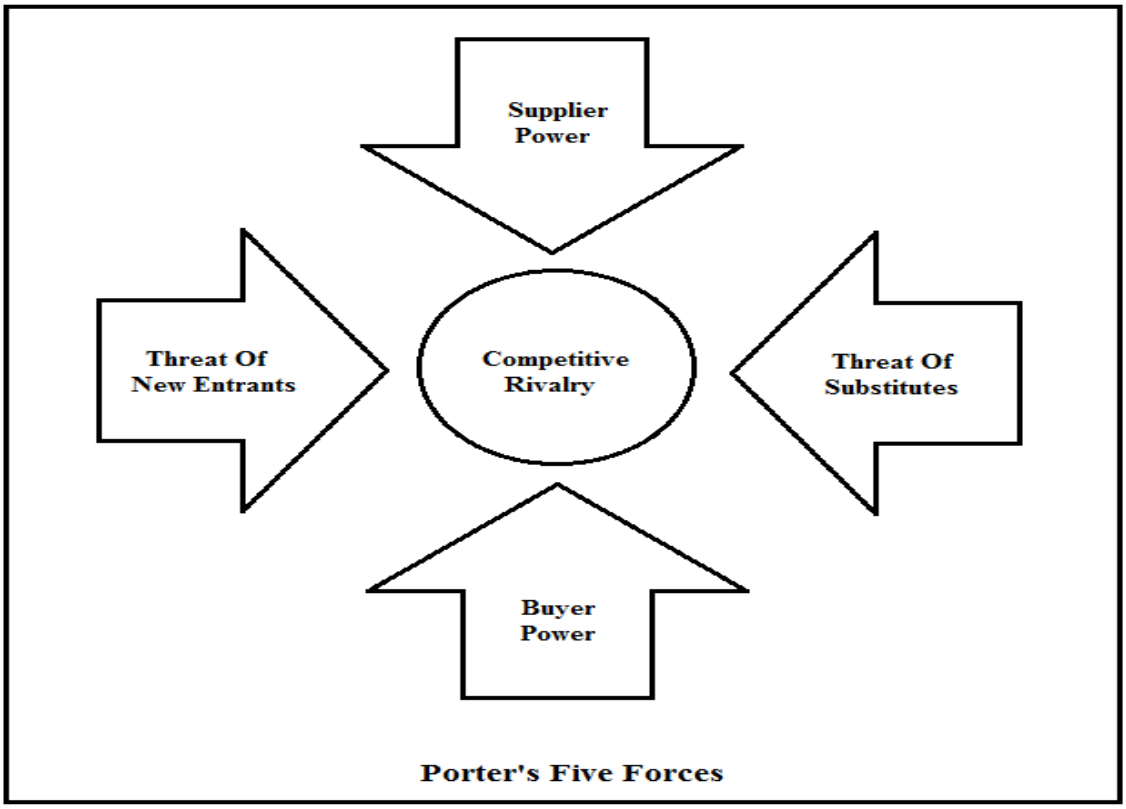
model supports analysis of the driving forces present in the industry. From the information derived from the Five Forces Analysis, management can decide how to exploit or influence particular characteristics of their industry scan.

Porter's model considered five forces that determined the attractiveness of market by carefully analyzing the competitive intensity. What Porter meant by a particular market being attractive was its overall industry profitability, which was assessed by looking at the risks and potential opportunities.

Always remember, Porter's Five Forces was designed for use at the line of business level. Line of business is defined as applying to a set of one or more highly related products that service a business need or a particular customer transaction.

The five key factors that this model uses to identify and evaluate the potential opportunities and risks are as following:

- Competitive Rivalry
- Bargaining Power of Suppliers
- Threat of Substitutes
- Threat of New Entrants
- Bargaining Power of Buyers

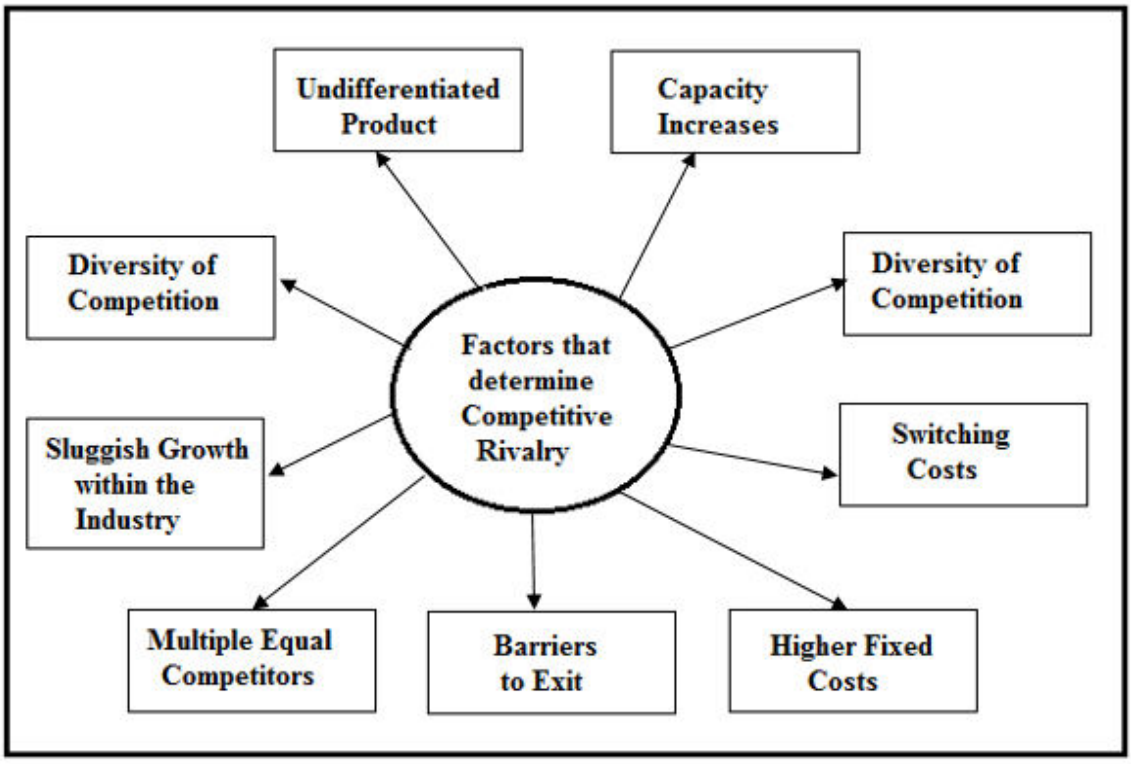


Porter's Five Forces

11.2 Competitive Rivalry:

The competitive pressure present in the industry can manifest itself through a number of different tactics. These can include advertising wars, New Products, Competition based on the Price etc. The rivalry may also gain traction whenever a company feels pushed by a competitor or it identifies an opportunity to grow its share of the market. Whatever be the reason, the actions of one company will definitely going to have an impact on its competitors. In turn, Competitors will also take action to retaliate against these actions. This scenario has the potential of turning into a cycle which may eventually end up harming the industry as a whole. It can become very unstable and affects the profit margin if the competition ends up being based on the price. On the other hand, advertising battles can end up raising the demand for a profit across the whole industry.

Factors Determining Competitive Rivalry:



The nature and structure of an industry may determine the nature of the competitive rivalry that can exist in it. Some of the factors that make an industry competitive includes:

- **Multiple Equal Competitors:**

  If the industry under consideration has numerous competitors who all can operate an equal level of product or service quality, then there is a very higher threat of competition.

Companies may feel the need to have more aggressive activities to gain a higher share of the market if they do not enjoy any sort of clear advantage over its competitors.

- **Sluggish Growth within the Industry**:

  If the industry is not having a rapid growth rate, then the only way for the company to increase its market share is to take it away from its competitor. There is also going to be a higher degree of protectiveness towards the existing share in the market, as once it is lost, it will going to be hard to regain.

- **Higher Fixed Costs:**

  If fixed costs are very high within an industry, then there is going to be more pressure to produce at full capacity in order to achieve the economies of scale. In order to make sure that stock is cleared, companies may guard their share of market aggressively and can also try to obtain more as well. In addition, Companies may have to sell at a lower rate to ensure that their stock is cleared.

- **Undifferentiated Product:**

  If the main product of the industry is generic one and there are no grounds to base the differentiation on, then the products can be treated as a commodity. This means that choice of consumer will be based on its price and value for money. This is naturally going to lead to price based competition.

- **Switching Costs:**

  If there is very little or no switching costs for a consumer then the industry is going to be more competitive. This scenario happens often in undifferentiated industries or the ones where the products are very similar in the feature, benefits and the Quality.

- **Capacity Increases:**

  If the increase in Production capacity is warranted by the need for economies of scale, then there may be a short/brief disruption in the demand and supply of the market. This may further result in overcapacity of products and price cut to make sure stocks are cleared.

- **Diversity of Competition:**

  If the industry is having different types of companies which are having differences in their origins and strategies, then there may be diverse ways to do the business. These

alternate methods can change the nature of the competition and the way of doing the business.

- **Strategic Focus:**

  Often a company may have high stakes to ensure that it stays in market/business over the long term. In this kind of scenario, the company may sacrifice their short term profitability to ensure the long term presence in the market. These companies will be focusing foremost on maintaining and growing their market share.

- **Barriers to Exit:**

  If some barriers are present to exit within the industry, then the companies which are having low profit and growth may also need to remain active, In such cases, there is going to be competitive pressure to stay relevant and also earn profits by any means. Some of the potential exit barriers can be the result of ownership of specialized assets, fixed costs of exit and might be due to governmental regulations.

11.3 Threat of New Entrants:

Porter believed that the possibility of having more new entrants can have a significant part to play in developing and changing the competitive dynamics of the industry. Porter's definition helped manager to see this threat as influential and substantial. According to him, this threat can change the competitive environment and it will directly impacts the profitability of an existing firm. If in any industry, there is a higher threat of new entrants, then this means that there are low barriers to entry and there is very high possibility that the industry profit potential will decrease as a whole. Same is due to the reason that competitors will going to fight more for the same amount of business. Sales and market share is going to be redistributed and there is also going to have its impact on the price and product quality.

Means of Entry into a Market:

A new firm entering a market can happen in a number of ways:

- **Take-over**:

A company from outside the industry might take over an existing firm, thereby avoiding any of the traditional barriers to entry present within the firm. This firm may also bring

new and innovative expertise within the industry, which is going to change the competitive dynamics for everyone.

- **Diversification**:

  Diversification of products from existing firms into other categories.

- **Competitive advantage**:

  Competition, through development of a specific competitive advantage over other companies can also be a threat.

- **Demand**:

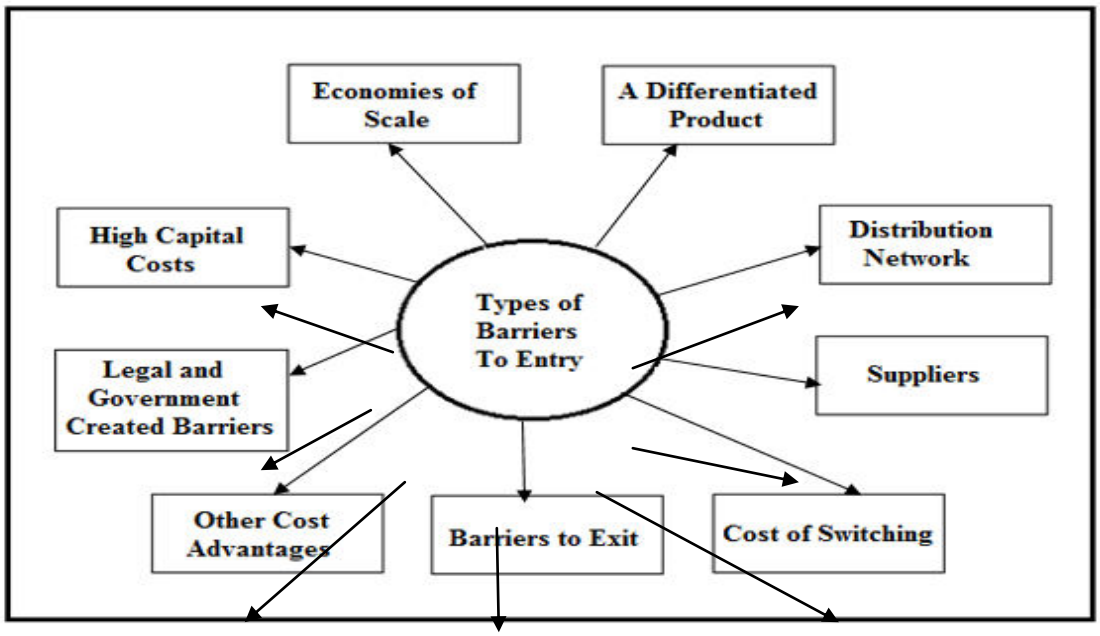
  Increase in demand may result in increase in prices which might allow a new entrant to make use of this increase and offset any high costs of the market entry.

- **Control**:

  Existing firms may choose to control how a new firm will enter the market rather than attempting to stop any new competitors from emerging.

Types of Barriers to Entry:

There are many types of barriers to entry into a market. Some of these include:



- **Economies of Scale:**

  When selling or manufacturing at a very large scale, companies are able to avail the cost advantages because per unit cost of the product decreases. So, the more the company manufactures in quantity the more will be the benefit. When existing companies are having this advantage, this can act as a barrier to entry for new entrant because a new entrant will have to try to match the scale to achieve the similar cost advantage as the existing company. This may not be possible for the new entrant at the initial stage.

- **A Differentiated Product:**

  If the product which is being sold by the existing company or companies is highly differentiated or is enjoying a strong brand loyalty, then this can also act as a strong barrier to entry. The new entrant will have to invest in developing a product with newer and unique features and benefits that needs to surpass those offered by the existing company. In addition, there will be need for strong efforts to break the existing brand loyalties and shift them to a newer untested company.

- **High Capital Costs:**

  If an industry requires huge capital investments at the very beginning, then this will act as a barrier to entry for many of the potential new entrants. Only those companies will attempt to enter the competitive fray who have the requisite resources to make high initial investment.

- **Other Cost Advantages:**

  Apart from those cost benefits that come due to economies of scale, there are many other advantages that an existing firm may enjoy. These advantages include access to the best suppliers, an understanding of the existing materials and knowledge of their quality, possession of any necessary and important patents, and proprietary information and technological knowledge required. There are also learning advantages, which is achieved over years of business and experience in industry.

- **Cost of Switching:**

  The cost which is associated with a consumer's move from one company or product or another is called the switching cost. If the switching costs are significant, then a new

entrant may not be able to create means of removing these. Or, they may need to offer significant advantages to customer to counter these switching costs at their own expense.

- **Distribution Network:**

  Often, distribution relationships are very well established and which may prove to be a strong barrier to entry for a new company. A new entrant will obviously need access to same distribution channels but will need to invest extra in order to engage the distributors who are having established relations with existing competitors.

- **Suppliers:**

  As with distributors, suppliers are also vital to the operations of a new business. Existing suppliers might have loyalties or contracts with existing companies and may prove to be difficult to form relationships with new entrant.

- **Legal and Government Created Barriers:**

  Government and regulatory requirements like permits and licenses can be a strong barrier to entry. There can also be laws governing ways to conduct the business that might conflict with a company's practices in some other countries.

- **Barriers to Exit:**

  Interestingly, barriers to exit may also act as a deterrent to entry by new entrants. If a company is unable to leave a competitive environment easily in case business does not work out, then it needs to stay and compete even if there is detrimental business practice. In such a case, the company may choose to not enter the market in the first place itself.

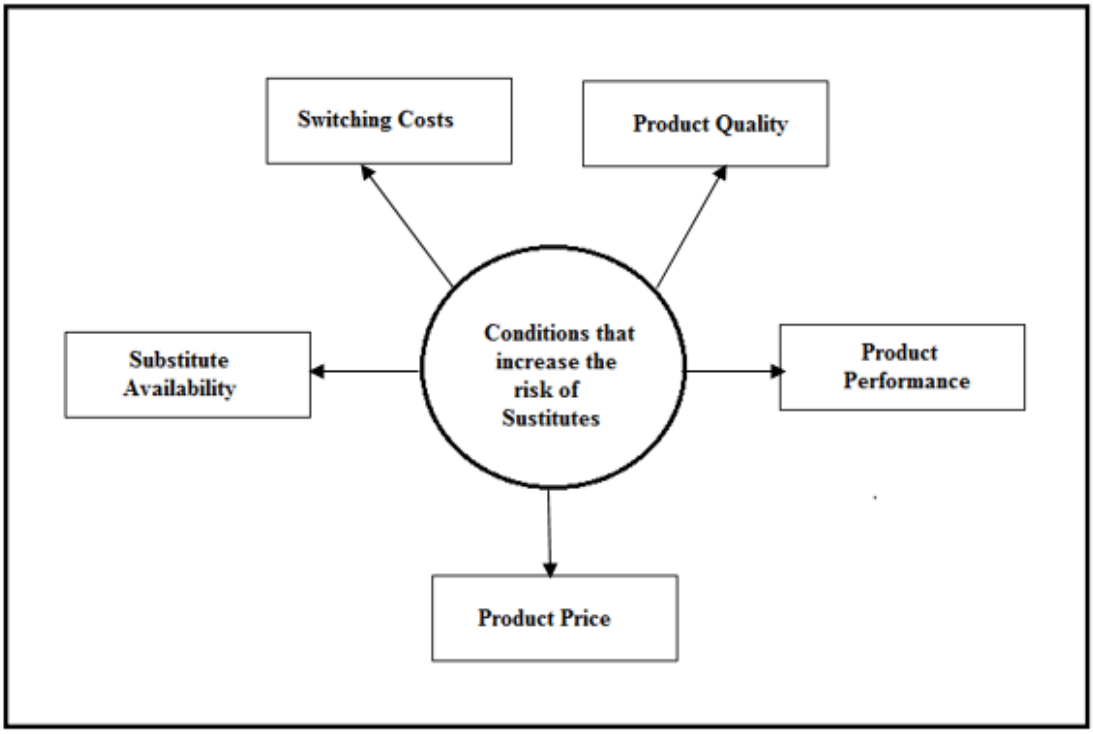
11.4 Threat of Substitutes:

Substitute product is the one that is offering the same or similar benefits to a company as a product from another industry. Threat of a substitute is the risk level that a company faces from replacement by its substitutes. For more generic, undifferentiated products this threat is always way higher than that from more unique products. A company that is having several possible substitutes that can easily be switched has very little or no control over the prices it sets or how it chooses to sell its product.

The existence of substituted product offer different choices to customers and allows them options within the industry and beyond it to products that may fulfill the similar need. In case of more generic products, there are often more than one way to address the particular need. For Example, option to choose from different modes of transportation when going from destination Point A to Destination point B. If some taxi company operates on that route, it must compete with all other taxi companies on that route as well with any other possible routes such as airlines, buses and trains.

Analyzing the threat of substitutes can be difficult because the items being compared are not exactly alike but vary either slightly or greatly in what they offer. Customer will often base their analysis on the value offered by the product and its price.

Factors that increase the risk of Substitutes:



There are many conditions or situations in which the threat of substitutes is stronger than usual. Some of these conditions are:

- **Switching Costs:**

If there is little or no switching costs for a consumer, then chances are more that they will explore and move over to a more attractive substitute. In the absence of other factors such as differentiation or brand loyalty, the choice to move will be very easier. For example,

Apparel firms have very low switching cost among customers, who can easily find clothing deals and compare prices by walking from one store to another.

- **Product Price:**

  If the price of the substitutes are more reasonable, then there may be more risk of consumers switching the products. In addition, this can act also as a barrier to how much a company can increase the prices for its own product. Any move to raise the price higher than substitutes may lead to consumer migration and loss profits.

- **Product Quality:**

  If the substitute products quality is higher than that of any product, then there is more likelihood that consumers will want to make use of this difference and switch over.

- **Product Performance:**

  If the performance of the substitute product is better than a product then there is a chance that consumers will want to switch over. For example, in travelling short distances, if an airline's flights are always delayed, while a bus is always on time, customers may choose to travel by road rather than wait endlessly for a plane to take off.

- **Substitute Availability:**

  All of the above mentioned factors can only come into play if there are actually substitutes available in the market. To identify the potential threats, the company needs to be creative in its thought process and look beyond its traditional competitors.

11.5 Bargaining Power of Suppliers:

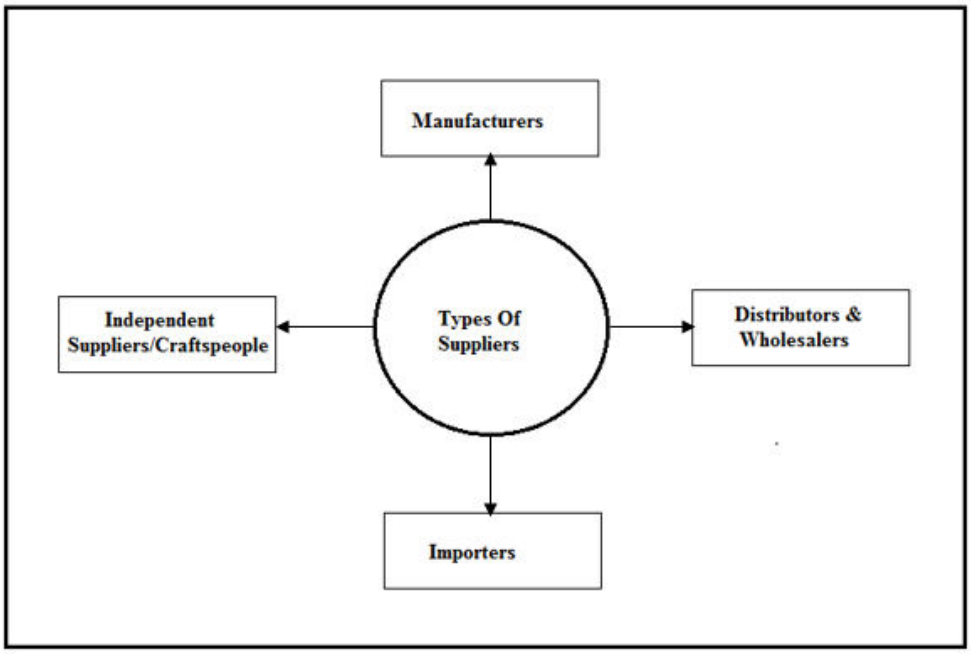
An important force within the Five Forces model is the **bargaining power of suppliers**. The presence of powerful suppliers reduces the profit potential for an industry. Suppliers can increase the competition within the industry by threating to raise the prices or reduce the quality of goods and services.

Types of Suppliers:

Depending on the industry, there are different types of suppliers. Some of these may be:

- **Manufacturers:**

  Manufactures are the producers of components that is feed into the end product manufacturing process. If the manufacturer has expertise or there is no competing producer, they will have more power. Conversely, if the supplied parts are generic and alternatives are easily available, then the manufacturer will be having less power.



- **Distributors & Wholesalers:**

  Distributors & Wholesalers are types of suppliers who purchase the products in large quantities from different companies present in industry, store these products and eventually sell to retailers. These products are sold at higher prices than if bought directly from the manufacturers, but this also allows purchases to be made in smaller quantities than a manufacturer will not be willing to supply.

- **Independent Suppliers/Craftspeople:**

  Unique items in small quantity are manufactured by Independent Suppliers/Craftspeople. These Products are exclusive and sold through representatives or trade shows.

- **Importer:**

These type of suppliers purchase the products from the international sources and then sell it to local retailers. These type of suppliers acts like domestic wholesalers for these products.

Power of Supplier Group:

The following conditions indicate that a supplier group is powerful:

- If suppliers are in concentrated numbers compared to the industry to which it sells.
- If switching costs associated with a move to another supplier are high.
- If suppliers are having ability to integrate forward or can start producing the product themselves.
- If suppliers are having specific expertise or technology required to manufacture goods.
- If the product supplied is highly differentiated
- If no substitutes are available for the products supplied
- If many buyers are present but none of them make up significant portion of sales
- If end users are strong enough to exert power over the organization in favor of the supplier. (This can happen in the case of labor situations)

In all of these cases, the bargaining power of supplier is high, Supplier can set their own timelines or demand premium prices,

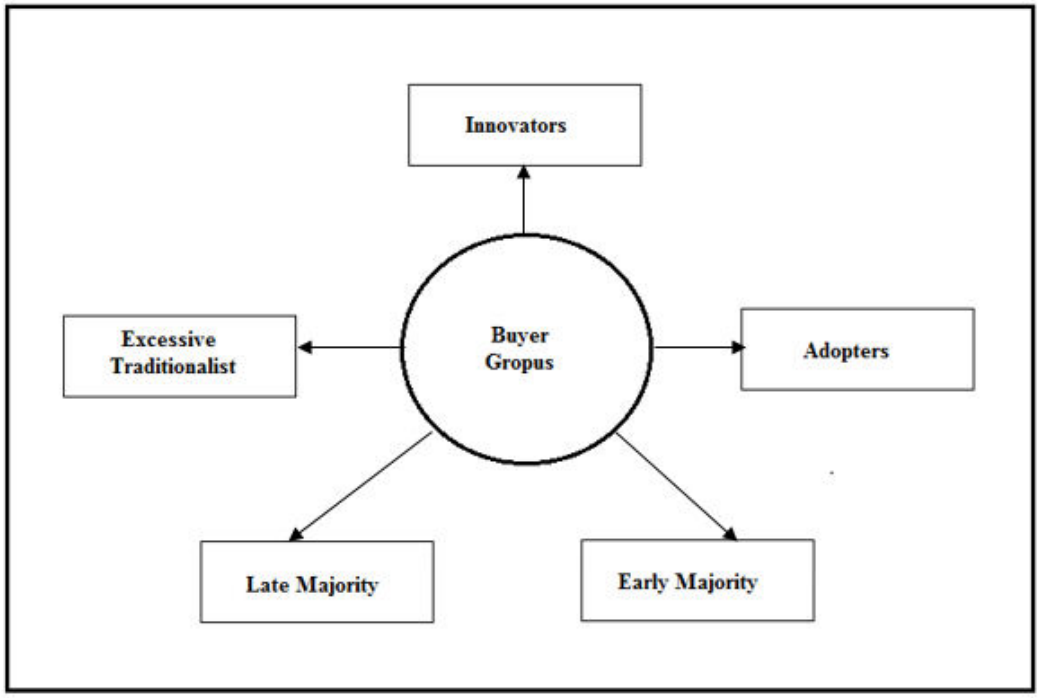
11.6 Bargaining Power of Buyers:

Buyers have bargaining power whenever they are strong enough to exert collective pressure on the companies producing a product or a service. Their power is highest whenever buyers group is concentrated and purchases large volume relative to the producer's sales. The presence of powerful buyers reduces the profit potential in an industry.

Types of Buyers:

Companies need to understand the different types of buyers before trying to create strategies to handle different types of buyers. Different types of buyers need to be treated in consideration of their unique behavior.

Inside each market segment, there are following five different groups of buyers:



- **Innovators:**

Smallest group of early purchasers is called Innovators. They stay updated on the current, upcoming trends and newest technologies present in the industry. They have high degree of self-confidence and always look forward to experiment with new things. If a new product turns them on, they will use it and influence other possible innovators to use the product as well. However, the usage and acceptance of a product by innovators may not lead to a widespread trend.

- **Adopters:**

The next type of buyers are the early adopters. These people set an example for others by their decision and are true opinion leaders of a particular market segment. If a new Products offers them significant benefit, they will definitely try out the product. Being an agents of change, they will understand the benefits of the product and seek reference from other satisfied users before they adopt it and this leads credibility to their references.

- **Early Majority:**

  The next group of buyers is called early majority. The early majority group is relatively slower in adopting or trying a new product offering. They will usually embrace a new product only after it is accepted by their peers and strong references are received from them. This is a more practical group of people who are less technology driven and are not necessarily excited by the new or innovative.

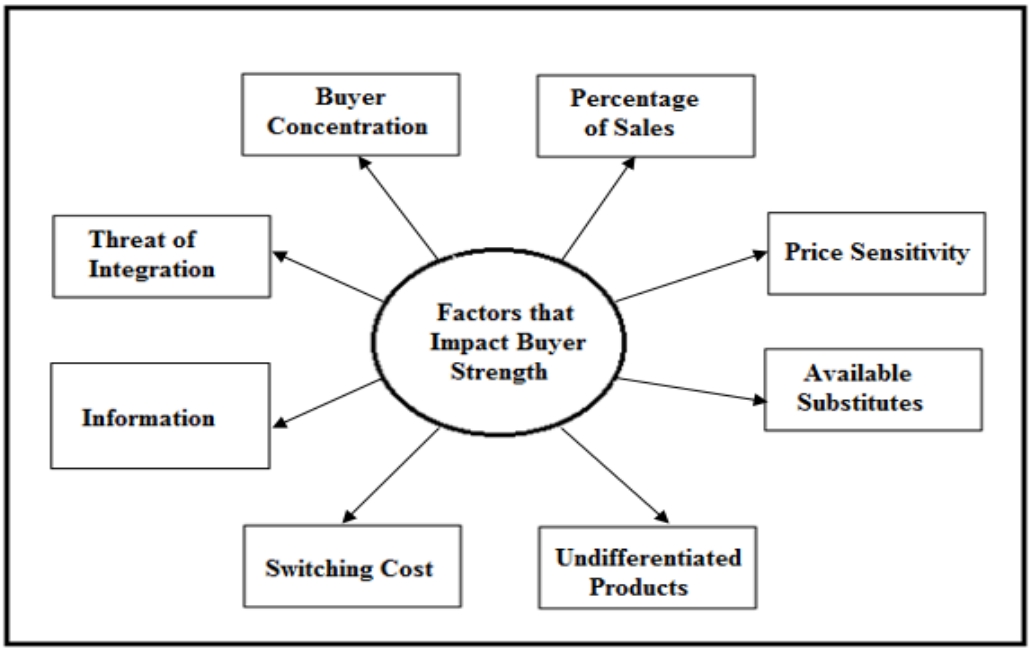
- **Late Majority:**

  Next group is late majority group. This group will only become consumers of a particular product much later in the product's life cycle, when stronger buyers might have already discovered the next new product. Their motivation is to wait for prices to fall and the product to become established in the market with proof of reliability and longevity.

- **Excessive Traditionalists:**

  This is the last buyer group to come onboard regarding the product. This group wait till the price of product have reached their lowest point, competitors have entered the market and established themselves and the product has become an absolute need. The product may have become close to obsolete by this time. They represent only five percent of any market.

Power of Buyer Group:



Each of the mentioned buyer group has a different potential power over the producer and need to be managed accordingly. There are several different types of market conditions that will determine whether the buyers will have power or not. Some of these factors are:

- **Buyer Concentration:**

  Whenever buyers are limited in number and are more concentrated, then they have a higher power over the producer. The sales revenue of the producer will be completely dependent on those few customers and they will not be able to ignore any demands. Conversely, if the buyers are large in number and widespread, then producer can easily ignore the demand.

- **Percentage of Sales:**

  Another bargaining chip for a buyer or buyer group is the amount of business they provide to a producer. If the buyer or buyer group is purchasing large volume relative to the seller's sale, then the producer will not want to risk losing their business.

- **Undifferentiated products:**

  If the producer sells undifferentiated or standard product, then they will have the potential threat of a buyer switching producers. If there are more than one producers supplying the similar type of product, a buyer will have the option of exploring possibilities.

- **Switching Cost:**

  If switching costs are low for a buyer i.e. little or no penalty for moving to another supplier, then any dissatisfaction with a producer or a product will lead to loss of business as the buyer will be able to find an alternate with minimum hassle and inconvenience.

- **Threat of Integration:**

  Sometimes buyers pose a threat of backward integration. This means that they may engage in tapered integration by producing some components in-house and purchasing the rest from other suppliers.

- **Information:**

If buyers have full information regarding the producers operations, demand, market prices and supplier costs then they will be able to demand better prices from the producer.

- **Price Sensitivity:**

If the buyers are sensitive to changes in price of product and may stop purchase, the producer will not be able to ignore their demands.

- **Available Substitutes:**

If substitutes or alternatives are easily available in the market, then the buyers will have options to switch and shop around, making their power over the producers substantial.

11.7 Porter's Value Chain Analysis:

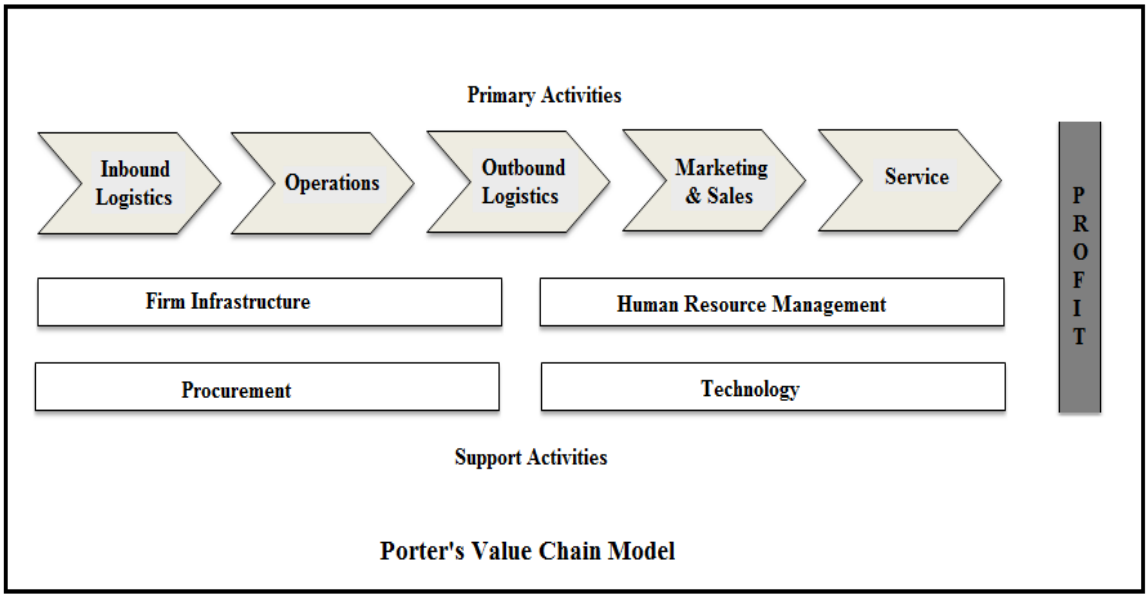
The value chain is easily recognizable in the Production industry, where a company takes raw material and perform a set of activities in order to deliver a valuable product which it sells to customers. Value chain is difficult to be identified in other industries. Any Company who wish to find ways to optimize processes while also creating an advantage in the marketplace must study the value chain first. The value chain can be used to find potential competitive advantages.

The goal of this strategy is to first identify the most valuable activities for the company and then take action on the activities that can be improved to add competitive advantage. Differentiation and Cost are two advantages within the value chain. Cost advantage demonstrate that the company is performing business activities at a lower cost which leads to greater profit. Differentiation Advantage demonstrates that a company is performing the business activities better than its competitor companies.

There is a direct relationship between the competitive advantage and sales of a product or service. Higher the competitive advantage, the more likely people are going to purchase the product or service. A close scrutiny and analysis of a company's processes can lead to superior product quality, higher profits and a greater market share through the value chain analysis.

Components of the Value Chain Strategy:

According to the Value Chain Strategy, there are two main components: **primary activities** and **support activities.** Within these two categories there are additional processes that helps to narrow down the specific areas that add values to a company.



Porter's Value Chain Model

Primary Activities within Value Chain:

The primary value activities are directly linked with the creation, sale, support and maintenance of the product or service. These primary activities are going to vary depending on the industry or business. Primary value activities add value directly to the production process but they are not necessarily more important than the support activities.

- **Inbound Logistics:**

The Inbound Logistics component focuses on all methods which are used to bring raw materials, or company inputs, into the business. This can include arranging the inbound movement of material from suppliers to assembly plants, warehouses, distributing material internally.

- **Operations:**

As the raw material makes it way though the company, Operations adds value by transforming the input (raw material, labor, energy) into outputs (in the form of goods and/or services). This is the stage of value chain that produces a product for customers.

- **Outbound Logistics:**

  Once the product development has been completed, the process of moving it from the end of the production line to the consumers is called Outbound Logistics. Collecting, storage and distributing products, as well as preparing the company for additional growth is part of this stage.

- **Marketing and Sales:**

  The methods which are used to convince consumers to purchase products or services over another's business are called marketing and sales. Value can be found by the addition of benefits and the success of communicating those benefits to customers, clients and partners.

- **Service:**

  Service component in a value chain considers the value in maintaining their product/service working effectively for the buyer after it is sold and delivered.

Support Activities within Value Chain:

In addition to the primary value activities, the value chain also considers support activities. Support activities are the behind the scenes aspect of a company that indirectly add value to products or services. There are four major components within support activities.

- **Firm Infrastructure:**

  This includes the control systems and the overall structure of the organization. Firm Infrastructure consists of the activities such as legal, finance, public relations, quality assurance, accounting and general management.

- **Human Resource Management:**

  Concerned with the human element of the company, this section of the value chain accounts for employee interactions. It encompasses recruiting, hiring, developing, training, compensating and laying off personnel and is one of the largest components in the value chain.

- **Technology Development:**

  An important feature of the value chain, the technology development component pertains to the hardware, software, equipment, technology costs, managing information and maintaining current technology standards.

- **Procurement:**

  This component studies how the company acquires the needed resources like goods, services or works from outside external source to operate. It also includes vendor and supplier negotiations.

Using the Value Chain Strategy:

If value chain strategy is not followed by analysis and planning of action steps, then it is a worthless exercise. Depending on the advantage type desired by the company to focus on, the resulting analysis and action plan will going to have different strategies.

Differentiation Strategy:

Value Chain Analysis is done differently when a firm competes on differentiation rather than costs. The source of differentiation advantage comes from the production of superior products, availability of more features and satisfying varying customer demands. To accomplish this type of advantage, company may require a higher cost structure, but can ultimately pay off in higher profits if managed correctly by the firm. The Value Chain Analysis focus primarily on identifying and optimizing the activities in the process chain that contribute the most to creating customer value. Additionally, the company should also focus on adding more features to their products, while maximizing the customer service experience and increase the potential for customization. The ultimate goal of the value chain strategy for the company desiring differentiation is to pursue sustainable differential advantage.

Cost Strategy:

A company that wishes to compete in the marketplace on the basis of cost advantage must evaluate the value chain data from a different perspective. This type of approach is used

when firms try to compete on costs and wants to understand the source of their cost advantage or disadvantage and what factors drive these costs.

- An exhaustive study to identify the primary and support activities of the company must be done and detailing how the work is completed at each step of the process.
- Establish the relative importance of each primary and support activity in the total cost of the product. This allows companies to identify inefficiently performed activities or large sources of cost activities to be analyzed and evaluated.
- Evaluation of the cost drivers for each activity must be performed. Determining what is driving the costs allows the company to identify ways of reducing the costs at each stage of the production.
- Identification of the links between the parts of the processes can help the company in the understanding of how cost changes in one part of the process may affect a different part of the process.
- Identify the opportunities for reducing costs. When the company knows its inefficient activities and cost drivers it can plan to improve on them. Reduction of cost through the identified areas will generate the opportunity for a successful value chain creation.

After completing a Value Chain Analysis, it can be overwhelming or tempting to consider the dozens of areas that can be improved. Select several easy-to-implement opportunities first and put them into motion immediately. This will going to create excitement and buy-in by the employees who will be enthused with the quick amount of success that can be had. Analyze the list of action steps and prioritize them according to feasibility, cost of implementing and necessity. Then begin to implement changes according to the strategy type desired. As the dynamic marketplace changes, additional evaluation of the value chain may be necessary to maintain a competitive edge.

11.8 Summary:

- ❖ Michael Porter provided a framework that models an industry as being influenced by five forces
- ❖ The strategic business manager seeking to develop an edge over rival firms can use this model to better understand the industry context in which the firm operates

- This framework should ideally be applied at all levels of the organization. This is sometimes difficult with mid or low level managers. A way to combat this is to make it intuitive in the company and should be emphasized in day to day activities.
- Helps the organization to look at all of the five forces concurrently when conducting an industry analysis. When a strategist loses sight of the big picture, they are more likely to let things slip through the cracks.
- Differentiating your product or service based on customer service can put you ahead of the competition in most industries.
- The Value Chain framework of Michael Porter is a model that helps to analyze specific activities through which firms can create value and competitive advantage.

11.9 Keywords:

- ***Diversification:*** the process of a company enlarging or varying its range of products or field of operation
- ***Differentiation:*** the process of distinguishing a product or service from others, to make it more attractive to a particular target market
- ***Value Chain:*** the process or activities by which a company adds value to an article, including production, marketing, and the provision of after-sales service

11.10 Self-assessment Questions:

1. What is the main purpose of Porter's Five Forces Model?
2. According to Porter, which are the most important factors which help in achieving a competitive advantage.
3. What is likely to happen if many new businesses enter a market?
4. What are the factors to cause high bargaining power of suppliers?
5. Discuss the value chain model and its advantages.

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Subject: Supply Chain Management	
Course Code: POM-323	Author: Prof.(Dr) Hemant Sharma
Lesson No.: 12	Vetter:
Concept of Total Cost, Supply Stream Strategies, Classification and Development Guidelines	

Structure

12.0 Objectives:

This chapter will help the students to understand the:

- Evolution of costing techniques in supply chain
- Nature and characteristics of supply chain
- Concept of Total Cost of Ownership (TCO) in supply chain
- Various dimensions and complete methodology to be used in TCO
- Modern supply chain models

12.1 Introduction:

Total Supply Chain Management Cost is the cost incurred in the total functioning of the supply chain right from placing the order to executing it. It covers all the costs the company needs to incur for the successful functioning of the Supply Chain team in the organization. This is basically divided into five elements, namely:

- Order processing
- Acquisition of materials
- Manage inventory
- Manage supply chain finance and planning
- Manage Supply Chain related IT costs

So, the Total Supply Chain Management Cost would be the addition of the costs incurred for each of these functions individually and is divided by the total product revenue. This is a very important metric as it helps to know the Total cost for Supply Chain Management and compare it to the allocated budget for the same function. Dividing this into 5 buckets gives a better clarity to understand which function in SCM is more cost effective and which is not and helps to take corrective actions accordingly.

A company which tracks its Total Supply Chain management cost takes into account all the costs incurred throughout the entire process according to these five buckets which then eventually helps them to calculate the entire Supply Chain Management Cost.

In the era of control regime, the task of purchasing and selling was relatively easy. Competition was less and the market was fixed. But suddenly all that changed - the markets opened and competition increased; selling is now possible only if prices are reduced and quality improved - in other words, the customer wants more and more per unit cost. To minimise the total production costs, it is recognised that one way is to tighten operations; another time tested method is to reduce cost of inputs.

While it would be desirable that our suppliers reduce the cost of their supplies to us, the importance of building a relationship with the supplier has been recognised. Establishing a long term relationship is possible only when the supplier and purchaser jointly decide to reduce the life cycle cost of an item by proper procurement, in such a way that it would lead to a win-win situation to both the parties - in other words, suppliers become “Partners in Progress”.

Purchaser cannot squeeze the supplier endlessly; sourcing the right item from the right vendors, getting it to the purchaser's premises in the right way at the right price and at the right time can alone optimise costs for the purchaser. This is possible only if there is mutual trust, which builds up in long term relationships. The purchase bill can be lowered if the total life cycle cost is optimum. In other words, the Total Cost of acquisition and ownership of the item must be optimum. The major costs involved as we trace the path of a product from its raw material stage till it is consumed in our process would look like this –

SUPPLIERS COST STRUCTURE	
LEVER	***COST***
Wastage, spillage, pilferage	1
Inventory carrying cost	3
Handling and storage cost	1
Inspection & testing cost	2
Transportation & freight costs	3
Packing & forwarding costs	3
Duties & taxes	4
Margins of supplier	15
Labour & other overheads	16
Manufacturing cost	12
Raw Materials cost	40

Total Cost of Acquisition = Rs. 100/-

Landed Cost = Rs. 95/-

Ex-Works Price = Rs. 83/-

The example given above is only an illustration. It shows that 83% of the total cost of an item is controlled by the supplier; 12% is logistics and 5% is internally controlled costs. Each of these costs represents an opportunity for reduction. The basic price of the supplier cannot be reduced. The margins can be played upon. The opportunity for reduction therefore lies in the supply chain - packing, forwarding, transportation, wastages, handling, storing, etc. Efficient supply chain management helps in reducing the Total Cost of Acquisition (TCA) of an item. It is important to know the right supply chain for an item - this is possible only through the study of the Total Cost of Acquisition.

12.2 How to Manage Total Cost of Acquisition:

The TCA concept, which has begun to be followed by some progressive organisations around the world, looks at the following four major levers.

Specifications

• Are we using the correct specs?

• Can we rationalise the variants/sub variants?

Price

• Are we buying the product the most optimal way?

• Number of suppliers

• Import/domestic or a combination of both

• Commercial terms

Logistics

• Are we getting the product to our premises the right way?

• Mode of packing and transportation

• Handling losses

• Stages of inspection

• Inventory Management

Usage

• Are we using the product the right way?

• Operating parameters

• Work practices

• Wastage/recycling

In specifications, requirements should be minutely looked into - whether tailor made or general, number of variants and whether they can be clubbed etc. The organisation needs to relook into its own requirement in the changing times to be able to identify alternatives. One example would be the use of zinc for galvanising of steel. Traditionally, high grade zinc with purity of 99.5% has been used by the steel plants. Lately, it has been established that prime western zinc with purity of 98.5% is technically a better substitute, for galvanising of steel and also costs lesser by at least Rs.5OOO/Ton. To identify alternate specifications, periodic diagnostic studies need to be conducted to arrive at the best specifications for any item. We need to identify and consolidate supplier base and decide on the best and most effective commercial terms with them.

One should try to understand the supplier cost structure - his limitations, economics, overheads and margins, his competitors and industry benchmarks, to be able to identify the

cost reduction opportunities. A supplier workshop could elicit a wealth of information. An effective negotiation strategy based on this information would help to reach the best price. Logistics call for an understanding of the total supply chain, the elements of which include inventories, packing, forwarding, freight, storage and handling.

The study of logistics is especially important for bulk raw materials, where substantial outflow of freight is involved. Management of logistics is an art which is extremely difficult to perfect - in India, JIT ends up being SHIT -Somehow in Time. The study of logistics is important to establish a lean supply chain which would give the advantage of quick product changeover capability; excellent short and long term forecast visibility and JIT capability. While studying the usage, one should look into their own operations and practices - the way the item is charged or fed, losses during charging, is recycling possible, ideas to reduce wastages, pilferage, etc. For example in a steel plant, reversing a conveyor belt whose bottom rubber layer has worn out, and using it postpones its replacement for some time. A belt which has worn out on the sides can be trimmed and used on a different location where lower widths are required.

Numerous instances are available on how little ideas can lead to good savings. In India most of the ISO certified companies have been exempted from pre-despatch inspection. Creating a list of approved vendors, entering into profit sharing arrangements with selected vendors, assisting them in their expansion and diversification are only some ways in which companies ensure supplier loyalty. Supply chain management has become important like never before, with the revolution in Information Technology and breakdown of geographical barriers. A combination of meticulous analysis, sensible strategy and effective implementation can enable a company to manage its profitability.

12.3 Concept of Total Cost of Ownership (TCO):

The problem of determining supply chain costs has been recognized since the 1930s. Firms even then faced the problem of selecting the combination of distribution channels and supply chain partners which would yield the most profitable mix over the long run. As a result, logistics managers have repeatedly required the capability to isolate logistics costs by function, territory, commodity, channel, method of sale, class of trade, order size, operating or product divisions, delivery method, terms of sale, etc.

However, no methodology has proven entirely satisfactory in providing the required information. Newer costing techniques such as direct product profitability, total cost of ownership, and activity-based costing have provided useful information but have not satisfactorily addressed the entire supply chain.

Distribution costs remained largely a “dark continent” through the early 1960s. Distribution managers had visibility over the costs of individual functions such as warehousing or transportation; however, they had practically no cost visibility over all the activities encompassed by distribution. The fragmentation of distribution activities made it impossible to isolate costs or fix responsibility. This situation led to the decision in some firms to bring together all distribution activities under a single individual with responsibility for the identification, control, and reduction of distribution costs. Industry-based analyses of further cost reduction opportunities within the distribution channel quickly followed. Creation of physical distribution organizations in the 1950s and 1960s and rising distribution costs emphasized the need for more detailed cost information to support contribution analyses and to make accurate cost trade-offs.

Since the 1960s, accurate logistics costs and contribution analysis by customer, product, or supply chain have increased in importance to the firm. “Tailored” logistics services and shifting power within the supply chain have renewed an interest in the accurate assignment of logistics costs. Efforts undertaken to increase the visibility of logistics costs within the supply chain include direct product profitability, activity-based costing, total cost of ownership, and efficient consumer response.

Direct product profitability (DPP)

Direct product profitability (DPP) represented the first significant effort to determine the costs of moving products through an entire supply chain. The grocery trade initiated DPP as a pricing technique during the 1960s. DPP provided a technique for identifying the profit contribution of individual products by taking into account the specific handling and space costs incurred by an item. Proponents of DPP suggested the approach would provide a better understanding of the profit implications of various merchandising and product-handling decisions.

DPP more accurately depicts product profitability by subtracting from gross margin those costs directly attributable to the product. DPP would include the cost of activities such as handling, freight, discounts, allowances, storage, and direct labour. However, DPP excludes "fixed" overhead costs such as supervision, facilities, management, detention, demurrage, purchasing, and inventory carrying costs.

Activity-based costing (ABC)

Activity-based costing (ABC) emerged during the 1980s as a means to more accurately assign costs within an organization. ABC is a technique for assigning the direct and indirect

costs of an organization to the activities consuming the organization's resources and then subsequently tracing the costs of performing these activities to the products, customers, or distribution channels consuming the activities. ABC overcomes the problems encountered with DPP by assigning indirect as well as direct costs.

It also differs from traditional cost accounting by using multiple drivers to assign costs. Traditional cost accounting typically relies on a very limited number of allocation bases or drivers to assign costs such as direct labour. All costs are assumed to vary in direct proportion to the allocation basis. However, indirect costs frequently do not vary in direct proportion with labour hours, machine time, or material consumption. ABC recognizes the different relationships and uses multiple drivers to trace the consumption of indirect resources to the activities consuming them. ABC goes one step further by tracing the activity costs to objects consuming the activity costs. Firms using ABC can obtain more accurate information of how specific products, customers, or supply chains affect costs and contribute to overall profitability.

Despite the advantages provided by ABC, the methodology does not provide a satisfactory solution to supply chain management. ABC applications have concentrated on determining how other supply chain partners affect the firm's costs and profitability

Total Cost of Ownership (TCO)

Total Cost of Ownership (TCO) represents a more recent attempt to cost a specific portion of the supply chain. "Total cost of ownership is a structured approach for determining the total costs associated with the acquisition and subsequent use of a given item or service from a given supplier." The approach recognizes that the purchase price represents only a portion of the total cost of acquiring an item. Vendor performance also affects the costs of ordering, expediting, receiving, and inspecting. Many firms obscure these costs by burying them in overhead or general expenses. TCO attempts to identify the total acquisition price by including the costs of purchasing, holding, poor quality, and delivery failure.

Companies have already begun to use TCO as a means for measuring and evaluating their suppliers. Assigning costs to activities affected by the buyer decision provides another tool in the supplier decision. Buyers can evaluate alternate vendors based on the costs associated with the number of product returns, under shipments, non-conformance, or late shipments. Companies incorporating these factors into their ownership analysis can better determine which suppliers offer the best overall value to them.

TCO provides the capability to assess how inter-firm relationships affect costs within the purchasing firm. It links supplier performance to specific activities performed throughout the purchasing firm and translates the activities into costs. When coupled with activity-based costing, TCO can provide an even more accurate depiction of the activities and resources consumed in dealing with specific vendor. Companies employing TCO can use the information to negotiate with or select upstream channel members based on total acquisition costs and other performance criteria. Although TCO does provide more accurate information on how the performance of one firm in the supply chain affects the costs of another, it does not provide the total supply chain cost.

The costs captured in a TCO analysis only include the costs of one member of the supply chain. TCO does not capture the upstream firm's costs. By not capturing these costs, TCO may miss opportunities for making inter-firm cost trade-offs. One of the firms may more efficiently perform some activities than the other such as transportation, packaging, warehousing, or inventory management. TCO also does not demonstrate how the buyer's behaviour may affect the suppliers' costs. The lack of an integrated costing approach may preclude the supply chain from achieving a cost competitive position.

Efficient Consumer Response (ECR)

Efficient Consumer Response (ECR) provides the most comprehensive technique currently available for costing a supply chain. Although not a costing model, "ECR focuses on shortening time and eliminating costs in the core value-adding processes of the grocery chain." ECR attempts to link the individual components of the supply chain into a unified, replenishment loop. Cost savings will occur in the form of lower administrative costs from automation the automation of ordering activities, labour savings by cross-docking instead of putting away and selecting inventory, and more efficient utilization of manufacturing or store space.

Previous efforts to cost supply chain performance have focused on the effects of internal activities or those spanning neighbouring firms. These efforts have provided useful information and have spurred significant improvements. However, they have not produced a measurement system capable of tracing how management decisions within the supply chain effect landed marketplace costs. Current techniques cannot measure costs across the entire supply chain, identify activity or process costs outside the firm, or simulate the effect of proposed changes on overall supply chain costs. Visibility and a reluctance to share cost

information represent significant hurdles for evaluating supply chain performance. Despite these drawbacks and obstacles, the techniques used in these earlier efforts can be combined into a methodology for evaluating supply chain costs and performance.

12.4 Supply Chain Costing: The Methodology

Supply chain costing provides a mechanism for developing cost-based performance measures for the activities comprising the key processes within the supply chain. The capabilities provided by supply chain include the ability to: determine the overall effectiveness of the supply chain, identify opportunities for further improvement or reengineering, measure performance of individual activities or processes, evaluate alternative supply chain structures or select supply chain partners, evaluate effects of technology improvements. Supply chain costing employs many of the techniques embedded in DPP, ABC, TCO, and ECR; however, it differs by costing activities across the entire supply chain. The approach overcomes the obstacles regarding the availability of cost information by making use of standard or engineered times and existing rate information. Supply chain costing also differs by including transaction, information, physical flow, and inventory carrying costs. The costing makes use of standard or engineered times to determine resource requirements.

Supply chain costing does not replace traditional cost accounting or general ledger accounts. Instead, it translates existing ledger accounts into a diagnostic tool that managers can use to evaluate performance and resource consumption. Supply chain costing essentially creates another set of "books" that can be used to trace the effect of management decision making to corporate profitability or to supply chain costs and performance.

The methodology employs six steps:

- **Analyzing Supply Chain Processes:** methodology begins with the identification of the key processes within the supply chain. The process analysis begins with the design and manufacture of the product and extends through delivery and sale to the ultimate customer. The analysis identifies the major functions performed within each process by each member of the supply chain. This step is completed when the supply chain participants and their major functions have been identified and placed in a flow diagram.

- **Breaking Processes Down Into Activities:** major tasks identified in the previous step do not provide sufficient detail for costing or reengineering. The tasks must be broken down into the specific activities performed by each component of the supply chain.

Activities are "a unit of work performed within an organization. A description of the work that goes on in the organization and consumes resources."

Receiving or order picking could represent activities. The decomposition of activities occurs until the activities represent relatively homogenous functions or low cost centers. For example, receiving may represent a major task. It could be further broken down into the type of goods received (apparel, hardware, etc.) or by type of shipment (TL, LTL, UPS, etc.). A "top-down" decomposition should have stopping rules based on homogenous functions, relative cost, or management interest to prevent too much detail in the activity analysis. For example, decomposing the receipt of apparel into receipt of men's, women's, and children's apparel should only occur if major differences occur in the receipt of these goods, represent major differences in the consumption of personnel or equipment, and have a significant management interest.

Breaking down receiving by type of commodity (apparel, hardware, consumer goods, etc.) will probably provide sufficient detail to capture the major diversity in resource consumption driven by product type, customer, or supply chain. The processes decomposed in this step should include all of those affected by supply chain performance. The analysis should consider processes affecting the level of inventory carried, physical flow, information processed, and transactions performed.

The capture of these activities will facilitate cost trade-off analyses between information and inventory or other logistical relationships when the supply chain costing is completed. The final product of this step is a flowchart illustrating the sequence of activities performed in moving products from the initial source to the ultimate customer. The flow- chart should reflect alternate paths the movement may follow due to different customer requirements or channel structure. The flowchart should also include the activities required for exchanging information, processing transactions, and holding inventory within the supply chain.

- **Identifying the resources required to perform an activity.** Performance of the activities will result in the consumption of supply chain resources. Resources include the labour, facilities, utilities, material, etc. required to perform an activity. The general ledger or budget contains the costs of these resources; however, these costs are frequently aggregated at too high a level for management purposes. The accounts or resources must be split to capture important differences in the way they are actually consumed by activities.

  The proportion of a resource consumed in performing an activity determines the amount of the resource cost traced to a specific activity. This approach employs the same

techniques used by activity-based costing in assigning resource costs to activities. The process is replicated for each resource until all traceable costs are assigned to the activities. A major difference between supply chain costing and ABC occurs when activities span firms or when costing other firms' activities.

- **Costing the activities:** The activity cost represents the total cost of performing a specific unit of work. An activity's cost is the sum of the resource costs traced to the activity. An activity cost would include the cost of the labour, material, administration, supervision, facilities, or other resources consumed in performing the activity. The activity cost differs from the cost obtained through direct product profit or direct product costing since it includes the direct as well as the indirect resources consumed by the activity.

  As a result, activity costs provide a more complete picture of how resources are consumed within an organization and the costs of providing specific logistics services within the supply chain. Activity costs can answer questions such as what work is performed in the supply chain, what activities consume the most resources, where should management focus to eliminate supply chain costs, and what how does the cost to perform an activity compare with value-added received by the customer.

- **Tracing activity costs to supply chain outputs:** Supply chain costing uses the activity costs to determine the total costs of serving specific products, customers, or distribution channels. The approach uses the activity cost and volume to calculate a cost per activity output. Consumption of the outputs determines the proportion of the activity cost traced to different products, customers, or distribution channels. The assignment of activity provides a complete picture how different products, customers or distribution channels affect activity and resource costs across the entire supply chain. Tracing costs to outputs provides several important insights
  - Profitability by customer, product, or supply chain;
  - The value-added versus the cost incurred by the final customer;
  - Non-value-added activities which can be targeted for elimination;
  - Potential for more cost effective trade-offs within the supply chain;
  - Opportunities to employ restructuring or "functional shiftability" to align activities with the firms which can most effectively perform them within the supply chain.

- **Analysis and Simulation.** Supply chain costing provides a tool for analyzing the cost drivers for specific activities and how variations in product flow or customer demand will affect costs throughout the supply chain. The information obtained from supply chain

costing can support a contribution analysis by product, customer, or distribution channel. Analyses can be performed to determine the causal effect between the customer demand for specific logistics services and activity costs spanning the entire supply chain.

The analysis will also enable individual firms to evaluate how different channel structures drive costs and contribute to overall profitability. The firms could use the analysis to determine the most cost competitive channel to serve their customers. Carriers and third-parties could use the analysis to demonstrate how their services add value or reduce overall supply chain costs. The ability to simulate changes represents one of the most significant capabilities offered by supply chain costing. The activities can be altered to reflect potential business process reengineering results, elimination of non-value-added activities, alternate channel structures, or changing the location of functions performed within the supply chain.

12.5 Essentials of Supply Chain:

Supply Chain Management not only includes the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities but also the coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies. Supply Chain Management is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model. It includes all of the logistics management activities noted above, as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, and finance and information technology.

A typical supply chain begins with the ecological, biological, and political regulation of natural resources, followed by the human extraction of raw material, and includes several production links (e.g., component construction, assembly, and merging) before moving on to several layers of storage facilities of ever-decreasing size and increasingly remote geographical locations, and finally reaching the consumer.

Many of the exchanges encountered in the supply chain are therefore between different companies that seek to maximize their revenue within their sphere of interest, but may have

little or no knowledge or interest in the remaining players in the supply chain. More recently, the loosely coupled, self-organizing network of businesses that cooperates to provide product and service offerings has been called the *extended enterprise*.

As part of their efforts to demonstrate ethical practices, many large companies and global brands are integrating codes of conduct and guidelines into their corporate cultures and management systems. Through these, corporations are making demands on their suppliers (facilities, farms, subcontracted services such as cleaning, canteen, security etc.) and verifying, through social audits, that they are complying with the required standard. A lack of transparency in the supply chain is known as mystification, which bars consumers from the knowledge of where their purchases originated and can enable socially irresponsible practices. Supply Chain Managers are under constant scrutiny to secure the best pricing for their resources, which becomes a difficult task when faced with the inherent lack of transparency. Cost Benchmarking is one effective method for identifying competitive pricing within the industry. This gives negotiators a solid basis to form their strategy on and drive overall spend down.

12.6 Modern Supply Chain Models:

There are a variety of supply chain models, which address both the upstream and downstream elements of supply chain management (SCM). The SCOR (Supply-Chain Operations Reference) model, developed by a consortium of industry and the non-profit Supply Chain Council (now part of APICS) became the cross-industry de-facto standard defining the scope of supply chain management. SCOR measures total supply chain performance. It is a process reference model for supply-chain management, spanning from the supplier's supplier to the customer's customer. It includes delivery and order fulfilment performance, production flexibility, warranty and returns processing costs, inventory and asset turns, and other factors in evaluating the overall effective performance of a supply chain.

The Global Supply Chain Forum has introduced another supply chain model. This framework is built on eight key business processes that are both cross-functional and cross-firm in nature. Each process is managed by a cross-functional team including representatives from logistics, production, purchasing, finance, marketing, and research and development. While each process interfaces with key customers and suppliers, the processes

of customer relationship management and supplier relationship management form the critical linkages in the supply chain.

Process Classification Framework (PCF) model was developed as an open standard to facilitate improvement through process management and benchmarking, regardless of industry, size, or geography. The PCF organizes operating and management processes into 12 enterprise-level categories, including process groups, and over 1,000 processes and associated activities. In the developing country public health setting, John Snow, Inc. has developed the JSI Framework for Integrated Supply Chain Management in Public Health, which draws from commercial sector best practices to solve problems in public health supply chains.

In 2013, the *Supply Chain Roadmap* has been presented. It is a method where an organization's supply chain strategy can be reviewed in an organized and systematic approach in order to assure alignment of the supply chain with the business strategy. The method is supported in the most important and recognised theories and practices about supply chain strategy and business strategy. The method allows the characterisation of the supply chain under analysis by 42 factors in a single page view called "The Map", and allows the comparison of this supply chain with 6-supply chain archetypes (fast, efficient, continuous flow, agile, custom configured, flexible), in order to find gaps between supply chain under analysis and the most proper supply chain model. Method is applied in four steps (scope, understanding, evaluation, redesign and deployment). The method was developed by Prof Hernan David Perez, an experienced supply chain manager in several industrial sectors.

12.7 Summary:

The move toward supply chain management has offered the firm an opportunity to create significant productivity gains at the interface between the vendor and the customer. Productivity is no longer limited to the transaction boundaries of the firm itself, but can be driven upstream to the vendor and downstream to the ultimate user or consumer. This opportunity has been recognized all over the world. There is enormous potential gain from improving productivity at the interface between partners, rather than simply focusing within the four walls of the firm itself. However, recognizing this fact, and moving from a traditional channel and a traditional costing system to a point where the firm’s costing system is congruent with the supply chain relationships require a new costing capability. Downsizing, rightsizing, and reengineering may cut cost out of the system, but it appears

that the name of the game in the last analysis is bringing value to the customer. Focusing on the consumer is not something new, but balancing customer value with cost reduction across an entire supply chain represents an important new frontier in the management process.

Resilience, as "the ability of a supply chain to cope with change", is regarded as the next phase in the evolution of traditional, place-centric enterprise structures to highly virtualized, customer-centric structures that enable people to work anytime, anywhere. Resilient supply networks should align its strategy and operations to adapt to risks that affect its capacities. There are 4 levels of supply chain resilience. First is reactive supply chain management. Second is internal supply chain integration with planned buffers and then comes collaboration across extended supply chain networks. Finally is a dynamic supply chain adaptation and flexibility.

12.8 Key Words:

- **Interface:** a point where two systems, subjects, organizations, etc. meet and interact
- **Productivity:** the effectiveness of productive effort, especially in industry, as measured in terms of the rate of output per unit of input.
- **TCO:** Total cost by ownership
- **Resilience:** the ability of a supply chain to cope with change
- **Simulation:** Imitation of situation or process

12.9 Assessment Questions:

- Explain the evolution of TCO concept in supply chain.
- Define TCA. Explain the different stages of TCA.
- Discuss in detail the complete methodology of TCO.
- “Modern approach of supply chains favours the alignment of the supply chain with the business strategy”. Comment on the statement with logics.

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