



T.Y. MCA
SEMESTER - V

**SUPPLY CHAIN
MANAGEMENT AND
LOGISTICS**

SUBJECT CODE : 56405

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SYLLABUS
T.Y. M.C.A.
SUPPLY CHAIN MANAGEMENT AND LOGISTICS
(ELECTIVE)

1. Understanding of Supply Chain

Objectives of Supply Chain, Importance, Decision Phase, Process View, Examples, Supply Chain Performance Drivers
Evolution and Overview of Supply Chain Management, Traditional and Modern Approach of SCM, Elements in SCM

2. Demand Management in Supply Chain

Demand planning & Forecasting, Types of Demand, Characteristics of forecasts, Components of a Forecast & Forecasting Methods, Basic Approach to Demand Forecasting, The Role of IT in Forecasting, Risk Management in Forecasting, Forecasting in practice, case studies

3. Procurement Management in Supply Chain

Introduction, Traditional Inventory Management, Inventory models, New Paradigms in Inventory, JIT, vendor managed inventory, case studies

4. Logistics Management

Introduction, History & evolution of Logistics, elements of logistics, Distribution management warehousing (types, operations, site selection, layout and design), Packing for logistics (concepts, importance, requirement, important aspects of logistics, packing Repacking & forwarding, Trends in packaging)

5. Transportation Problem

Role and Functionality in Supply Chain, Participants in transportation, Transportation formats, Modes, Decision and Other Formats and Transport Documentation Private Fleet Management : Process Factors and Drivers

6. Benchmarking the Supply Chain

Introduction and Concepts, Benchmarking the logistics process, Mapping SC process, Supplier and Distributor benchmarking, Case Study

7. IT for SCM

Concept of IT (need for IT, IT tools for business) IT Application in SCM, Evolution, benefits, role of internet, Issues with SCM system typical Data warehouse concepts, Data Mining, use of Data mining tools in SCM

8. Distribution Networks of Supply Chain :

Role of Distribution, influencing factors, design, application to e-business, Distribution networks in Practice

9. Network Design in Supply Chain :

Role of Network Design, influencing factors and Framework, models of facility location and capacity allocation, role of IT in network Design decisions in practice Term work/Practical : Each candidate will submit assignments based on the above syllabus will be submitted with the internal test paper.

References :

1. Supply Chain Management (Concepts & cases) – Rahul V. Altekar – [Prentice Hall of India, 4th Edition]
2. Supply Chain Management (Strategy, planning and operation) – Sunil Chopra, Peter Meindl, D.V. Kalra – [Pearson, 3rd edition]
3. Principles of Supply Chain Management : A Balanced Approach, Eisner, Cengage India
4. Logistics & Supply Chain Management (Strategies for Reducing cost & improving service) – Martin Christopher [FT financial Times/Pitman publishing, 2nd edition]
5. Logistics & Supply Chain Management (Cases & Concepts) – Raghuram & N. Rangaraj [McMillan India Ltd, 1st edition]



MODULE I- UNDERSTANDING OF SUPPLY CHAIN

1

INTRODUCTION TO SUPPLY CHAIN

Unit Structure :

- 1.0 Objectives
- 1.1 What is a supply chain?
- 1.2 The Objective of a Supply Chain
- 1.3 The Importance of Supply Chain Decisions
- 1.4 Decision Phases in a Supply Chain
- 1.5 Process View of a Supply Chain
- 1.6 Question
- 1.7 References

1.0 LEARNING OBJECTIVES:

After reading this chapter, you will be able to:

1. Discuss the goal of a supply chain and explain the impact of supply chain decisions on the success of a firm.
2. Identify the supply chain decision phases and explain the significance of each one.
3. Describe the cycle and push/pull views of a supply chain.
4. Classify the supply chain macro processes in a firm.

We provide a conceptual understanding of what a supply chain is in this chapter, as well as the different issues that must be considered when designing, planning, or running one. We address the importance of supply chain decisions and supply chain efficiency for a firm's success because supply chains play such a significant role in the success of any firm or organisation.

We also present many case studies from various industries to demonstrate the wide range of supply chain problems that organisations must consider at the strategic, planning, and operational levels.

1.1 WHAT IS A SUPPLY CHAIN?

A supply chain is a network that connects a business with its suppliers in order to manufacture and deliver a particular product to the end user. Different activities, individuals, organisations, knowledge, and

resources are all part of this network. The supply chain also refers to the measures involved in getting a product or service from its initial state to its final destination.

Companies build supply chains in order to minimise costs and stay competitive in the marketplace. Since an integrated supply chain results in lower prices and a quicker development cycle, supply chain management is critical.

A supply chain is made up of all parties involved in fulfilling a customer's order, whether directly or indirectly. Not only do manufacturers and suppliers play a role in the supply chain, but so do transporters, warehouses, retailers, and even consumers. The supply chain encompasses all roles involved in obtaining and fulfilling a customer request within each company, such as a producer. New product creation, marketing, operations, delivery, finance, and customer support are only a few of these features.

The customer and his or her need for detergent are at the start of the supply chain. The customer enters the Wal-Mart department store, which is the next level of the supply chain. Wal-Mart replenishes its shelves with products obtained from a finished-goods warehouse or a distributor using trucks provided by a third party. The distributor in turn is stocked by the manufacturer (say, Proctor & Gamble [P&G] in this case). The P&G manufacturing plant receives raw material from a variety of suppliers, who may themselves have been supplied by lower-tier suppliers.

For example, packaging material may come from Tenneco packaging, while Tenneco receives raw materials to manufacture the packaging from other suppliers. This detergent supply chain is illustrated in Figure 1.1 [1], with the arrows corresponding to the direction of physical product flow.

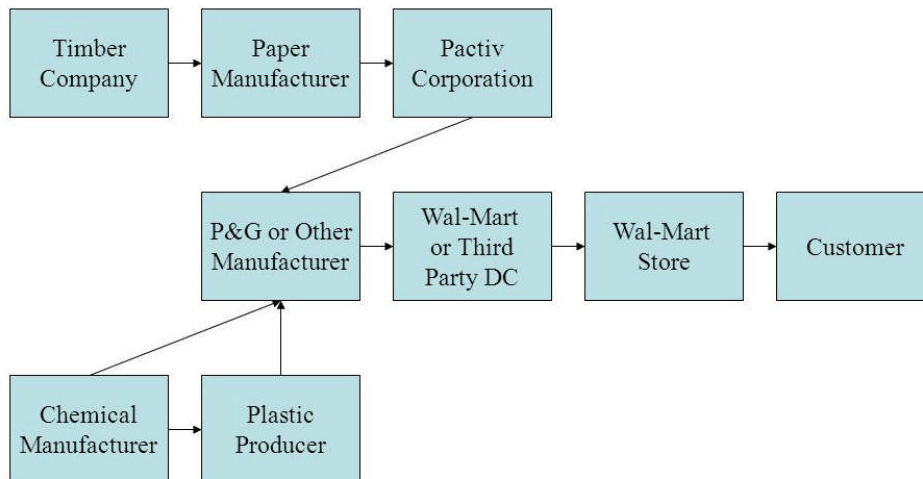


Fig 1.1 Stages of a Detergent Supply Chain

The constant flow of knowledge, product, and funds between stages of a supply chain makes it dynamic. Wal-Mart, in our case, gives the consumer the product as well as pricing and availability details. Wal-Mart receives the funds from the client. Wal-Mart sends point-of-sale data and replenishment orders to a warehouse or distributor, which then transports the replenishment order back to the store via trucks. Following the replenishment, Wal-Mart sends funds to the dealer. The dealer also sends Wal-Mart pricing details and distribution schedules. Wal-Mart can return your packaging to be recycled. Similar information, material, and fund flows take place across the entire supply chain.

The majority of supply chains are in fact networks. To define the structure of most supply chains, it may be more appropriate to use the terms supply network or supply web, as shown in Figure 1.2 [1].

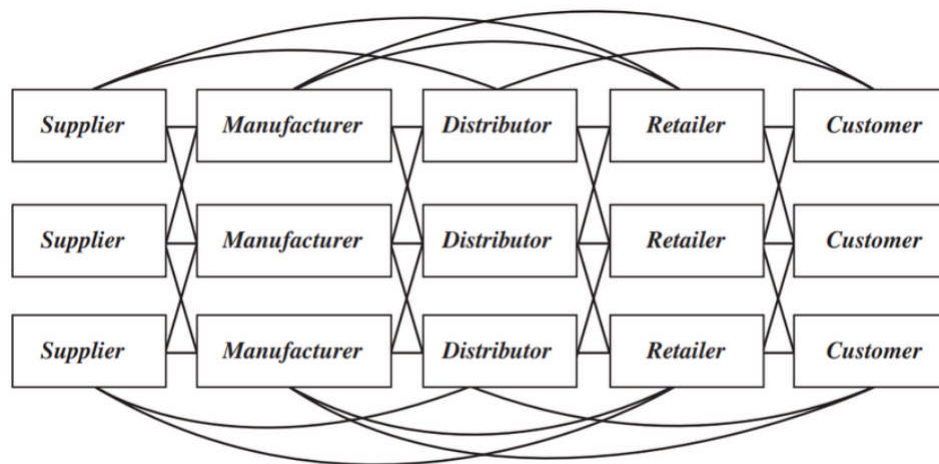


Fig. 1.2 Stages of Supply Chain

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

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

Each stage in a supply chain is connected through the flow of products, information, and funds. These flows often occur in both directions and may be managed by one of the stages or an intermediary. Each stage in Figure 1-2 need not be present in a supply chain. The appropriate design of the supply chain depends on both the customer's needs and the roles played by the stages involved. In some cases, such as Dell, a manufacturer may fill customer orders directly. Dell builds-to-order; that is, a customer order initiates manufacturing at Dell. Dell does not have a retailer, wholesaler, or distributor in its supply chain.

In other cases, such as the mail-order company L.L. Bean, manufacturers do not respond to customer orders directly. In this case, L.L. Bean maintains an inventory of products from which it fills customer orders. Compared to the Dell supply chain, the L.L. Bean supply chain contains an extra stage (the retailer, L.L. Bean itself) between the customer and the manufacturer. In the case of other retail stores, the supply chain may also contain a wholesaler or distributor between the store and the manufacturer.

1.2 THE OBJECTIVE OF A SUPPLY CHAIN

Every supply chain's goal should be to optimise the overall value created. The discrepancy between what the finished product is worth to the consumer and the costs the supply chain incurs in fulfilling the customer's request is the profit a supply chain produces. For most industrial supply chains, value is highly correlated with supply chain profitability (also known as supply chain surplus), which is the discrepancy between consumer sales and total supply chain costs.

For example: When a customer buys a wireless router from Best Buy, they pay \$60, which reflects income for the supply chain. Costs are incurred by Best Buy and other stages of the supply chain to transmit information, produce components, store them, transport them, and move funds, among other things. The benefit or surplus of the supply chain is the difference between the \$60 charged by the consumer and the total costs incurred by the supply chain to manufacture and deliver the router. The net benefit to be spread across all supply chain stages and intermediaries is known as supply chain profitability or surplus. The more profitable the supply chain, the more competitive the supply chain.

The performance of a supply chain should be calculated in terms of overall profitability rather than profits at individual stages. After defining a supply chain's performance in terms of profitability, the next logical step is to search for revenue and expense sources. There is only one source of revenue for every supply chain: the consumer. A customer who buys detergent at Wal-Mart is the only one who brings positive cash flow to the supply chain. Since various stages have different owners, all other cash flows are essentially fund exchanges that occur within the supply chain. When Wal-Mart pays a supplier, it takes a portion of the funds provided by the buyer and gives it to the supplier. Within the supply chain, all flows of knowledge, commodity, or funds produce costs.

Thus, the supply chain success depends on the proper control of these flows. To optimise overall supply chain profitability, effective supply chain management includes the management of supply chain assets and products, knowledge, and fund flows.

1.3 THE IMPORTANCE OF SUPPLY CHAIN DECISIONS

The performance of a supply chain is closely linked to the design and management of supply chain flows (product, information, and funds). Companies like Wal-Mart, Dell Computer, and Seven-Eleven Japan have based their reputation on superior supply chain design, preparation, and service.

Many e-businesses failure, such as Webvan's, can be due to flaws in their supply chain design and preparation. Similarly, Quaker Oats' 1994 purchase of Snapple is an example of how failure resulted from an inability to efficiently plan and control supply chain flows.

Wal-Mart has been a pioneer in supply chain design, preparation, and execution. To facilitate the efficient flow of goods and information, the organisation has invested heavily in transportation and information infrastructure since its inception.

Wal-Mart built its supply chain with clusters of stores around distribution centres to allow for regular and cost-effective replenishment of its retail stores. Stores that replenish often will better balance supply and demand than their competitors. Wal-Mart has been a pioneer in exchanging data and working with manufacturers to reduce costs and increase product selection. The outcomes are outstanding. The business posted a net income of more than \$9 billion on sales of about \$250 billion in their 2004 annual report. These are remarkable results for a business that had just \$1 billion in annual revenue in 1980. The growth in sales represents an annual compounded growth rate of 26 percent.

Dell has risen to become the world's largest personal computer (PC) maker in a relatively short period of time. Dell made a profit of over \$2.6 billion in 2004 on sales of just over \$41 billion. The way the company handles product, knowledge, and funds flows within its supply chain has been credited with a large part of its success. Dell sells directly to consumers, bypassing distributors and stores. Dell can create better predictions by keeping close touch with its customers and knowing their needs. Dell makes an active effort to direct consumers toward PC configurations that can be designed provided the components in real time, on the phone or on the Internet, to enhance the match between supply and demand. Dell consolidates production and inventory in a few locations and defers final assembly before orders arrive. As a result, Dell is able to provide a wide range of PC configurations while maintaining low inventory levels.

Dell had less than five days' worth of inventory in 2004, while the competition, which sold through supermarkets, had several weeks' worth. If Intel launches a new product, Dell's low inventory enables it to be first to market with a computer that includes the chip. If rates fall abruptly, as

they often do, Dell will have less inventory, which will lose value in comparison to its rivals. Dell does not maintain inventory for certain items, such as Sony monitors. The transportation company simply picks up the required number of computers and monitors from Dell's Austin, Texas, plant and Sony's factory in Mexico, matches them to customer orders, and delivers them to the customers. Dell will save time and resources by avoiding the extra handling of monitors with this technique.

The Dell supply chain's success is aided by sophisticated knowledge exchange. Dell provides manufacturers with real-time data on the current state of demand. Suppliers have access to the inventory levels of their products at the warehouses, as well as regular production requirements. Dell has developed personalised Web pages for its major suppliers to display demand projections and other customer-sensitive data, allowing suppliers to better understand customer demand and align their production schedules with Dell's. Dell's low inventory levels often help to prevent defects from spreading through a wide number of items. Supplier engineers are stationed in the plant when a new product is introduced. Output may be halted and flaws corrected in real time if a customer reports a problem. The amount of faulty products manufactured is reduced since there is no finished product in inventory. Dell also has a strong cash flow management strategy. It achieved a cash conversion period of negative 36 days in 2004 by closely monitoring inventories, receivables, and payables.

In other words, Dell made a profit on the people's money! Dell's supply chain design, as well as its product, knowledge, and cash flow management, clearly play a key role in the company's success. Dell's supply chain architecture, on the other hand, faces some new challenges in the changing industry. Although Dell has a supply chain that is well-suited to providing a high level of customization at a low cost, it is unclear if hardware customization will continue to be important for PCs and other Dell products. Dell's supply chain architecture will need to be rethought in the future if it is to remain effective. Many e-businesses, such as Webvan and Kozmo, have failed due to their inability to plan adequate supply chains or efficiently handle supply chain flows. Webvan devised a supply chain that included vast warehouses in a number of major US cities, from which groceries were distributed to customers' homes. Traditional supermarkets could not cope with this supply chain design in terms of cost. Complete truckloads of goods are delivered to a store near the customer by traditional supermarket chains, resulting in very low shipping costs.

They switch their inventory around quickly and let the customer do the majority of the picking in the shop. Webvan, on the other hand, turned inventory slightly faster than supermarkets, but at a much higher cost of shipping for home delivery and high labour costs for picking customer orders. As a result, the company folded in 2001, just two years after its highly profitable initial public offering. With its purchase of Snapple, Quaker Oats offers yet another example of how a failure to design and

control supply chain flows resulted in financial failure. Snapple, a maker of packaged natural beverages such as teas, was acquired by Quaker Oats for \$1.7 billion in December 1994. Quaker Oats' most popular beverage was Gatorade, the top-selling brand in the sports drink market. Snapple was high in the Northeast and on the West Coast, while Gatorade was strong in the South and Southwest of the United States. One of the main reasons for the merger, according to Quaker Oats, was the possible synergies between Snapple and Gatorade's distribution networks. However, the organisation was unable to capitalise on these synergies. Problems arose as a result of factors such as various production facilities and customer groups. Gatorade was made in Quaker Oats plants, while Snapple was made on a contract basis by outside plants. Snapple sold primarily through supermarkets and convenience stores, while Gatorade sold primarily through supermarkets and grocery stores through restaurants and independent retailers. In the two years following its purchase of Snapple, Quaker Oats' efforts to combine the two distribution networks failed to achieve much synergy. Quaker Oats sold Snapple to Triarc Companies for about \$300 million, or about 20% of the purchase price, just 28 months later. The failure of Snapple for Quaker Oats was largely due to the inability to create synergies between the two supply chains.

1.4 DECISION PHASES IN A SUPPLY CHAIN

Many decisions about the flow of knowledge, product, and funds are required for successful supply chain management. Every decision should be taken with the goal of increasing supply chain surplus. Depending on the frequency of each decision and the time period within which a decision process has an effect, these decisions are divided into three groups or phases. As a consequence, each decision category must take into account uncertainty over the decision horizon.

1. Supply Chain Strategy or Design: Given a product's marketing and pricing strategies, a company chooses how to structure the supply chain for the next few years during this process. It determines the chain's configuration, resource allocation, and the processes that each stage will execute. Companies make strategic decisions on whether to outsource or conduct supply chain functions in-house, the location and capacity of manufacturing and warehousing facilities, the goods to be produced or processed at various locations, the types of transportation to be made available along various shipping legs, and the type of information system to be used.

During this process, a company must ensure that its supply chain configuration supports its strategic goals and increases supply chain surplus. Cisco's decisions about product supply sources, contract manufacturers, and warehouse position and capability are both supply chain design or strategic decisions. Decisions on supply chain design are usually taken for the long term (a few years) and are very costly to change

on short notice. As a result, when businesses make these decisions, they must factor in the volatility of market conditions in the coming years.

2. Supply Chain Planning: The time period considered for decisions taken during this process is a quarter to a year. As a result, the supply chain configuration established during the strategic process is set in stone. This configuration defines the parameters under which planning must take place. Given the constraints, the aim of planning is to optimise the supply chain surplus that can be produced over the planning horizon during the strategic or design phase. Companies begin the planning process by forecasting demand in various markets for the coming year (or a comparable time frame). Making decisions on which markets will be supplied from which locations, production subcontracting, inventory strategies to be followed, and the timing and scale of marketing and price promotions are all part of planning.

Planning decisions are Dell's decisions about markets served by a production facility and target production amounts at each site. Planning sets the conditions under which a supply chain can operate over a given time span. Companies must factor volatility in demand, exchange rates, and competition into their planning decisions over this time period. Companies in the planning phase aim to leverage any flexibility built into the supply chain in the design phase and use it to maximise efficiency, given a shorter time period and better predictions than in the design phase. Companies describe a collection of operating policies that control short-term operations as a result of the planning process.

3. Supply Chain Operation: The time horizon here is weekly or regular, and companies make decisions about individual customer orders during this process. The supply chain configuration is considered set at the organisational level, and planning policies are already established. The aim of supply chain operations is to efficiently process incoming customer orders. During this phase, Firms allocate inventory or production to individual orders, set a deadline for filling orders, create pick lists at warehouses, assign orders to specific shipping modes and shipments, set truck distribution schedules, and position replenishment orders. There is less confusion regarding demand information since operational decisions are taken in the short term (minutes, hours, or days).

The aim of the operation phase is to leverage the reduction of uncertainty and maximise efficiency, given the constraints imposed by the configuration and planning policies. A supply chain's architecture, preparation, and execution have a significant effect on overall profitability and performance. It's safe to say that a significant part of Wal-and Mart's Dell's success can be attributed to their efficient supply chain planning, design, and service.

1.5 PROCESS VIEWS OF A SUPPLY CHAIN

A supply chain is a series of processes and flows that occur within and between stages in order to fulfil a customer's product need. There are two ways to look at the processes that take place in a supply chain.

1. Cycle View: A supply chain's processes are divided into a sequence of cycles, each of which is carried out at the point where two stages of the supply chain meet.

2. Push/Pull View: A supply chain's processes are classified into two groups based on whether they are carried out in response to a customer order or in anticipation of customer orders. Pull processes are started and completed in response to a customer request, while push processes are started and completed in advance of customer orders.

CYCLE VIEW OF SUPPLY CHAIN PROCESSES:

The five stages of a supply chain shown in Figure 1.2 [1], all supply chain processes can be broken down into the following four process cycles, as shown in Figure 1.3 [1]:

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

Each cycle occurs at the interface between two successive stages of the supply chain. As a consequence of the five phases, there are four supply chain phase cycles. All four cycles can not be clearly differentiated in any supply chain. All four cycles are likely to be divided in a food supply chain in which a retailer stores finished-goods inventories and places replenishment orders with a distributor. Dell, on the other hand, sells to consumers directly, bypassing the retailer and distributor.

Each cycle consists of six sub processes as shown in Figure 1.4 [1]. The supplier begins each cycle by selling the commodity to customers. After that, a customer places an order, which is then fulfilled by the supplier. The customer receives the order, which is fulfilled by the supplier. Any of the product or other recycled material can be returned to the supplier or a third party by the customer. The sequence of events then repeats itself.

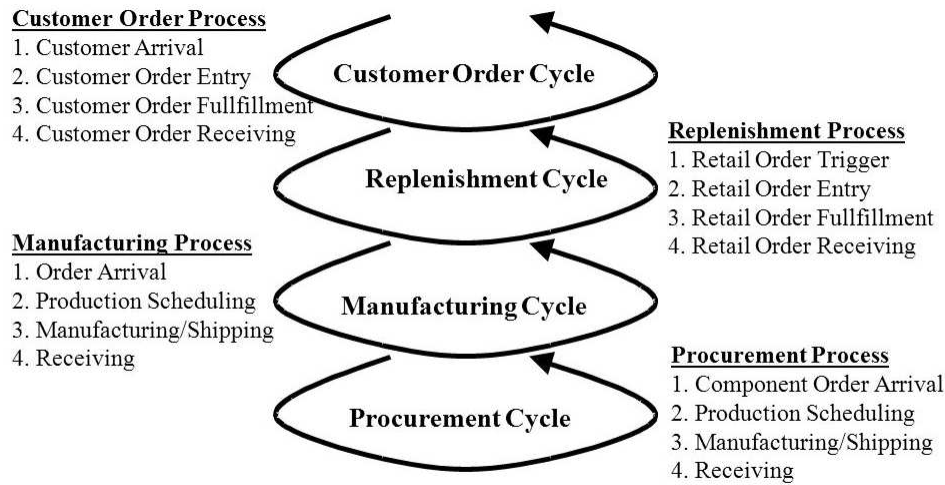


Fig. 1.3 Cycle view of Supply Chain Processes

Depending on the transaction in question, the sub-processes in Figure 1.4 [1] can be applied to the appropriate cycle. Customers that shop on Amazon are part of the customer order chain, in which the customer acts as the retailer and Amazon acts as the seller. Amazon, on the other hand, is part of the replenishment period as it buys books from a seller to replenish its inventory. Amazon is the retailer, and the distributor is the supplier.

The buyer's aim in each cycle is to ensure product availability and achieve ordering economies of scale. The supplier tries to anticipate consumer requests in order to lower the cost of receiving them. The supplier then works to complete the order on schedule and increase the order fulfilment process' quality and accuracy. The customer then sets out to reduce the cost of receiving. Reverse flows are managed to reduce cost and meet environmental objectives.

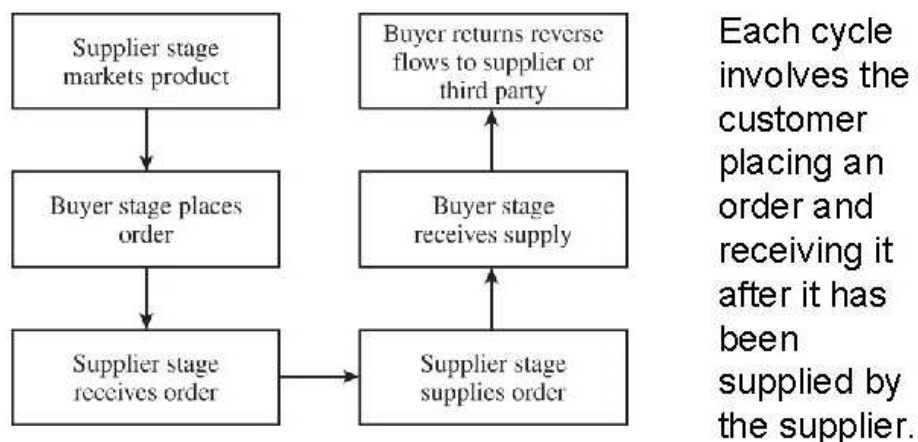


Fig. 1.4 Subprocesses in Supply Chain

Despite the fact that each cycle has the same basic sub-processes, there are a few key variations. Demand is external to the supply chain and therefore unpredictable in the customer order cycle. Order placement is

unpredictable like all other cycles, but it can be forecasted based on the policies adopted by the supply chain stage in question.

For example: Once the manufacturer's production schedule is established, a tyre supplier to an automotive manufacturer can accurately forecast tyre demand during the procurement cycle.

The size of an order is the second difference between cycles. Whereas a customer buys a single vehicle, the dealer orders several cars from the manufacturer at the same time, and the manufacturer, in turn, orders even more tyres from the supplier. The number of individual orders decreases as we switch from customer to supplier, while the size of each order increases.

As we get further away from the end user, exchanging knowledge and operating policies through supply chain stages becomes more relevant. When making tactical decisions, a cycle view of the supply chain is very useful because it clearly defines the functions of each supply chain member. The cycle view's comprehensive process overview forces a supply chain planner to think about the infrastructure needed to support these processes. When setting up information systems to support supply chain processes, for example, the cycle view is useful.

PUSH/PULL VIEW OF SUPPLY CHAIN PROCESSES

Depending on the timing of their execution in relation to end user demand, all processes in a supply chain fall into one of two groups. Pull processes begin execution in response to a customer request. Push processes start the execution phase before the customer orders come in. Therefore, at the time of execution of a pull process, customer demand is known with certainty, whereas at the time of execution of a push process, demand is not known and must be forecast.

Since they respond to customer demand, pull processes are also known as reactive processes. Since they respond to speculated (or forecasted) rather than actual demand, push processes are also known as speculative processes. As shown in Figure 1.5 [1], the push/pull boundary in a supply chain divides push and pull processes. Since consumer demand is unknown, push processes work in an unpredictable setting. Pull processes are used in situations where consumer demand is understood. However, they are often limited by inventory and capability decisions made during the push process.

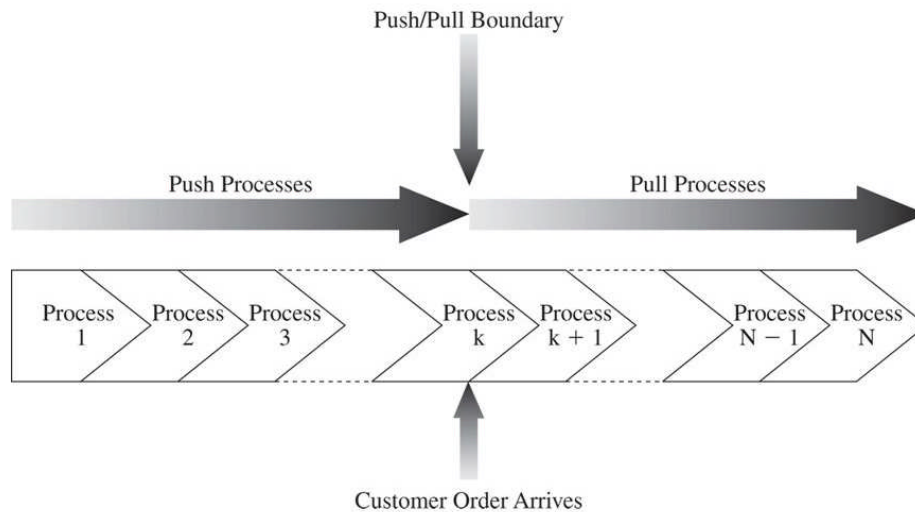


Fig. 1.5 Push or Pull View of Supply Chain

Let us compare a make-to-stock environment like that of L.L. Bean and a build-to order environment like that of Dell to compare the push/pull view and the cycle view.

After the customer arrives, L.L. Bean completes all processes in the customer order cycle. As a result, all processes related to the customer order cycle are pull processes. Order fulfilment is carried out using items that have been set up in anticipation of customer orders. The replenishment cycle's aim is to ensure that products are available when a customer order arrives. All processes in the replenishment cycle are push processes because they are carried out in anticipation of demand. The same can be said for the production and procurement processes. In reality, raw materials such as fabric are often purchased six to nine months ahead of anticipated consumer demand. Three to six months before the point of sale, the manufacturing process begins. As shown in Figure 1.6 [1], the processes in the L.L. Bean supply chain are divided into pull and push processes.

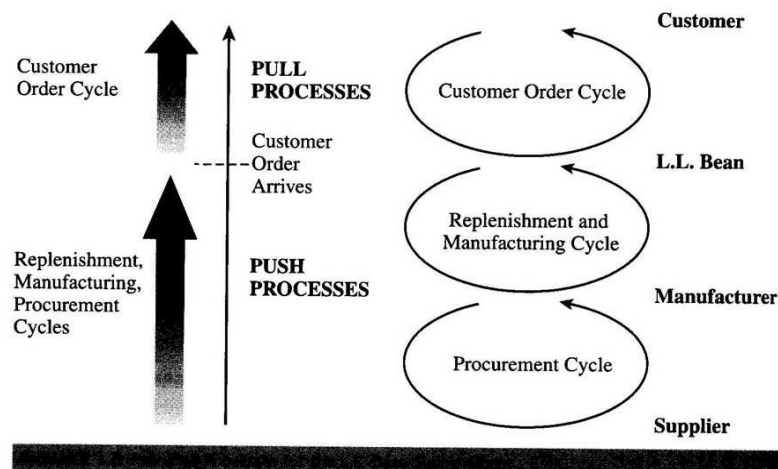


Fig. 1.6 Push/Pull View for L. L. Bean Supply Chain

The situation is different for a build-to-order computer manufacturer like Dell. Dell does not sell through a reseller or distributor but directly to the consumer. Demand is not filled from finished-product inventory, but from production. The arrival of a customer order triggers production of the product. The manufacturing cycle is thus part of the customer order fulfillment process in the customer order cycle. There are effectively only two cycles in the Dell supply chain: (1) a customer order and manufacturing cycle and (2) a procurement cycle, as shown in Figure 1-7.

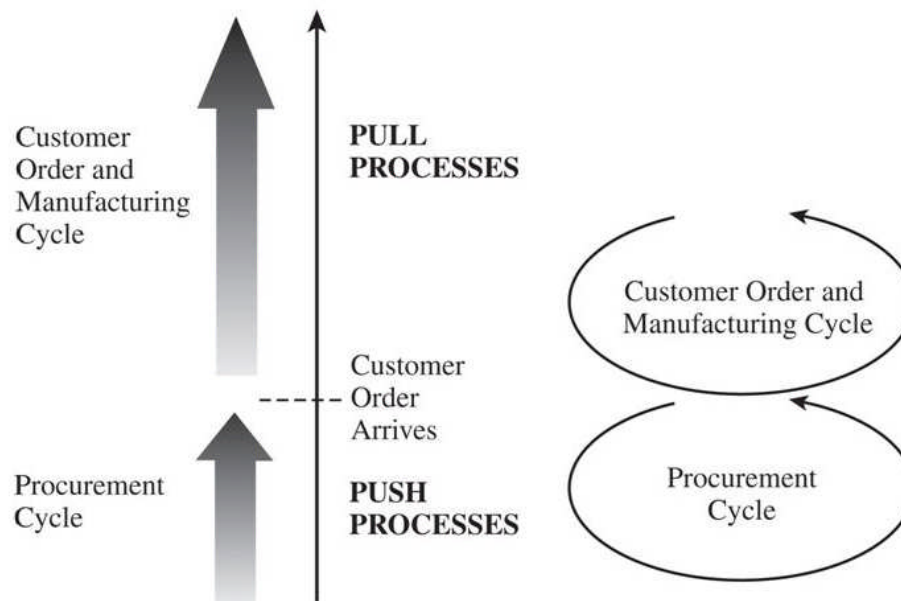


Fig. 1.7 Push/Pull View for Dell Supply Chain

Since customer arrival initiates all processes in the customer order and manufacturing cycle at Dell, they are known as pull processes. Dell, on the other hand, does not position part orders based on customer requests. In order to meet consumer demand, inventory is replenished. Since they are in response to a forecast, all processes in the Dell procurement cycle are known as push processes. As shown in Figure 1.7 [1], the processes in the Dell supply chain are divided into pull and push processes.

When making strategic choices about supply chain architecture, a push/pull view of the supply chain is extremely useful. The aim is to find an optimal push/pull boundary that allows the supply chain to efficiently balance supply and demand.

A great example of the benefits of properly adjusting the push/pull boundary is the paint industry. The manufacturing of paint necessitates the development of a foundation, the mixing of appropriate colours, and the packaging of the finished product. Both of these processes were carried out in huge factories until the 1980s, and paint cans were delivered to shops. These were classified as push processes because they were carried

out according to a schedule in anticipation of consumer demand. The paint supply chain had a tough time balancing supply and demand due to the volatility of demand. Paint supply chains were restructured in the 1990s so that colour mixing could be performed at retail stores after consumers had placed their orders.

In other words, even though base preparation and can packaging were still done in the push process of the supply chain, colour mixing was moved to the pull phase. As a result, consumers will still get the colour they want, while overall paint inventories in the supply chain have decreased.

KEY TAKEAWAYS

- A supply chain is a network between a company and its suppliers to produce and distribute a specific product or service.
- The entities in the supply chain include producers, vendors, warehouses, transportation companies, distribution centers, and retailers.
- The functions in a supply chain include product development, marketing, operations, distribution, finance, and customer service.
- Supply chain management results in lower costs and a faster production cycle.

1.6 IMPORTANT QUESTION

1. What is the objective of a supply chain?
2. What are the drivers of supply chain performance?
3. How are firms' core processes identified?
4. Discuss the goal of a supply chain and explain how supply chain decisions affect the success of a firm.
5. Explain the impact of responsiveness and efficiency on each of the major drivers of supply chain performance.
6. What is a supply chain?
7. What is a supply chain network?
8. Identify the major drivers of supply chain performance.
9. What are some ways that a firm such as Wal-Mart from outsourcing decisions?
10. Describe the impact of risk sharing on supplier performance and information distortion.

11. What are the decision phases in supply chain management? Identify factors influencing supply chain network decisions.
12. Explain the push/pull view of the processes within a supply chain and illustrate it with an example.

1.7 REFERENCES

1. Supply Chain Management (Concepts & cases) – Rahul V. Altekar – Prentice Hall of India, 4th edition]
2. Supply Chain Management (Strategy, planning and operation) – Sunil Chopra, Peter Meindl, D.V. Kalra – [Pearson, 3rd edition]



MODULE I- UNDERSTANDING OF SUPPLY CHAIN

2

OVERVIEW OF SUPPLY CHAIN MANAGEMENT

Unit Structure :

- 2.0 Objectives
- 2.1 Examples of Supply Chains
- 2.2 Supply Chain Performance Drivers
- 2.3 Evolution and Overview of Supply Chain Management
- 2.4 Traditional and Modern Approach of SCM
- 2.5 Elements in SCM
- 2.6 Questions
- 2.7 References

2.0 LEARNING OBJECTIVES:

After reading this chapter, you will be able to:

1. Describe how a company achieves strategic fit between its supply chain strategy and its competitive strategy.
2. Discuss the importance of expanding the scope of strategic fit across the supply chain.
3. Develop a sound understanding of the important role of supply chain management in today's business environment.
4. Become familiar with the traditional and modern approach of SCM.

2.1 EXAMPLES OF SUPPLY CHAINS

In this chapter, we examine a number of supply chains and ask questions that must be answered during the design, planning, and implementation stages.

2.1.1 TOYOTA: A GLOBAL AUTO MANUFACTURER

Toyota Motor Corporation is Japan's largest car manufacturer, with a long history of strong global market growth. The creation of Toyota's global manufacturing and distribution network is a top priority. Toyota's global plan calls for the company to construct factories in each of the regions it serves [1]

It must decide the production capacity of each plant, as this will have a direct impact on the distribution system desired. On the one hand, each plant could be set up to produce only locally. Each factory, on the other hand, has the capacity to meet any demand.

Even though the local market is weak, it upgraded its plants to be able to export to high-demand markets. Toyota refers to this approach as "global complementation."

Toyota is also discussing whether its parts plants should be global or local. Is it possible to build them for local use, or can a limited number of parts plants supply several assembly plants around the world?

Any global producer, such as Toyota, must answer the following questions about the supply chain's configuration and capability:

1. What should be the locations of the plants, and how much flexibility should be built into each? What should each plant's potential be?
2. Is it better for plants to be able to grow for all markets or only specific contingency markets?
3. How should plants be assigned to markets, and how often should this be done?
4. What level of flexibility does the delivery system have?
5. How valued should this flexible investment be?
6. What actions may be taken during product design to facilitate this flexibility?

2.1.2 AMAZON.COM: AN E-BUSINESS

AMAZON.COM is a leader in consumer e-business, selling books, music, and other products over the Internet. In response to customer requests, Amazon, based in Seattle, started by fulfilling all orders by buying books from a distributor. In contrast, a traditional bookstore purchases books directly from publishers and stores them on hand in preparation for customer orders [1].

It has six warehouses where it stores its products. Best-sellers are available on Amazon, but it still collects titles from distributors and publishers. Customers receive books through the US Postal Service and other package carriers such as UPS and FedEx.

Amazon has begun to broaden the range of products available for purchase on its website. Aside from books and music, it now sells toys, clothes, electronics, jewellery, and shoes. After several years of losses, Amazon has been profitable since 2003. [1]

There are some questions about Amazon's structure and how conventional bookshops have responded:

1. Why is Amazon expanding its warehouse footprint? What should be the number of warehouses, and where should they be located?
2. What are the benefits of selling books online versus in a conventional bookstore? Are there any drawbacks to selling on the internet?
3. Should Amazon stock every book it sells?
4. Should conventional bookstores manage e-commerce as a separate supply chain or incorporate it into their existing supply chain?

2.2 SUPPLY CHAIN PERFORMANCE DRIVERS

To understand how an organisation can improve supply chain performance in terms of responsiveness and quality, we must look at logistical and cross-functional drivers of supply chain success, such as warehouses, inventory, transportation, information, procurement, and pricing. The ability of these drivers to communicate with one another determines the supply chain's responsiveness and efficiency.

There are six Supply Chain Performance Drivers as follows:

1. **Facilities:** The physical locations in the supply chain network where product is assembled or fabricated are known as facilities. Production and storage facilities are the two most common types of facilities. The supply chain's output is heavily influenced by decisions about the role, location, capacity, and flexibility of facilities.

For example: Even though this activity decreases performance, an auto-parts dealer aiming for responsiveness can have several warehousing facilities located close to customers. A high-performance dealer, on the other hand, would have fewer warehouses to improve efficiency, despite the fact that this would decrease responsiveness.

2. **Inventory:** A supply chain's inventory includes all raw materials, work in progress, and finished products. Changing inventory policies can have a significant impact on the quality and responsiveness of the supply chain.

For example: A clothing store may improve its responsiveness by stocking large volumes of inventory and meeting consumer demand from stock. However, a large inventory raises the retailer's costs, making it less effective. Inventory reduction makes the retailer more competitive, but it damages its responsiveness.

3. **Transportation:** Transportation is the process of transferring inventory from one stage in the supply chain to another. Many different modes and routes may be used for transportation, each with its own set of performance characteristics. The type of transportation used has a significant effect on supply chain responsiveness and performance.

For example: A mail-order catalogue business can use a quicker mode of transportation to ship goods, such as FedEx, making the supply chain more responsive, but at the expense of efficiency due to FedEx's high costs. Alternatively, the company can ship the product through ground transportation, which is slower but less expensive, making the supply chain more efficient but limiting its responsiveness.

4. **Information:** Throughout the supply chain, information consists of data and analysis about warehouses, inventory, distribution, costs, prices, and consumers. Since it has a direct impact on all of the other drivers in the supply chain, information has the potential to be the most important driver of success. Management has the ability to make supply chains more responsive and effective by using information.

For example: A pharmaceutical company can produce and stock drugs in advance of customer demand using information on customer demand patterns, making the supply chain very responsive because customers will find the drugs they need when they need them.

This demand information can also improve the supply chain's efficiency by allowing the pharmacy company to better predict demand and manufacture only what is required. Information can also improve the efficiency of this supply chain by providing managers with shipping options that enable them to choose the most cost-effective option while still meeting service requirements.

5. **Sourcing:** Sourcing is the process of deciding who will handle a specific supply chain task, such as manufacturing, storage, transportation, or data management. These decisions decide what functions a company performs and what functions it outsources at the strategic level. A supply chain's responsiveness and quality are influenced by sourcing decisions.

For example: Motorola's productivity improved after it outsourced most of its production to contract manufacturers in China, but its responsiveness suffered due to the long distances. Motorola began flying in some of its mobile phones from China to compensate for the decrease in responsiveness, despite the fact that this option raised transportation costs.

Flextronics, an electronics contract manufacturer, wants to provide its customers with both responsive and reliable sourcing options. It is attempting to make its manufacturing facilities in the United States more responsive while maintaining the efficiency of its facilities in low-cost countries. Flextronics aims to become a reliable source for all customers by combining these resources.

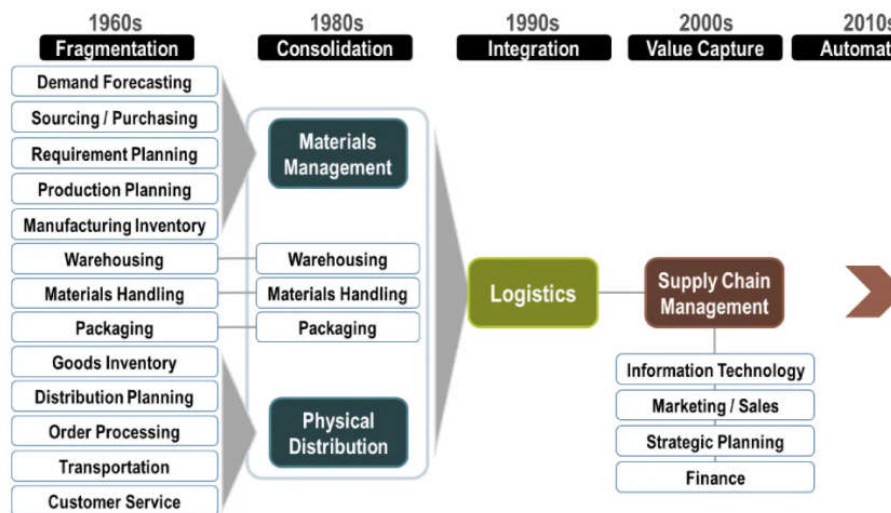
6. **Pricing:** Pricing establishes how much a company can charge for the products and services it makes available across its supply chain.

Pricing has an impact on the buyer's conduct, which in turn has an impact on supply chain efficiency.

For example: Customers who value efficiency will order early, while customers who value responsiveness will wait and order just before they need a product transported. If a transportation company bases its charges on the lead time offered by customers, it is very likely that customers who value efficiency will order early and customers who value responsiveness will order just before they need a product transported. If rates do not vary with lead time, early orders are less likely.

2.3 EVOLUTION AND OVERVIEW OF SUPPLY CHAIN MANAGEMENT

Since the system was highly fragmented, the evolution of supply chain management has been marked by a growing degree of convergence of separate activities, a pattern that was highlighted in the 1960s as a key area for potential efficiency improvements.



The Evolution of Supply Chain Management

Fig 2.1: The Evolution of Supply Chain Management

Fig.Source: <https://transportgeography.org/contents/chapter7/logistics-freight-distribution/evolutionlogistics-2/>

While the activities that make up logistics have remained largely consistent, in the 1970s and 1980s, they were split into two distinct functions: materials management and physical delivery.

With the development of supply chain management, however, a more complete integration became possible only with the introduction of new information and communication technologies. It enables the integrated management and control of information, financial, and product

flows, as well as the development of new manufacturing and distribution systems.

Supply chain management has evolved into a dynamic series of practises aimed at maximising value and increasing productivity. More recently, the evolution of both physical distribution and materials management has been dominated by the increasing degree of automation of supply chains.

This digitalization is especially noticeable in distribution centres, which have seen a significant push toward automation in areas like storage, materials handling, and packaging. Automated delivery vehicles may become a reality as a result of automation.

The two ends of the assembly line gradually became incorporated into the logistics of the supply chain, as advances in information and communication technology allowed for the timely supply of raw materials and parts from outside, as well as the efficient organisation of distribution and marketing.

Early examples of logistical engineering included high rack storage, which later became automatically driven, and the internal movement of packages by flat robots. Initially, logistics was divided into four functions: supplying, warehousing, manufacturing, and distribution, with the majority of them operating independently of one another. Firms were taking a more integrated approach with the new organisation and management concepts, leading to the upcoming demand for flexibility without increasing costs. At the same time, many companies used outsourcing and off shoring to take advantage of new manufacturing opportunities in developed countries.

As production became increasingly fragmented, activities related to its management were consolidated. Spatial fragmentation became a by-product of economies of scale in distribution.

2.4 TRADITIONAL AND MODERN APPROACH OF SCM

A supply chain is a global network that ensures that goods and services are delivered both domestically and globally. A supply chain ensures product distribution from raw materials to final customers by using a defined framework that includes an effective network and knowledge channel. Any product's specific supply chain includes raw materials, manufacturer, distributor, retailer and customer.

There are three entities of the supply chain, i.e. supplier, producer, and the customer, who perform different functions:

- The supplier provides raw materials, services, components and energy to the producer (i.e. fabric).
- The producer produces finished goods by utilizing the components or services provided by the supplier (i.e. clothes).
- The end customer is the one who purchases and receives the final product after it has been successfully manufactured and shipped.

SCM refers to the management of the supply chain, or the movement of products and services from the point of origin to the point of use. Multiple vendors and consumers are involved in the new process of SCM, known as SCM 2.0, which is based entirely on automated business transactions. Most freight companies now have a large SCM component. By offering the right technologies and services, SCM provides unique value to small, medium, and large businesses.

2.4.1 What is traditional SCM?

The traditional type of SCM entails a few, but straightforward, measures. To better understand the operating procedure of conventional SCM, consider the example of notebooks.

1. **Collection of raw materials:** The first phase entails gathering the raw materials needed to create the finished product. The raw materials in question may be of a single form or a mixture of goods gathered from different sources.
2. **Collection of material from the suppliers:** To produce the final finished product, the manufacturers must obtain all of the necessary raw materials.
3. **Manufacturing:** The manufacturer then starts and finishes all of the steps necessary to create the finished product. Various processes, such as making paper, binding papers, and covering the book, can be involved, with different equipment being used for each operation. After that, the company packages the books in boxes and prepares them for shipment and distribution.
4. **Distribution to the customers:** A process where the finished product, i.e. the book in this example, is distributed to the retailers.
5. **Consumption by the end customers:** The consumer purchases the finished goods as the final move. In this case, the book could be used for a variety of purposes by various people.

This is how the traditional SCM system works. SCM has become entirely digital as a result of technological advancements, resulting in a device known as Modern SCM. Modern SCM is used by top freight shipping companies, demonstrating the advancement of technology and its current effect on the logistics industry.

2.4.2 Traditional SCM Vs Modern SCM

1. Traditional SCM focuses only on production and provision, whereas Modern SCM focuses on the needs of the customers in general. For example, most of the freight companies also aim to improve the value of the product delivered to the customer, rather than just focusing on the aspect of distribution [2]
2. Traditional SCM encourages listed entities to follow a single direction, whereas modern SCM allows any business entity to enjoy the benefit of forming a partnership.
3. Modern SCM-enabled companies build and add value to the product that is purchased by the final consumer. Traditional SCM, on the other hand, lacks certain methods for increasing the value of the finished product.
4. Modern technologies and strategies are incorporated into Modern SCM. Whereas the traditional SCM follows the old methods.
5. Traditional SCM allows for a slower progression than Modern SCM. Traditional SCM does not allow businesses to use technologically advanced and integrated technology systems to ensure the expansion of their consumer portfolio, as modern SCM does.
6. Partnerships, alliances, and collaborations are more relevant in modern SCM. Companies can establish confidence and long-term relationships with their suppliers by improving their relationships with them. This has improved the export and import of goods to far-flung locations.

2.5 ELEMENTS IN SCM

There are four core elements of SCM as follows:

1. **INTEGRATION:** Integration should begin with your strategic planning phase and continue throughout your communications, knowledge exchange, data processing, and storage processes.

Human error, delays, shortages, and over/under-stocking are all reduced when you have a single-view, accurate, and reliable source of information on your supply chain activities and data. It also helps you to prepare for and manage supply problems or interruptions.

Examine your technology requirements and make sure that the solution you choose provides you with the resources you need to incorporate your entire supply chain solution while being versatile enough to adapt and expand with your business.

2. **OPERATIONS:** In order to track performance and forecast production and distribution patterns, your operations require an accurate, real-time representation of your inventory and production schedules.

You can align your operations with the rest of your company with the right tools, and provide accurate and reliable details on output and current inventories for more effective delivery processes.

Improve your profitability by anticipating potential interruptions and problems and streamlining your operating processes to ensure a faster, less costly road to fulfilment.

- 3. PURCHASING:** The right supply chain software will help you source goods for your supply chain and ensure you're getting the best prices and most consistent products.

Demand forecasting is a reliable and realistic way to ensure that you have the right commodity, in the right quantity, at the right time.

Keep track of vendors, competitors, and demand cycles to lower the operational costs in the sourcing and procurement process.

- 4. DISTRIBUTION:** The transportation, distribution, and return of goods are all aspects of your supply chain that can be streamlined, optimised, and corrected to improve customer experience and lower operating costs.

Regardless of whether an order originated in-store or online, the distribution and returns process should be centralised to provide a real-time view of inventory, order status, and stock position.

2.6 IMPORTANT QUESTION

1. In what way do supply chain flows affect the success or failure of a firm such as Amazon? List two supply chain decisions that have a significant impact on supply chain Profitability.
2. Give one example of Supply Chains.
3. What are Supply Chain Performance Drivers?
4. Explain the evolution and overview of Supply Chain Management
5. Explain the traditional and modern approach of SCM.
6. Differentiate between the traditional and modern approach of SCM.
7. Explain the different elements in SCM.
8. Explain why achieving strategic fit is critical to a company's overall success.
9. Discuss the role that IT can play in enabling supply chain management.

2.7 REFERENCES

1. Supply Chain Management (Concepts & cases) – Rahul V. Altekhar – [Prentice Hall of India, 4th edition]
2. Supply Chain Management (Strategy, planning and operation) – Sunil Chopra, Peter Meindl, D.V. Kalra – [Pearson, 3rd edition]



MODULE II: DEMAND MANAGEMENT IN SUPPLY CHAIN

3

DEMAND PLANNING & FORECASTING

Unit Structure :

- 3.0 Objectives
- 3.1 Demand planning & Forecasting
- 3.2 Types of demand Forecasting
- 3.3 Characteristics of Forecasts
- 3.4 Components of a Forecast and Forecasting Methods
- 3.5 Basic Approach to Demand Forecasting
- 3.6 Questions
- 3.7 References

3.0 Learning Objectives:

After reading this chapter, you will be able to:

1. Understand the importance of forecasting in both the business and supply chain.
2. Identify the components of a demand forecast.

3.1 DEMAND PLANNING & FORECASTING

The estimation of anticipated consumer demand based on historical sales data is known as demand forecasting. Despite the conflict between factual input and intuitive approximations, demand forecasting software has improved the accuracy of aggregate forecasts in this dynamic sector.

Demand forecasting's position in supply chain management is related to strategic business planning. Demand forecasting also initiates supply chain management drive processes such as raw material preparation, sourcing, and logistics. It directs the order management and delivery processes, as well as the pull processes.

3.1.1 Importance of Demand Forecasting in Supply Chain:

A product development strategy is a subset of a company's overall corporate strategy that involves introducing new products, improving existing products, and expanding product lines into new markets. To disrupt the rivalry, maintain market share, and meet sales growth and revenue targets, this is essential. This approach defines the new product's priorities and financing structure.

- **Boost Customer Satisfaction:** For assemble-to-order and made-to-stock business models, demand forecasting is particularly relevant. A satisfied customer is one who receives their ordered items on time. Shorter lead times and more effective delivery are made possible by demand forecasting.
- **Better Allocation of Resources and Capacity Planning:** Organizations can procure and purchase only the raw materials they need with a more reliable estimate of anticipated customer orders. It also ensures that, as a result of better capacity utilisation and resource distribution, the output plan would be more accurate.
- **Streamlining Inventory:** By offering more reliable inventory estimates across the supply chain, a good demand forecast reduces the Bullwhip effect. The company will only hold stock that will pass, from raw materials to finished goods. Overstocking and stockouts are less likely as a result of this.
- **Plan Sales Strategies:** Demand forecasts serve as a springboard for other company strategic planning activities such as product design and management for new and similar products. They also have critical information that is used to make buying, pricing, and marketing decisions for existing and new goods.
- **Better Supplier and Purchase Terms:** Demand forecasting, as previously mentioned, directs push processes including raw material preparation, sourcing, manufacturing, and inbound logistics. For buying managers, this means timely procurement plans that can be shared with suppliers ahead of time. As a result, you'll have stronger partnerships with suppliers and more negotiating power with them.

3.1.2 Advantages of Demand Forecasting:

Demand forecasting, when performed correctly, will help you increase your income by targeting the largest number of customers. However, profit isn't the only incentive to use demand forecasting software.

Other advantages include the following:

1) **Reduced Inventory Costs:** Static inventory, or inventory that doesn't leave your warehouse, takes up space and can raise prices. In reality, due to taxes, insurance, and warehousing costs, holding onto inventory for a year can increase the cost of that item by as much as 60%.

It's safer if an object spends as little time as possible in a warehouse.

2) **Better Supplier Relationships:** 3PLs collaborate closely with the vendors to ensure timely delivery of products and materials. Demand forecasting data may be used by purchasing managers to show suppliers how much more (or less) of a particular product or commodity would be

required over time. This degree of openness is beneficial to business and ensures that suppliers are satisfied.

3) Improved Resource Planning and Scalability: Every business wants to be thought of as scalable, but scalability can be difficult without demand forecasting. Scalability is a natural result of incorporating demand forecasting into the supply chain. These supply chains are designed to be adaptable, allowing them to scale up or down at any time.

4) Increased Customer Satisfaction: When discussing demand forecasting, it's easy to overlook the only thing that really influences demand: consumers. Customers are clear on what they want, and the faster they can get it, the better.

Demand forecasting keeps your warehouses ready for shifts in demand, so you'll be able to provide a fast, dependable solution for customers when a sudden spike in interest occurs. Customers will be pleased, and this will lead to increased customer retention, referrals, and valuable online feedback.

5) Better Performance: Every supply chain strives for efficiency, and demand forecasting improves efficiency. Demand forecasting helps every step of the supply chain, from staffing the right number of warehouse employees to ensuring that a warehouse isn't clogged with too many items.

3.2 TYPES OF DEMAND FORECASTING

The method of predicting potential consumer demand using historical sales data is known as demand forecasting. The accuracy of forecasts has an effect on a broad range of business processes, from inventory management to supply chain management.

A single demand forecasting model or a combination of multiple forecasting models may be used depending on a company's needs and objectives.

There are 6 types of demand forecasting:

1. Passive Demand Forecasting: It is the most basic form of demand forecasting, and it uses historical data to estimate potential consumer demand. Passive demand forecasting is a good match for companies that have good sales data and want to retain stability rather than expand.

2. Active Demand Forecasting: Market analysis and other external variables are used in active demand forecasting to estimate future consumer demand. Active demand forecasting is suitable for newly formed businesses or companies that are currently in a growth phase because it does not rely on sales data.

3. Short Term Projections: Customer demand for the next three months to a year is only estimated using short-term demand forecasting. Short-term market forecasting uses real-time sales data to update consumer demand forecasts that would have been obsolete if a long-term forecast had been used previously.

4. Long Term Projections: It forecasts consumer demand for the next one to four years. Market analysis and revenue data are used to make long-term forecasts. Since forecasts are likely to shift for such a long period of time, experts suggest that this forecasting style be treated as more of a general roadmap.

5. Internal Business Forecasting: It enables companies to determine if their capacity preparation is adequate to meet expected consumer demand. Internal market forecasting aids in recognising growth areas in order to maximise available capital by providing a more thorough overview of business operations.

6. External Macro Forecasting: It is a great way to control the supply chain. External macro forecasting identifies potential trends and how those trends can influence company objectives by focusing on external factors that influence market operations.

3.2.1 Demand Forecasting Models

Quantitative approaches and qualitative methods are the two types of demand forecasting models. When big data isn't available, such as when new goods are being produced and sales data isn't available, qualitative approaches come in handy. It uses techniques like machine learning to forecast potential consumer demand based on big data.

- 1. Trend projection:** It applies past sales data to future sales forecasts, and is widely regarded as the easiest and most streamlined forecasting model available. When unforeseen and influential changes occur, business professionals can update their trend forecasts in real time to ensure forecasting accuracy over time.
- 2. Sales Force Composite:** Sales force composite offers unparalleled insight into consumer needs and rivals by forecasting demand based on sales team feedback. The composite forecasting method for sales forces necessitates robust cross-departmental coordination, including managers and supervisors.

Business practitioners must take into account the fact that the sales force composite approach has a significant human bias. It is often used concurrently with quantitative methods for this reason.

- 3. Delphi Method:** The Delphi method employs external feedback in the form of surveys and questionnaires to forecast future demand. The Delphi forecasting model's end goal is a unified and informed consensus of experts.

4. **Market Research:** Market research forecasting is ideal for emerging businesses who need to consider consumer demand trends but don't have any previous sales data to analyse. Demand trends are established by the use of consumer feedback surveys, and potential marketing campaigns can be tailored to target particular audiences. Market research may take place over a short period of time or as part of a continuous business process.
5. **Econometrics:** Econometrics, which uses a lot of data, is based on a complex study of external variables. Because of the large amount of data that needs to be processed, machine learning tools are particularly useful in econometrics.

The ultimate goal of econometrics is to find connections between external economic variables. For example, customers with an increase in their incomes may correlate with increased home renovations. For example: customers with an increase in their incomes may correlate with increased home renovations.

3.3 CHARACTERISTICS OF FORECASTS

Demand forecasting characteristics in Supply Chain Management are as follows [1]:

- A. **Demand Forecasting is Always Wrong:** It is critical to recognise that demand predictions are always incorrect. Even if the demand forecasts are developed using demand forecasting software, some degree of error should be expected in the forecasts. This is because, no matter what business you work for, demand predictions will still vary from year to year. Seasonality and macroeconomic factors must be considered.
All of these factors, as well as others, would have a significant impact on demand, leaving you unable to reliably forecast demand.
- B. **Long-Term Demand Forecasts are Less Accurate:** Long-term demand forecasts are even less reliable than short-term forecasts, owing to the fact that demand forecasting is often incorrect. This is because the more you stretch your demand prediction, the more difficult it becomes to foresee what it would be. This is due to all of the variables involved in demand forecasting, as well as any unexpected events that may occur. As a result, it's critical to limit yourself to using only short-term demand forecasts to get a sense of what demand might be.
- C. **Aggregate Demand Forecast is More Accurate:** When it comes to precision, aggregate demand forecasts take the cake. This is due to the fact that aggregate demand planning has a lower standard deviation of error as compared to the mean. Aggregate demand forecasting is used by many major production plants, and it has resulted in significant

productivity gains in their operations. This form of software may be a bit more expensive than the others but is well worth the cost. The greater the aggregation, the more accurate is the forecast.

D. Collaborative forecasting reduces forecast error: In general, the higher an organisation is in the supply chain, the more information it receives is distorted. The bigger the forecast error, the higher up the supply chain an organisation is. Upstream businesses can reduce forecast error by using collaborative forecasting based on sales to the end customer.

3.4 COMPONENTS OF A FORECAST AND FORECASTING METHODS

What a company knows about its customers' past actions, on the other hand, may help it predict their potential behaviour. Demand does not arise in a vacuum. Companies must first determine the factors that affect future demand before determining the relationship between these factors and future demand in order to forecast demand.

When predicting demand, companies must consider both objective and subjective factors. We focus on quantitative forecasting methods in this chapter, companies must include human input when they make their final forecast.

For Example: Seven-Eleven Japan is a convenience store that provides its store managers with a cutting-edge decision support system that forecasts demand and recommends an order. The store manager, on the other hand, is in charge of making the final decision and placing the order because he or she may have access to business information not included in historical demand results. This understanding of business dynamics would almost certainly boost the forecast.

Improving demand forecasting by qualitative human inputs may result in significant payoffs for a supply chain. A company must be aware of a variety of factors relating to demand forecasting. Few of these factors are as follows:

- 1) Past demand
- 2) Lead time of product
- 3) Planned advertising or marketing efforts
- 4) State of the economy
- 5) Planned price discounts
- 6) Actions that competitors have taken

Such considerations must be understood before a company can choose an acceptable forecasting approach. For example, a company's demand for chicken noodle soup may have been low in July and high in December and January in the past. The scenario is likely to change if the

company plans to discount the commodity in July, with any potential demand moving to July. This aspect should be taken into account when the firm makes its forecast.

Forecasting methods are classified as follows:

- A. Qualitative
- B. Time series
- C. Causal
- D. Simulation

A. Quantitative: Primarily subjective; rely on judgment and opinion.

Qualitative forecasting relies heavily on human intuition and is often subjective. When there is a lack of historical data or when experts have business intelligence that might impact the prediction, they are the best option. In a new industry, such methods may be needed to forecast demand for many years.

B. Time series: Use historical demand only (like static , adaptive)

To make a prediction, time-series forecasting methods use historical demand. They are founded on the premise that market patterns in the past are a strong predictor of future demand. When the basic demand trend does not change dramatically from year to year, these strategies are most appropriate. These are the easiest approaches to adopt and can be a good place to start when forecasting demand.

C. Causal: Use the relationship between demand and some other factor to develop forecasts.

The demand forecast is strongly correlated with certain environmental conditions, according to causal forecasting methods. It discovers a connection between demand and environmental factors and forecasts future demand using predictions of what those factors will be. Consumer pricing, for example, is highly associated with demand.

As a result, companies may use causal approaches to calculate the effect of their behaviour.

D. Simulation: Imitate consumer choices that give rise to demand, can combine time series and causal methods.

Market decisions are imitated by simulation forecasting techniques. To arrive at a prediction, demand must increase. A company may use simulation to incorporate time-series and causal approaches to address questions like: What would the effect of a price reduction be? What effect will a rival opening a store nearby have? Airlines simulate consumer purchasing behaviour to predict demand for higher-fare seats.

It can be difficult for a company to determine which approach is best for forecasting. Several studies have shown that using several forecasting methods to produce a composite forecast is more accurate than using only one.

When future demand is linked to historical demand, growth rates, or seasonal patterns, time-series methods are the best option. There is always a random factor in any forecasting system that cannot be explained by historical demand trends.

Therefore any observed demand can be broken down into a systematic and a random component:

Observed demand (O) = systematic component (S) + random component (R)

The systematic portion calculates the expected value of demand and includes three components: level, which is the current deseasonalized demand; trend, which is the expected rate of growth or decrease in demand over the next period; and seasonality, which is the predictable seasonal variations in demand.

All a company can predict is the size and uncertainty of the random variable, which serves as a measure of forecast error. A successful forecasting tool, on average, has an error that is comparable to the random portion of demand. A manager should be wary of any forecasting system that claims to have no forecasting error based on historical demand. The approach has combined the historical random component with the systematic component in this case. As a result, the forecasting approach would almost certainly underperform. Forecasting's goal is to remove the random (noise) component and estimate the systematic component. The forecast error is a measurement of the discrepancy between predicted and actual demand.

3.5 BASIC APPROACH TO DEMAND FORECASTING

The six-step methodology outlined below will assist a company in forecasting effectively [1]:

- I. Understand the objective of forecasting.
- II. Integrate demand planning and forecasting throughout the supply chain.
- III. Understand and identify customer segments.
- IV. Identify the major factors that influence the demand forecast.
- V. Determine the appropriate forecasting technique.
- VI. Establish performance and error measures for the forecast.

I. Understand the objective of forecasting:

Every forecast supports decisions that are based on the forecast, so identifying these decisions clearly is an essential first step. How much of a specific product to produce, how much to inventory, and how much to order are all examples of such decisions. The relation between a supply chain decision and the forecast should be understood by all parties involved.

For Example: Wal-plans Mart's discount detergent during July must be discussed with the manufacturer, transporter, and those involved in filling demand, as they all have to make decisions based on demand forecasts. All parties involved should develop a joint forecast for the promotion and a plan of action based on the forecast. If these decisions aren't made together, there could be too much or too little inventory at different stages of the supply chain.

II. Integrate demand planning and forecasting throughout the supply chain:

A company's forecast should be linked to all supply chain planning activities. Capacity planning, production planning, marketing planning, and purchasing are only a few examples. Both the information system and human resources management should have this connection.

Since the results of the planning phase impact a wide range of roles, it's important that they're all factored into the forecasting process. In one unfortunate example, a retailer produces forecasts based on promotional events, while a producer, unaware of these promotions, develops a different forecast based on historical orders for its production planning. As a consequence, there is a supply-demand imbalance, resulting in weak customer service.

To achieve this convergence, a company should form a cross-functional team with members from each affected function responsible for forecasting demand, and even better, members from various companies in the supply chain should collaborate to produce a forecast.

III. Understand and identify customer segments:

The consumer segments that the supply chain serves must be identified by the company. Similarities in service specifications, market levels, order frequency, demand uncertainty, seasonality, and other factors may be used to group customers. Companies can use various forecasting methods for different segments in general. A better understanding of the customer segments allows for a more reliable and straightforward forecasting method.

IV. Identify the major factors that influence the demand forecast:

Following that, a company must determine which demand, supply, and product-related phenomena affect demand forecasting. On the demand side, a business must determine whether demand is increasing, decreasing, or seasonal. These projections must be based on data from demand and not from sales.

For example: In July 2005, a supermarket advertised a specific cereal brand. As a result, demand for this cereal was strong in July, while demand for similar cereal brands was poor. The supermarket does not predict that demand for this brand will be strong in July 2006 based on sales data from 2005, since this will only happen if the same brand is sold again in July 2006 and other brands react similarly to the previous year.

When forecasting demand, the supermarket must consider what demand would have been like if there were no promotions, as well as how promotions and competitor activities influence demand. Given the promotional activity planned for that year, a combination of these pieces of data would allow the supermarket to forecast demand for July 2006.

On the supply side, a company must consider the available supply sources when determining the forecast's accuracy. A highly accurate forecast might not be necessary if alternative supply sources with short lead times are available. However, if there is only one supplier with a long lead time, a reliable forecast would be extremely useful.

On the product side, a company must know how many variations of a solid product there are and whether these variants replace or supplement each other. When demand for one product affects or is affected by demand for another, it is better to make both predictions at the same time. For example: When a company launches an updated version of an existing product, demand for the original product is likely to fall as new consumers purchase the improved version. While historical data does not show a drop in demand for the original product, it is still useful because it helps the company to predict the overall total demand for the two versions. Clearly, demand for the two products should be forecast jointly [2].

V. Determine the appropriate forecasting technique:

A firm should first consider the dimensions that are applicable to the forecast before choosing an appropriate forecasting technique. Geographical location, product groups, and consumer groups are examples of these dimensions. The company should be aware of the variations in demand along each dimension, as each would most likely require different forecasts and techniques.

At this point, a company chooses one of the four forecasting methods discussed earlier: qualitative, time-series, causal, or simulation. As previously stated, combining these strategies is often the most efficient.

VI. Establish performance and error measures for the forecast:

To assess the forecast's accuracy and timeliness, companies should develop consistent performance metrics. These metrics should be closely correlated with the goals of the forecast-based business decisions. Consider a mail-order business that places orders with its suppliers higher up the supply chain using a forecast.

Orders take two months to arrive from suppliers. Because of the two-month lead period for replenishment, the mail-order company must ensure that the prediction is made at least two months before the start of the sales season. The organisation must equate real demand to forecasted demand at the end of the sales season to determine the forecast's accuracy. Following that, proposals for reducing potential forecast errors or reacting to observed forecast errors can be implemented.

3.6 IMPORTANT QUESTIONS:

1. What role does forecasting play in the supply chain of a build-to-order manufacturer?
2. How could manufacturers use collaborative forecasting with its suppliers to improve its supply chain?
3. What role does forecasting play in the supply chain of a mail order firm such as L.L. Bean?
4. What systematic and random components would you expect in demand for chocolates?
5. Why should a manager be suspicious if a forecaster claims to forecast historical demand without any forecast error?
6. Give examples of products that display seasonality of demand.
7. What is the problem if a manager uses last year's sales data instead of last year's demand to forecast demand for the coming year?
8. How do static and adaptive forecasting methods differ?

3.7 REFERENCES

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2. Supply Chain Management (Strategy, planning and operation) – Sunil Chopra, Peter Meindl, D.V. Kalra – [Pearson, 3rd edition]



MODULE II: DEMAND MANAGEMENT IN SUPPLY CHAIN

4

THE ROLE OF IT IN FORECASTING

Unit Structure :

- 4.1 The Role of IT in Forecasting
- 4.2 Risk Management in Forecasting
- 4.3 Forecasting in Practice
- 4.4 Case Studies
- 4.5 Questions
- 4.6 References

4.1 THE ROLE OF IT IN FORECASTING

The Information Technology revolution impacted the environment as well as all dimensions of business operations. The advancement in information technology has resulted in a variety of alternative supply chain management strategies. Supply chain management is a data-driven process[1].

Few important role of information technology in forecasting are as follows:

- Costs of operating processes are being reduced.
- Human errors are reduced, which improves the quality of information.
- Knowledge is transferred quickly between organisations.
- Competitive advantage
- Gathering and Evaluating information
- Provide information availability and visibility
- Enable a single point of contact for data
- Allow decisions based on total supply chain information
- Enable collaboration with partners
- For report generation and decision making
- Integrating and coordinating processes of supply chain
- Cost of information sharing
- Quick response

1. Integrated and Coordinated Supply Chain: Only when a supply chain is well integrated and organised will it function effectively. This critical role is performed by IT, which brings in various innovations and combines them to optimise the supply chain. Data collection is now feasible, as well as much simpler and more reliable, thanks to these technologies. As a result, accurate and thorough data analysis is possible, resulting in rational business decisions.

2. Increased Productivity: All organisations in the supply chain benefit from a smooth flow of information, emerging technology, and efficient communication. It acts as a catalyst for product movement. Instead of going back and forth, IT provides a continuous connection that transmits the necessary data.

3. Cost Reduction: IT allows for the most efficient use of resources and assets. To research patterns, old data is used, and technology is used to analyse it in order to improve results. When resources are used to their full potential, costs are reduced [2]

4. Product Improvement: IT is made up of tools and software that can be used to raise awareness early on. In a market where customers are always looking for something different, the product will either have to adapt or become obsolete. You must implement product improvement and innovation earlier rather than later if you want to remain in the company. IT can be used to verify the type and level of product enhancement.

5. Supply Chain Visibility: Information allows supply chain administrators to see the whole supply chain. Managers use the flow of information from one partner to the next, as well as the effect it has on others, to make strategic decisions.

Information Technology-enabled supply chain management would give a company a competitive edge over its rivals in the industry. IT is crucial in the decision-making process. Inside the supply chain, IT will help with collaboration and planning.

IT provides the tools to gather relevant data, break it down for proper analysis, and execute it for optimal supply chain success. Data is critical to supply chain execution because it provides the foundation from which supply chain managers can make decisions.

The secret to effective supply chain management is real-time or near-real-time data. Decision-makers may prepare, monitor, and change processes to achieve targets in procurement, inventory, production, and other areas with knowledge about the different stages of the supply chain.

Given the vast volume of data involved, the frequency at which forecasting is conducted, and the importance of obtaining the highest-quality results possible, IT has a natural role to play in forecasting. A key supply chain software product is the forecasting module within a supply chain IT system, also known as the demand planning module.

Using the strengths of IT in forecasting has a number of significant advantages.

Commercial demand preparation modules include a number of forecasting algorithms, some of which are very sophisticated and proprietary. These methodologies also yield more reliable forecasts than a general package such as Excel or any data visualization softwares.

Most demand planning software makes it simple to compare different forecasting algorithms to historical data in order to find the one that better suits the observed demand trends. Since different forecasting algorithms provide different levels of quality based on actual demand trends, having a variety of forecasting options is essential. As a result, the IT system can be used to evaluate the best forecasting approaches not just for the company as a whole, but also for specific product categories and markets.

A successful forecasting package can include forecasts for a wide variety of items that are updated in real time as new demand information becomes available. This allows businesses to adapt quickly to market shifts and escape the costs of a delayed response.

Good demand forecasting modules connect not only to customer orders but also to customer sales details, allowing for the most up-to-date data to be incorporated into the demand forecast. IT advances that enable the sharing and integration of forecasts between organisations are responsible for much of the progress in areas like collaborative planning.

Good demand planning modules include tools for performing what-if analyses to see how price changes might affect demand. These tools can be used to determine the scope and timing of promotions as well as analyse their impact on demand.

None of these techniques are foolproof. Forecasts are almost always incorrect. A successful IT system can aid in the tracking of previous forecast errors so that they can be factored into future decisions. A well-structured forecast, combined with a measure of error, will help you make better decisions.

Also with all of these advanced methods, human intuition is often the best predictor. One of the dangers of these IT tools is that they become too reliant on them, removing the human element from forecasting. Use the projections and the information they provide, but keep in mind that they can't determine any of the more qualitative aspects of future demand that you may be able to do yourself.

All of the major supply chain software companies, including ERP companies including SAP and Oracle, provide forecasting modules. There are also a range of statistical analysis software companies, such as SAS, that have forecasting programmes. Finally, with their emphasis on customer-facing processes, some CRM-focused companies have forecasting elements in their products.

Why is technology important in supply chain management?

In the last few decades, business processes have become digitized, and it has become a requirement rather than a choice. IT incorporates various supply chain activities carried out by various firms. It improves the efficiency of business processes and eliminates bottlenecks.

Companies, especially in manufacturing, are getting closer to achieving on-time procurement, shorter inventory, and improved performance.

Technology has paved the way for quicker and more reliable supply chain software. Businesses can use technology to provide data collection, enhance labour control, track resources, and reduce stock losses through real-time stock checking across warehouse and transportation systems.

How do suppliers benefit from Information Technology use in Supply Chain?

The supplies are the first link in the supply chain. Manufacturers and suppliers can better cooperate and prevent production delays due to inadequate raw materials if they use a secure supply chain programme that enables real-time knowledge sharing.

Normally, manufacturers conduct transactions with suppliers; however, if you're a supplier, you can keep track of your clients' inventory, predict potential demand, and ensure that you're ready to fill raw material orders. Suppliers may also use historical data to make informed decisions in areas such as contract management and collaboration.

How manufacturers benefit from IT in the supply chain?

IT allows for greater awareness and openness, which leads to increased accountability and control over product production. Manufacturers with good insight into their production processes may make changes to improve efficiency and predict and avoid problems. A producer, for example, may use IT to predict delays and make adjustments to the production schedule.

How information technology helps shippers in the supply chain?

In every sector, on-time delivery is critical. On-time delivery almost always leads to customer satisfaction, and customer satisfaction almost always leads to customer retention.

As a shipper or logistics company, you can improve order monitoring and distribution to ensure customer loyalty. Keeping suppliers and distributors up to date on the distribution process and any potential delays brings you one step closer to repeat business. Many distribution and shipping service providers' supply chain management solutions often enable you to provide clients with access to a forum where they can feel in charge.

How do distributors get benefits from the use of IT?

Distributors that waste a lot of time and resources on inventory management may rely on supply chain management software for some much-needed help. Distributors no longer have to worry about surplus or inadequate stock with the right method and recorded procedure. Instead, they can forecast demand and control inventory and orders efficiently.

How retailers can use Information Technology in the supply chain?

Retailers are the ones that interact with customers in the supply chain. They need integration, as well as versatility and visibility. Retailers can link their point-of-sale devices, which track transactions, with their stock-level tracking tool, which is noticeable to the distributor. Retailers may also set a reorder point, which will automatically create an order when it is reached.

4.1.1 The functional roles of IT in Supply Chain Management

Apart from the above-mentioned basic roles, there are three functional roles of IT in supply chain management. These are as follows:

1. **Transaction Execution:** The number of transactions between supply chain participants is reduced as information flows efficiently between them. IT improves the performance of data exchanges that are repeated. For delivery verification, order management, billing, and dispatch guidance, this information is typically sufficient.
2. **Collaboration and Coordination:** The flow of information is made by IT. This facilitates better preparation, teamwork, and cooperation among all participants. Forecasting demand allows for future planning, and order monitoring makes knowing the physical location of each order a fact. Neither of these things would be feasible without the use of technology.
3. **Decision Support:** Good choices do not appear out of nowhere. They are, and should be, data-driven. IT is a big help in decision-making. It can take even the most complex data and transform it into easy-to-understand graphs and reports. IT provides decision support to all managers in this situation.

4.1.2 Software for Supply Chain Management

There are many tools that are used for effective supply chain management. These are primarily categorised as:

1. **Enterprise Resource Planning:** Enterprise resource planning (ERP), a framework that connects individual IT applications into a single one, evolved from materials requirement planning, which was previously used to distribute resources for a manufacturing operation. As a consequence, the data and procedures of the whole enterprise are integrated.

As all processes are consolidated, data on cash flow and material flow becomes more understandable. ERP has evolved into the cornerstone of the supply chain, providing a unified view of the entire organisation. Many tasks have been automated as a result of ERP, requiring no human interference.

2. **Electronic Data Interchange (EDI):** The transmission of business data from one device to another is known as electronic data interchange. It is normally done in a standard format so that all parties involved can use it as required without having to continually request it. Electronic data

interchange helps businesses to connect with one another through industries.

All who use EDI adheres to the same set of rules and procedures. This results in enhanced inventory control, corporate relationships, and customer support.

3. Supply Chain Management Systems: A good supply chain management system can assist with planning, vendor selection, sourcing, storage, and customer relationship management. to provide the assistance needed The programme used is Supply Chain Planning (SCP) and Supply Chain Execution (SCE).

4. Customer Relationship Management: CRM, also known as e-CRM, is a form of IT that helps an e-business manage its customer base. It aligns consumer expectations with product plans in order to boost sales.

4.2 RISK MANAGEMENT IN FORECASTING

When planning for the future, the risks associated with forecast error must be addressed. Forecasting errors can result in major resource misallocations in inventory, equipment, transportation, sourcing, pricing, and even information management. Forecasting errors during network design can result in the construction of too many, too few, or the wrong types of facilities.

Forecasts are used to assess plans at the planning stage, so the actual inventory, manufacturing, shipping, sourcing, and pricing plans that a company creates and executes rely on accurate forecasting. Forecasting plays a role in the actual day-to-day activities that are carried out within an organisation, even on an operational level.

Forecasting requires a considerable amount of inherent risk since it is one of the first processes in any of these phases and impacts several other processes.

A variety of factors can cause a forecast to be incorrect, but a few stand out as being particularly common. Long lead times necessitate making predictions further in advance, lowering the forecast's reliability. Seasonality also has the effect of increasing forecast error. Since there is no historical data to base a forecast on when product life cycles are short, forecast errors rise.

Demand from a few large customers is always lumpy and difficult to forecast, whereas demand from a large number of small customers is smoother. When forecasts are based on orders put by intermediaries in a supply chain rather than end-customer demand, forecast consistency suffers.

This was particularly apparent in the telecommunications industry in 2001, when vendor predictions far outstripped consumer demand. Without a clear picture of end-customer demand, a company will still struggle to make accurate predictions.

Increasing the supply chain's responsiveness and leveraging demand pooling opportunities are two techniques used to minimise forecast danger. W.W. Grainger collaborated with manufacturers to reduce lead times from eight to under three weeks. Increased responsiveness enables the company to reduce forecasting errors and, as a result, the risk associated with them.

By combining several sources of demand, pooling helps to smooth out lumpy demand. Since Amazon pools regional demand through its warehouses, it has a lower forecast error than Borders.

Improved responsiveness and pooling are often associated with an expense. Increased speed can necessitate increased power, while pooling tends to raise transportation costs. It's critical to tailor mitigation strategies to strike the right balance between risk mitigation and expense.

For example: Spending huge sums to improve the supply chain's responsiveness is not warranted when dealing with a product where shortfalls can quickly be made up for by spot market purchases. Investing in responsiveness, on the other hand, could be worthwhile for a product with a short life cycle.

Similarly, the advantage of pooling is most likely to be significant only when the underlying forecast error is high. For goods with minor forecast errors, an expenditure in pooling efforts may not be justified.

4.3 FORECASTING IN PRACTICE

- Collaborate in building forecasts
- The value of data depends on where you are in the supply chain
- Be sure to distinguish between demand and sales

Collaborate in building forecasts:

When you collaborate with your supply chain partners, you will usually get a much more reliable forecast. Building partnerships with your collaborators takes time and effort before you can start sharing information and generating joint forecasts. Collaboration's supply chain benefits, on the other hand, are often orders of magnitude greater than the cost.

The fact is that most predictions today do not even take into account all of the data available through a company's various functions. Until all supply chain data is accounted for and used, progress must be made.

Share only the data that truly provide value:

The value of data is determined by one's position in the supply chain. A retailer, for example, considers point-of-sale data to be extremely useful in assessing the success of its stores. A manufacturer selling to a distributor who then sells to retailers, on the other hand, does not need all of the point-of-sale information.

The manufacturer considers aggregate demand data to be extremely useful, with precise point-of-sale data providing slightly more value. Limiting the data exchanged to what is actually necessary reduces IT investment and increases the likelihood of fruitful collaboration.

Be sure to distinguish between demand and sales:

Companies also make the mistake of looking at historical revenues and believing that this was the market in the past. Adjustments must be made for unmet demand due to stockouts, competitor behaviour, pricing, and promotions in order to obtain true demand. If you don't, you'll end up with predictions that don't reflect the current situation.

Limitations of Forecasting:

1. It requires a high degree of skill and the process must be undertaken by specialists. This is difficult in practice.
2. Proper forecasting needs adequate reliable information and it is very difficult to collect reliable information. Hence, a correct forecast is impossible.
3. There is no certainty of occurrence of future events predicted by forecasting.

4.4 CASE STUDIES

SPECIALTY PACKAGING CORPORATION, PART A

Julie Williams had a lot on her mind when she left the conference room at Specialty Packaging Corporation (SPC). Her divisional manager had informed her that she would be assigned to a team consisting of SPC's marketing vice president and staff members from their key customers. The goal of this team was to improve supply chain performance, as SPC had been unable to meet demand effectively over the previous several years. This often left SPC's customers scrambling to meet new client demands. Julie had little contact with SPC's customers and wondered how she would add value to this process. She was told by her division manager that the team's first task was to establish a collaborative forecast using data from both SPC and its customers. [1]

This forecast would serve as the basis for improving the firm's performance, as managers could use this more accurate forecast for their production planning. Improved forecasts would allow SPC to improve delivery performance. [1]

SPC

SPC turns polystyrene resin into recyclable/disposable containers for the food industry. Polystyrene is purchased as a commodity in the form of resin pellets. The resin is unloaded from bulk rail containers or overland trailers into storage silos. Making the food containers is a two-step process [1].

- 1) Resin is conveyed to an extruder, which converts it into polystyrene sheet wound into rolls. The plastic comes in two forms- clear and black. The rolls are either used immediately to make containers or are put into storage.
- 2) The rolls are loaded onto thermoforming presses, which form the sheet. The two manufacturing steps are shown in below figure 4.1.

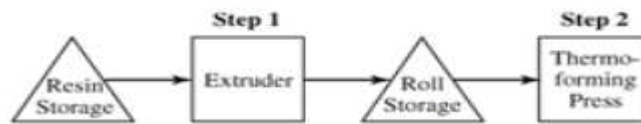


Fig: 4.1 Manufacturing process at SPC [1]

| <i>Year</i> | <i>Quarter</i> | <i>Black Plastic Demand (‘000 lb)</i> | <i>Clear Plastic Demand (‘000 lb)</i> |
|-------------|----------------|---|---|
| 2002 | I | 2,250 | 3,200 |
| | II | 1,737 | 7,658 |
| | III | 2,412 | 4,420 |
| | IV | 7,269 | 2,384 |
| 2003 | I | 3,514 | 3,654 |
| | II | 2,143 | 8,680 |
| | III | 3,459 | 5,695 |
| | IV | 7,056 | 1,953 |
| 2004 | I | 4,120 | 4,742 |
| | II | 2,766 | 13,673 |
| | III | 2,556 | 6,640 |
| | IV | 8,253 | 2,737 |
| 2005 | I | 5,491 | 3,486 |
| | II | 4,382 | 13,186 |
| | III | 4,315 | 5,448 |
| | IV | 12,035 | 3,485 |
| 2006 | I | 5,648 | 7,728 |
| | II | 3,696 | 16,591 |
| | III | 4,843 | 8,236 |
| | IV | 13,097 | 3,316 |

Table 4.1 Quarterly Historical Demand for clear and black plastic containers [1]

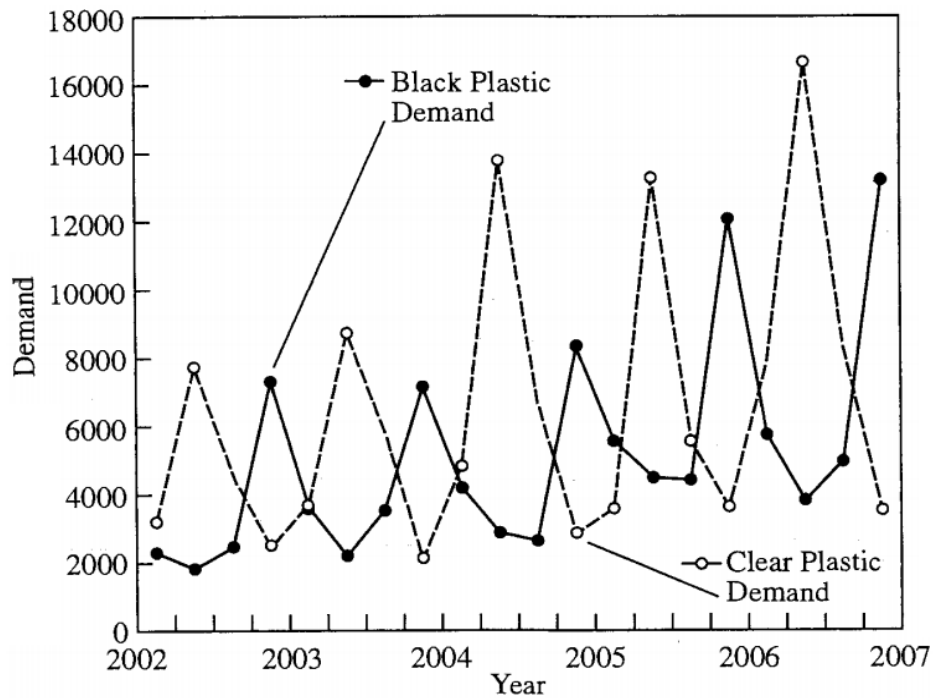


Fig: 4.2 Plot of quarterly demand for clear and black plastic containers [1]

Over the past five years, the plastic packaging business has grown steadily. Demand for containers made from clear plastic comes from grocery stores, bakeries, and restaurants. Caterers and grocery stores use the black plastic trays as packaging and serving-trays. Demand for clear plastic containers peaks in the summer months, whereas demand for black plastic containers peaks in the fall. Capacity on the extruders is not sufficient to cover demand for sheets during the peak seasons. As a result, the plant is forced to build inventory of each type of sheet in anticipation of future demand. Table 4.1 and figure 4.2 display historical quarterly demand for each of the two types of containers (clear and black). The team modified SPC's sales data by accounting for lost sales to obtain true demand data. Without the customers involved in this team, SPC would never have known this information, as the company did not keep track of lost orders.[1]

FORECASTING

As a first step in the team's decision making, they want to forecast quarterly demand for each of the two types of containers for the years 2007 to 2009. Based on historical trends, demand is expected to continue to grow until 2009, after which it is expected to plateau. Julie must select the appropriate forecasting method and estimate the likely forecast error. Which method should she choose?

4.5 IMPORTANT QUESTION

1. What is the role of IT in forecasting?
2. Why is technology important in supply chain management?
3. How do suppliers benefit from Information Technology use in Supply Chain?
4. How manufacturers benefit from IT in the supply chain?
5. How information technology helps shippers in the supply chain?
6. How do distributors get benefits from the use of IT?
7. How retailers can use Information Technology in the supply chain?

4.6 REFERENCES

1. Supply Chain Management (Concepts & cases) – Rahul V. Altekar – [Prentice Hall of India, 4th edition]
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MODULE - III

5

PROCUREMENT MANAGEMENT IN SUPPLY CHAIN

Unit Structure :

- 5.1 Introduction
- 5.2 Traditional Inventory Management
- 5.3 Inventory Models
- 5.4 New Paradigms in Inventory
- 5.5 JIT
- 5.6 Vendor Managed Inventory
- 5.7 Case Studies

5.1 INTRODUCTION

Procurement is the process of acquiring the goods for your company to smoothly run the business. Procurement refers to all of the tasks involved in obtaining the optimal product from the vendor, on optimal terms. The goal of procurement management is to ensure that the company receives goods, services, or works at the best possible price. Procurement involves everything it takes for a company to obtain the goods and services it needs as well as it includes planning, quality control, pricing, supplier selection, and waste management.

5.2 TRADITIONAL INVENTORY MANAGEMENT

Traditional inventory systems have continuously focused on enhancing forecasting. Traditional inventory systems attempt to resolve the inventory management problem through better forecasting, improvements in the order point / order quantity process, or by regulating protection stock levels. Traditional inventory management has technologically innovative and software-driven systems.

Elements involved in Traditional Inventory Management are: -

1) Dealer Agreements

Agreements with suppliers are significant starting point in a traditional inventory system. The moto is to keep away from paying complete remuneration for incoming stock. Aspect to stable fee contracts and reductions in alternate for consistent orders over specific periods. Since traditional systems absence the hyper-productivity of just-in-time systems, it is essential to reduce costs by establishing mutually beneficial, long-term relationships. Try to promote a small number of

complementary suppliers to make sure you have a reliable source if one supplier can't deliver on time.

2) Stock Levels

Once reordering process completed then Stock levels must be monitored frequently in a traditional inventory system. If you analyse the inventory in an average of four weeks, consider checking stock levels every week to find out what's running low. If you operate a point-of-sale system tied into your accounting system, run inventory reports directly from your accounting system to save time. However, audit your actual inventory levels frequently with hand counts to confirm accuracy. Adjust your reorder points over time to rise your ordering efficiency.

3) Traditional Order

Organization place orders in a traditional inventory system through an online way like Mobile phone, Email, Fax etc. The manual nature of this process sets it apart from modern technology-driven systems. In a just-in-time system, for example, integrated software housed by suppliers and customers both places and processes orders without providing any input.

4) Inventory Storage

Warehousing is an important element of traditional inventory management when it comes to price. The methodology for order-placement and processing traditionally work creates the need to have additional inventory on hand. That means having warehouses to stock goods until they can be distributed to customers. Perishable, refrigerated or risky goods require additional care and therefore requires additional expense. Cost disadvantages also include extra property taxes, security and safety systems, warehouse personnel, theft and damaged goods.

5.3 INVENTORY MODELS

Inventory also referred as stocks are basically the goods and raw materials that any organization would hold and are ready or will be ready for sale. Inventory model is a mathematical model that helps business in determining the optimum level of inventories that should be maintained in a production process, managing frequency of ordering, deciding on quantity of goods or raw materials to be stored, tracking flow of supply of raw materials and goods to provide uninterrupted service to customers without any delay in delivery.

There are two types of Inventory model widely used in business.

- 1. Fixed Reorder Quantity System**
- 2. Fixed Reorder Period System.**

A. Fixed Reorder Quantity System.

1. Fixed Reorder Quantity System is an Inventory Model, where an alarm is raised when the stock level drops below a **fixed quantity** and new

orders are raised to replenish the inventory to an optimum level based on the demand.

2. The point at which the inventory is ordered for replenishment is termed as **Reorder Point**.
3. The inventory quantity at Reorder Point is termed as **Reorder Level** and the quantity of new inventory ordered is referred as **Order Quantity**.
4. **Average Demand (DAv)**: It is the average number of order requests made per day.
5. **Average Lead Time (TL)**: The time required to manufacture goods or product.
6. **Average Lead Time Demand (DL)**: Average number of orders requested during the Lead Time.

$$\text{Average Lead Time Demand (DL)} = \text{Average Demand (DAv)} \times \text{Average Lead Time (TL)}$$

7. **Safety Stock (S)**: Organization always maintain extra stock that is always to mitigate any future risks arising due to stock-outs because of shortfall of raw materials or supply, breakdown in machine or plant, accidents, natural calamity or disaster, labour strike or any other crisis that may stall the production process. The quantity of safety stock is often derived by analysing historical data and is set to an optimized level by evaluating carefully the current cost of inventory and losses that may be incurred due to future risk.
8. **Reorder Level (RL)**: Reorder level is the inventory level, at which an alarm is triggered immediately to replenish that particular inventory stock. Reorder level is defined, keeping into consideration the Safety Stock to avoid any stock-out and Average Lead Time Demand because even after raising the alarm, it would take one complete process cycle (**Lead Time**) till the new inventories arrive to replenish the existing inventory.

$$\text{Reorder Level (RL)} = \text{Safety Stock (S)} + \text{Average Lead Time Demand (DL)}$$

9. **Order Quantity (O)**: Order quantity is the Demand (Order requests) that needs to be delivered to the customer.
10. **Minimum Level**: At least Safety Stock has to be always maintained to avoid any future stock-outs as per the standard practices of inventory management.

$$\text{Minimum Level (LMin)} = \text{Safety Stock (S)}$$

11. **Maximum Level**: The maximum level that can be kept in stock is safety stock and the demand (the quantity ordered).

$$\text{Maximum Level (LMax)} = \text{Safety Stock (S)} + \text{Order Quantity (O)}$$

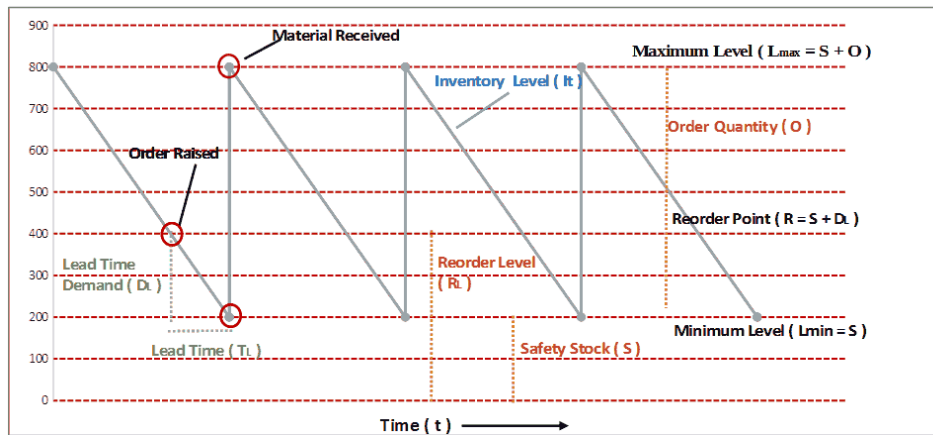


Figure 1: Inventory Model: Fixed Reorder Quantity System

Example: The order quantity of an Item is 600 Units. The safety Stock is 200 Units. The Average Lead Time is 5 Days and average consumption per days is 40 units.

Order Quantity (O) = 600 Units

Safety Stock (S) = 200 Units

Average Lead Time (TL) = 5 Days

Average Demand (DAv) = 40 Units

Average Lead Time Demand (DL) = Demand (DAv) X Lead Time (TL)

$$= 40 \times 5$$

$$= 200 \text{ Units}$$

Reorder Level (RL) = Safety Stock (S) + Average Lead Time Demand (DL)

$$= 200 + 200$$

$$= 400 \text{ Units}$$

Minimum Level (LMin) = Safety Stock (S) = 200 Units

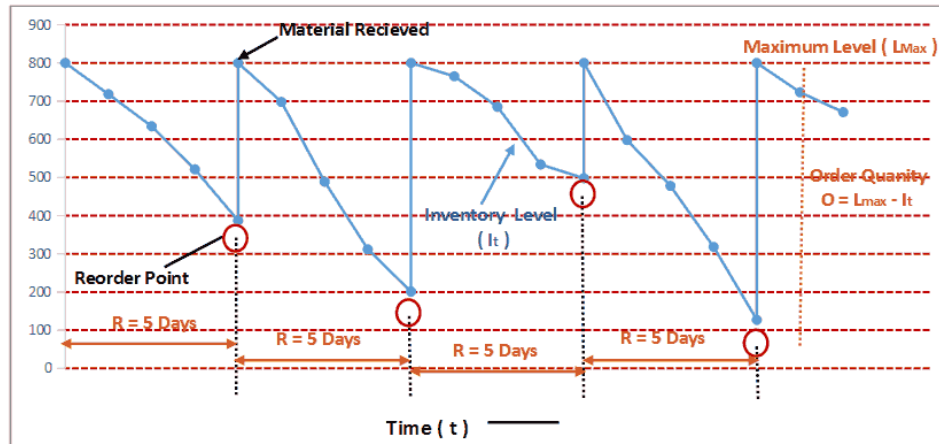
Maximum Level (LMax) = Safety Stock (S) + Order Quantity (O) = 200+600= 800 Units

B. Fixed Reorder Period System.

1. Fixed Reorder Period System is an Inventory Model of managing inventories, where an alarm is raised after every **fixed period of time** and orders are raised to replenish the inventory to an optimum level based on the demand. In this case replenishment of inventory is a continuous process done after every fixed interval of time.
2. **Regular Intervals (R):** Regular Interval is the fixed time interval at the end of which the inventories would be reviewed and orders would be raised to replenish the inventory.
3. **Inventory on Hand (It):** Inventory on hand is the Inventory level measured at any given point of time.

4. **Maximum Level (M):** It is the maximum level of inventory allowed as per the production guidelines. The maximum level is derived by analysing historical data.
5. **Order Quantity:** In this system, inventory is reviewed at regular intervals (R), inventory on hand (It) is noted at the time of review and order quantity is placed for a quantity of (M) – (It).

$$\text{Order Quantity (O)} = (M) - (It).$$



Example: Inventory is replenished at every regular interval of 5 days. The maximum allowable inventory is 800 Units. The inventory reviewed on Day-5, Day-10, Day-15 and Day-20 were 387 Units, 201 Units, 498 Units and 127 Units respectively.

Regular Intervals (R) = 5 Days

Maximum Level (M) = 800 Units

Inventory on Hand: I5 = 387 Units, I10 = 201 Units, I15 = 498 Units and I20 = 127 Units

| | | | |
|-------------------------------|------------|----------|-----------------|
| Order Quantity (O) = | (M) | – | (It). |
| Order Quantity (O5) = | 800 | – | 387 = 413 Units |
| Order Quantity (O10) = | 800 | – | 201 = 599 Units |
| Order Quantity (O15) = | 800 | – | 498 = 302 Units |
| Order Quantity (O20) = | 800 | – | 127 = 673 Units |

EOQ (Economic Order Quantity)

The Economic Order Quantity is the replenishment order quantity that minimizes the combined total cost of inventory maintenance and ordering.

$$EOQ = \sqrt{\frac{2 \times A \times P}{U \times C}}$$

Let A= Annual Consumption(units)
P= Cost of Ordering
U= Cost/Unit
C= Inventory Carrying Cost
Q= Quantity

5.4 NEW PARADIGMS IN INVENTORY

Over the past decade, the pace of innovation in logistics has continued to increase. As consumers expect two-day or faster shipping, the entire supply chain has had to change to accommodate this new standard. This has led to changes in inventory management as well as new technological developments like predictive analytics and improved inventory tracking.

These recent changes have upended some traditional inventory warehousing practices while causing others to evolve. Here are three of the most significant shifts:

1) Regional Warehousing Brings Several Changes

Consumer demand for fast, low-cost shipping options have pushed fulfillment centers closer to where consumers live. The result is growth in regional warehouses, often located inside or just outside urban areas. Regional warehouses can get products to consumers the next day or even the same day with lower costs. Accordingly, inventory must be managed more precisely to ensure sufficient supply, but also ensure that warehouses don't run out of space. This is a complex process that requires sophisticated warehouse management software.

2) Inventory Management Becomes More Efficient

A chaos-inspired inventory system that seeks to boost efficiency and speed order fulfillment. These results are accomplished using advanced warehouse inventory management software, which is the backbone of their warehouse operations and a way of getting order out of "chaos."

3) Faster Information Flow and New Warehouse Inventory Processes

Business alters the prices they charge customers based on inventory levels and the particular mix of items customer buy. This is not just simply a matter of supply and demand. Real-time information flow between warehouses and the retail environment enables quick responses.

5.5 JIT

JIT is concept used in supply chain management to moves material just before it's needed in the manufacturing process. This method reduces the need to store excessive levels of materials in a warehouse. The just-in-time supply chain aims to decrease timing delays and costs by perfecting the timing of ordering materials.

There are 3 JIT system principles which are of importance when considering implementation:

1. **Total quality control;** JIT system focuses on improving efficiency of material processes and quality is very important.

2. **Elimination of waste:** JIT system focuses on improving the effectiveness of processes and operations that add value to the materials. Inventory is considered as waste and should be reduced as much as possible.
3. **People involvement:** Employees are most valuable resource for company. It is important that everyone understands JIT system and gets involved with making it a success.

How Does a Just-in-Time Supply Chain Work?

1. JIT is scientific tool used supply chain professionals to deliver what your customers want and when they want it. Ideally, a business can accomplish this while spending as little money as possible.
2. JIT supply chains can also be applied to many other operations which is required to smoothly run the business. JIT can be applied to human resources and accounting departments to ensure the most effective use of time and resources.
3. While JIT is attractive to many who work closely with supply chains and finances, the practice is difficult to implement. To have an optimized supply chain, an organization must supply its customers what they want, when they want it—and spend as little money as possible getting that done. Those customers may be internal customers or external customers.
4. one of the most important aspects of JIT is understanding the demand of customers. The key to understanding that demand is communication. Communication can be direct, or it can make use of systems such as enterprise resource planning (ERP) and materials resource planning (MRP).
5. Once you understand your customer demand, the next step is to maintained a strong relationship with a supplier. You'll depend on this supplier to get you what you need exactly when you need it. Most suppliers aren't able to immediately distribute supplies, so a successful JIT supply chain depends on a business knowing exactly how early they need to order materials for it to arrive at the perfect moment they're needed.

Techniques are used for Successful Just-In-Time Services

Successful just-in-time logistics are cantered on peak efficiency, accuracy and speed. All such objectives are achieved through a following of techniques that help drive success and minimize costs:

- Systems design for streamlined manufacturing.
- Reduced complexity through focused, transparent operations.
- General practices that support continuous improvement and the elimination of waste.
- Enhancing process flows with strategic production line arrangement.
- Use of robust and flexible machines that are also relatively small and easy to use.

- Including staff in operational improvements and problem-solving.
- Increasing flexibility capacity by minimizing setup and change over timelines.
- Inspiring and supporting reliability by employing total productive maintenance.

Benefits of Implementing JIT System: -

- Productivity improvements and greater control between various production stages.
- Diminished raw materials, work in progress, and finished goods inventory.
- A decrease in manufacturing cycle times.
- Dramatically upgraded inventory turnover rates.
- Decrease distribution costs.
- Lesser transportation costs.
- Enhanced quality of supplier products.
- Reduced number of transportation carriers and suppliers.

5.6 VENDOR MANAGED INVENTORY

Vendor-managed inventory is defined as an inventory management practice in which a supplier of good and manufacturer is responsible for optimizing the inventory held by a distributor. In simple world, the buyer simply provides the information and the vendor supplies and takes complete responsibility of providing and maintaining the inventory at the buyer's desired location. Vendor managed inventory (VMI) take initiative in a supply chain where the supplier is officially managed inventories as well as they agreed-upon stock-keeping units at customer sites. It is also called as JIT- II.

“Vendor-managed inventory (VMI) is a business model in which the buyer of a product provides certain information to a vendor or the supplier of that product and the supplier takes full responsibility for maintaining an agreed inventory levels of the material, usually at the buyer's preferred location or store”. For this reason, this method is also called supplier managed inventory, collaborative replenishment, or continuous replenishment.

Advantages of Vendor Managed Inventory System

➤ **Avoids overstocking**

One of the major benefits of the Vendor Managed Inventory system is that you don't need to store stock of the products. Generally, retailers end up stocking products more than required due to the fear of going out-of-stock. However, the inventory and their quantities are maintained by the supplier in the Vendor Managed Inventory system therefore, the products are available as and when required and there is no need to overstock them.

➤ **Cost-effectiveness**

Vendor Managed Inventory is suitable for big businesses like Walmart because first of all, it removes the need to overstock the products. Secondly, since a lot of bulk ordering is done by big businesses, it becomes cost-effective. VMI supports in overcoming the shortages of stocks. The vendor is always alert of the inventory held by the seller so he replenishes the stock as soon as it hits a low-level stock in inventory. Hence, removing the extra cost incurred for expedited shipping.

➤ **Seamless flow of inventory**

Vendor Managed Inventory depends upon processes and updated data on software. A smooth flow of inventory becomes possible because the information of stock count on each product is updated on the system automatically. This system supports real-time inventory management due to that more accurate inventory control also becomes possible. The vendor and the buyer know about the exact amount of inventory stock available and therefore can re-order as soon as the inventory levels dropped. VMI also helps in demand forecasting to maintaining the specific stock for each item as per their future demand.

➤ **Improves customer satisfaction and loyalty**

This is one of the biggest benefits of vendor managed inventory. Business never run out-of-stock for any products, the customers keep coming to you each and every time. This system helps in real-time inventory management and since you are buying the products in huge amount from the vendor so provide heavy discounts and try keep your customers happy.

Challenges while practicing vendor managed inventory system

➤ **Establishing trust**

In business to maintain trust is a time-consuming process. Vendor managed inventory system is dependent on trust since the supplier has to trust on the buyer and keep the inventory at his place and yet be responsible for it. Trust is certainly a factor that can build life-long business relationships if fulfilled properly by both parties. However, it is a long process, and therefore, the Vendor Managed Inventory system is meant for someone with grit to last longer in the market.

➤ **Duly fulfilling the responsibility of supplying the products**

More Responsibility on the vendor part can be bulky if the vendor is not well prepared for it. The vendor has to take care of delivering the products as well as decide when the customer would need more goods. The vendor has to be prepared at all times with the ready products to be supplied as soon as gets the information. If the vendor is not able to responsibly supply the products in a given time, then it risks gaining the trust between the buyer and him.

➤ **Frequent and bulk replenishment**

The challenges in the Vendor Managed Inventory system is that the purchaser must order the commodities in bulk and too frequently that

means the business must be really big and the demand for the products must be high in the market. Hence, VMI system is not meant for small businesses with limited orders and space for storage.

➤ **Be sound technologically**

Smaller businesses are prone to have barriers to technology and inefficient at deploying them due to their limited budget. In such a scenario, the Vendor Managed Inventory system cannot flourish. Vendor Managed inventory is dependent on technology and proper implementation of processes to be successful. Thus, having proper technology and process in place can be a challenge at times for both vendors and buyers.

5.7 CASE STUDIES

Walmart's Vendor-Managed Inventory Model

Walmart's success in managing its inventory is partly due to the effective implementation of the vendor-managed inventory model. In this model, suppliers access data from the company's information systems, such as data on current inventory levels and the rate at which certain goods are sold. Suppliers decide when to send additional goods to Walmart, while the company monitors and controls the actual transit of goods from warehouses to the stores. This strategy shifts some of the inventory control activities onto the side of the suppliers.

Walmart's vendor-managed inventory has the benefit of minimizing delays in the movement of inventory across the supply chain. This benefit is achieved because suppliers can directly access current data about the inventory of their goods at Walmart stores. Another beneficial effect of using the vendor-managed inventory model is the minimization of costs in inventory management activity. The company does not need to spend for extra personnel to manage each supplier's goods. Instead, this financial and human resource expense is directly passed on to Walmart's suppliers.

Types and Roles of Inventory at Walmart Inc.

Walmart uses many types of inventory, each with a corresponding set of management approaches, strategies, and tactics. Each type fulfils a certain role in the retail company's inventory and supply chain. The following types of inventory are some of the most notable in Walmart's practices:

1. Finished Goods Inventory
2. Transit Inventory
3. Buffer Inventory
4. Anticipation Inventory

Finished goods inventory. The finished goods inventory type is the most significant in Walmart's business. Finished goods arrive at the company's stores. These goods are stored and the inventory is replenished regularly.

Thus, the role of this type of inventory is to support Walmart store operations, where the finished goods are moved from the company's merchandise distribution centres to be sold to the retail buyers at the stores.

Transit inventory. Walmart uses the transit inventory type as the second most significant in supporting its retail operations. This type of inventory refers to the goods that are held while in transit. The global extent of Walmart's supply chain means that some goods are in transit for days or weeks. The role of this inventory type is to support the replenishment of the finished goods inventory in the merchandise distribution centres and Walmart stores.

Buffer inventory. Walmart uses the buffer inventory type in its stores by keeping a small margin of extra goods in order to maintain business continuity when demand suddenly fluctuates. For this purpose, there will always be an extra stock of goods at Walmart stores. The role of this type of inventory is to ensure the adequate capacity of the company to satisfy sudden increases in demand, considering that current retail market prediction models may be accurate, but not perfect in modelling such fluctuations.

Anticipation inventory. Walmart uses the anticipation inventory type to ensure optimal capacity to satisfy consumer demand. This type is similar to the buffer inventory because the company maintains extra stocks of goods to address an increase in demand. However, the anticipation inventory type is based on seasonal changes and corresponding empirical data on seasonal changes in the market. For example, Walmart dramatically increases its inventory size right before and during Black Friday to satisfy the massive increase in demand during this special shopping day. The company also uses anticipation inventory for the Christmas season and some long holiday weekends. Walmart does not use the anticipation inventory type during regular shopping days, which are basically the rest of the year. The role of this inventory type is to enable the company to satisfy expected seasonal increases in demand.

Just-in-Time Cross-Docking in Walmart's Inventory Management

Walmart uses different methods to manage its inventory. Just-in-time inventory is the application of the just-in-time (JIT) method to inventory management. This method involves measures and activities for the operational objective of minimizing storage and related costs. At Walmart, the just-in-time inventory method is applied in the form of cross-docking. In cross-docking, suppliers' trucks and the company's trucks meet at the company's warehouses or merchandise distribution centers. Goods are transferred from the suppliers' trucks directly to Walmart's trucks, which deliver the goods to the stores.

The main benefit of cross-docking at Walmart's warehouses is the minimization of inventory size. Fewer goods are stored at the warehouses. A smaller inventory is less costly to maintain. Also, cross-docking enables

Walmart to quickly deliver goods to the stores. This condition enables the firm to rapidly respond to fluctuations in demand and related changes in the market. Thus, this method of inventory management supports Walmart's operational efficiency and business resilience.

Walmart's Measures of Inventory Performance

Considering the size of its business and the variety of products it offers, Walmart uses numerous variables as measures of inventory performance. The following measures are some of the most significant:

1. Inventory turnover
2. Stock-out rate
3. Inventory size

Inventory turnover is the rate at which Walmart's inventory is sold out and replenished. It is a measure of the cost of keeping each item in stock. A higher inventory turnover rate is less costly and more desirable for the company. The stock-out rate is the frequency at which Walmart's inventory becomes inadequate in satisfying demand. A lower stock-out rate is desirable. In addition, the company uses inventory size as a gauge of cost. As noted, the corporation spends less for a smaller inventory. These measures reflect the cost minimization objectives linked to Walmart's cost leadership generic competitive strategy, which requires low costs to maintain attractive low selling prices.

5.8 REFERENCES

- 1) Case Study: - Articles By: Roberta Greenspan (Walmart's Inventory Management - Panmore Institute)
- 2) Inventory Model & Types (whatissixsigma.net)

5.9 QUESTION BANK

- Q.1) What elements are involved in the traditional inventory management?
- Q.2) Explain different types of inventory model with suitable example.
- Q.3) What are the new paradigms in inventory?
- Q.4) Explain vendor managed inventory with its benefits.
- Q.5) Explain vendor managed inventory with its challenges.
- Q.6) Short Notes on: -
- A. JIT
 - B. Fixed Reorder Period System
 - C. Fixed Reorder Quantity System
- Q.7) Tata Ltd. One component has annual recruitment of Rs. 30000. The ordering cost is Rs. 300 per day. The purchase price per unit is Rs, 10. The inventory carrying cost is 20 % of inventory value. Find EOQ. (Answer – 3000).



MODULE IV LOGISTICS MANAGEMENT

6

INTRODUCTION TO LOGISTICS MANAGEMENT

Unit Structure :

- 6.1 Introduction to Logistics Management
- 6.2 History & evolution of Logistics
- 6.3 Elements of logistics
- 6.4 References

6.1 INTRODUCTION TO LOGISTICS MANAGEMENT

Logistics management is the method of planning, coordinating, and executing a project. When it comes to business, the process refers to the flow of work from beginning to end in order to meet both customer and organisational standards [1][2].

“Logistics 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 current and future profitability are maximized through the cost-effective fulfilment of orders.” [1]

Logistics management is responsible for a wide variety of services, including physical products (such as materials, machinery, and supplies) as well as food and other consumables. Logistics management entails integrating the flow of information and its management resources, as well as materials handling, production packaging, inventory, transportation, warehousing, and, on occasion, defence.

A dedicated simulation software is often used to model, analyse, visualise, and optimise this complex logistics. A logistician is someone who works in this area.

Logistics management 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 current and future profitability are maximized through the cost-effective fulfillment of orders. (Source: Christopher, M. (1998). Logistics and Supply Chain Management: Strategies for reducing cost and improving service, (2nd Ed.). New York: Prentice Hall.)

From ensuring that the company has what it needs to deliver results to ensuring that consumers are happy, efficient logistics is a crucial factor in ensuring the performance of an organisation. The following presentation was created to provide the reader with a summary of logistics management, starting with the definition of logistics and progressing through the phases of logistics management.

What is Logistics?

The movement of goods, services, and knowledge between the point of origin and the point of destination is managed in this way (point of consumption). The process of planning and executing effective transportation and storage of goods from one location to another is known as logistics. It ensures that all supplies and resources are available on time and in the correct location in order to achieve a business goal.

As a result, logistics entails providing the right product or service at the right time, in the right place, at the right price, and in the right condition. Logistics is a branch of supply chain management that is linked to project management by ensuring project execution on time.

The scope of logistics spans the organization, from the management of raw materials through to the delivery of the final product.

The aim of Logistics Management is to ensure supply to the customer the:

- Right product
- Right cost
- Right quantity
- Right quality
- Right place
- Right time

Logistics management is a subset of supply chain management, which is a larger subject. From the point of origin to the point of consumption, supply chain management plans, executes, and monitors the efficient movement of storage, products, services, and related information. This is done in order to satisfy the needs of consumers.

In the corporate world, logistics management is used in a variety of industries. Its goal is to manage project life cycles, supply chains, and the efficiencies that result. Company logisticians have developed into supply chain logisticians as markets have become more complex and expanded into a global marketplace.

Inbound logistics for internal functions and outbound logistics for the outward movement from point of origin to point of consumption are the two main focuses of logistics management in industry. Inventory control, ordering, shipping, warehousing, consultation, and the coordination and mapping of these processes are all areas where logisticians specialise.

Components (activities) of Logistics [2]:

1. Transportation
2. Supply.
3. Inventory planning and management.
4. Warehousing.
5. Packaging.
6. Order processing.

Objectives of Logistics Management:

1. To choose the most effective transportation routes
2. To identify the best delivery method
3. To seek continuous quality improvement
4. To minimize the cost of transportation
5. To facilitate quick response to customer requirements
6. To improve customer service
7. To minimize damage to goods

Why Is Logistics Management Important?

The goal of logistics management is to find more efficient and reliable ways to transfer resources and goods from idea to completion, and then to the customer. However, the driving force behind these decisions is to satisfy consumer demand and offer the best service possible in order to attract customers and preserve their satisfaction. Customers are demanding better service, which necessitates shipping quicker, more precisely, and with a high degree of quality. Customer satisfaction is achieved by logistics management.

However, it isn't the only advantage of logistics management. It also aids in the visibility of the company's supply chain. Logistics managers can improve the flow of products and prevent future delays by reviewing historical data and monitoring the real-time movement of goods.

As a result, logistics management contributes to increased sales. It enhances customer experience and strengthens the company's identity, resulting in new and increased sales. By tracking inbound funds, holding inventory at the right level, and organising the reverse flow of products, there is the potential to save costs in operations with greater insight into the supply chain.

Why Logistics Is So Important in Supply Chains?

1. **Logistics Strategies Generate Positive Business Results:** An established third-party logistics partner will make your company's back end appear easy. They will bring effective, simple, and observable logistics solutions to the table. It's possible for transportation processes, origins, and item locations to become a shambles, so getting a solid logistics plan will help you avoid problems. Your logistics plan should be designed to work in tandem with your transportation and distribution partners to achieve your objectives. To avoid affecting your clients, it should be adaptable to

changes in your supply chain. A good logistics strategy should include the following to provide positive business results:

- Ensure the right people in your organization are aware of changes in the supply chain
- Involve the right number of warehouses or distribution centres
- Measure the frequency that products should leave each warehouse or distribution center
- Regular reviews to find out if the logistics partnerships are working well for you and your customers
- Regular strategy revisions for optimization

2. Logistics Help Businesses Create Value: More than just promoting positive results for your business, key logistics strategies are essential. These tactics add value to the customers as well. The more you improve your ability to make your goods more accessible to your buyers, the more important your commodity becomes. As more goods become available on a global scale, rising demand increases the value of those items. When problems have a negative effect on your clients, make sure to revisit your approach. You may add value for them by dealing with problems related to delivery or transportation. You should adapt to provide better service and fix this problem if problems like warehouse overload continue to affect those customers.

3. Logistics Reduce Expenses for Effective Cost Accounting: Operating costs are another significant problem in supply chain management. These can be difficult to account for in the cost accounting processes, but with a strong logistics programme, you can keep these costs in check while cutting costs in areas like climate management, warehousing, and transportation. A successful logistics plan can also completely reduce larger costs, allowing you to deposit more money in the bank.

4. Logistics Improve Warehouse Management: The more efficiently you can handle your logistics, the more efficiently you can manage your factory. The type of products you store has a big impact on your warehouse operations. If you distribute perishable products such as food, the logistics approach should include a warehouse inventory plan to reduce waste. Working with a third-party logistics provider gives you complete insight into your company's goals and weak spots, allowing you to develop successful solutions.

6.2 HISTORY & EVOLUTION OF LOGISTICS

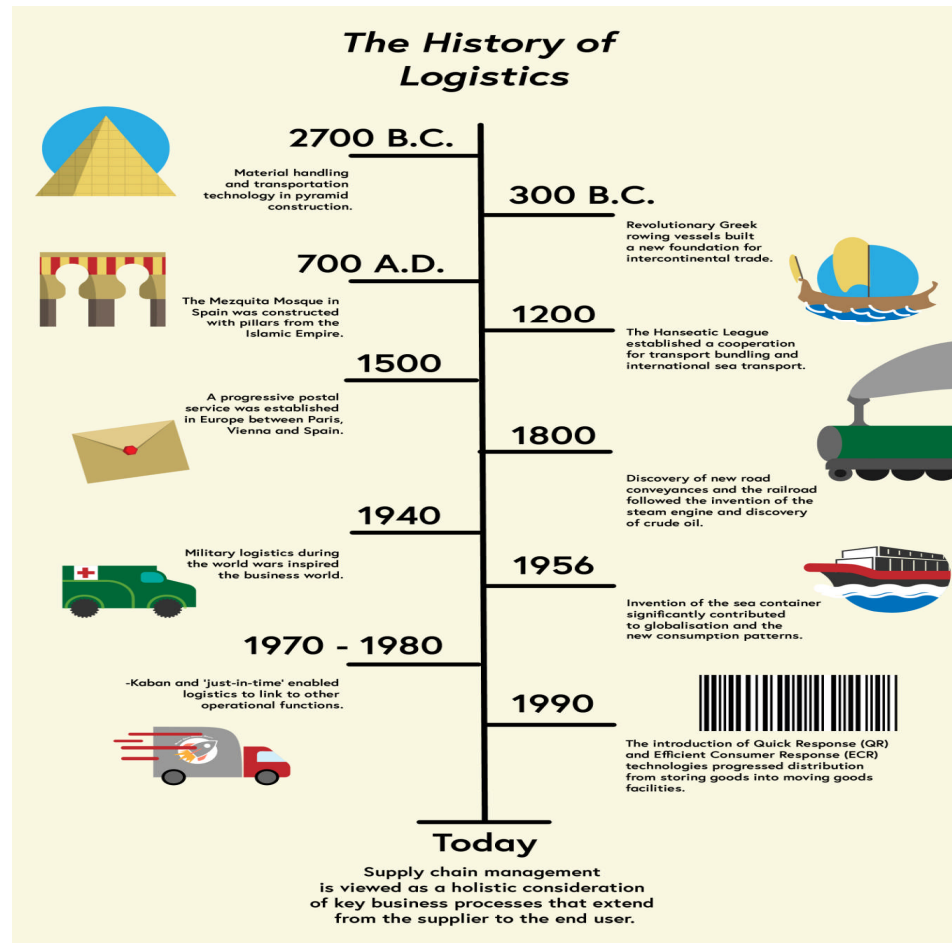


Fig: 6.1 History and evolution of Logistics (Source: Uhl, A., & Gollenia, A. (2014). *Digital enterprise transformation: A business-driven approach to leveraging innovative IT*. Gower Publishing Limited.)

Origin of the Word Logistics

- Etymology: Logistics = Logic + Statics
- Language: Latin
- **The Inception: Evolution of logistics Until 1950**

Importance of logistics increased after World War II (WW-II)

Earlier logistics was a military application (Before 1950s)

1. More systematized Movement and Storage Systems for firm-level Decision Making
2. Physical Distribution Management
3. Outbound logistics activities

Military was using this term for three important things:

1. Procurement
2. Maintenance
3. Transportation

Three things were involved in the logistics of military:

1. Facilities
2. Materials
3. Personnel (HR)

Other key points

1. Logistics was not included in the education courses and syllabus
2. Lack of integration

The emergence of Logistics: Evolution of logistics after the 1960s**Logistics & Education**

1. The first college course related to logistics management: Michigan State University
2. Also, the first textbook content related to logistics: Smykay

Business Logistics

1. The focus was on outbound logistics
2. Physical distribution renamed as business logistics

Logistical Challenges

1. High cost from 14% to 32%

Logistics In the 1970s

Physical Distribution + Some part of Financial subsystem

Monitoring and Planning for efficient completion of the cash cycle after product dispatches

Started recognizing the benefit of proactively examining inbound logistics and co-ordination between Inbound and outbound logistics for efficient use of Physical infrastructure

The 1990s: Globalization Era & Evolution of Logistics Management

Background:

1. Wave of Globalization
2. The increased flow of export and import
3. So Transportation became an important and crucial part of the business to gain competitive advantage

Problem: Business failure if failed to manage transportation

Solution: To overcome this situation, businesses started using logistics management widely and deeply (deep integration with core functions of businesses).

Impact: Observed more than 20% growth (per annum) in logistics management

Logistics Management Today

1. Transformation: Currently Supply Chain Management is practised as logistics management
2. Logistics as a subset: Logistics is observed as a subset of supply chain management
3. Limited Scope: Logistics has a limited scope within a firm's boundaries

Evolution of Logistics:

Logistics is a term that gets thrown around now and then; in this article, we'll look at how the term and the logistics process have developed. The Latin terms 'logic' and 'static' are combined to form the term logistics. Historically, logistics was mostly used by the military. However, during World War II, it became more mainstream, and logistics was viewed and applied as a scientific topic. When companies realised the value of logistics, they began to use logistics services. From the beginning of the 1960s to the present, logistics has continued to evolve.

“Effective preparation and execution of goods, resources, and information flow from the starting point (origin) to the end point (customers), including transportation, storage, and control” is a simple definition of logistics. By the 1990s, globalisation had accelerated, and businesses were required to import and export a great deal. As a result, transportation has become an important business aspect. Every company saw transportation as a critical factor in staying competitive, so they managed and incorporated transportation systems. Businesses began to lose market share as transportation became more strategically important.

The area of "logistics management" arose in response to the aforementioned situation and to sustain market competitiveness. Logistics management encompasses the entire transportation process, from start to finish. Any business is either a buyer or a seller once globalisation has taken a turn. Every company wants to find the easiest, quickest, and most cost-effective way to sell their goods all over the world.

They must depend more on logistics to buy and sell goods between countries. The explanation for this is that every country needs logistics because by that time, every country has turned into a potential market. So far, logistics has grown at a rate of up to 20% every year since its inception. Later, the logistics department created a supply chain department to provide full services from preparation to the end of the product cycle. This is how the logistics and supply chain management industry as a whole was born. It is booming and will continue to do so for many years.

6.3 ELEMENTS OF LOGISTICS

Logistics management consists of eight elements called wings of logistics. These are discussed in a nutshell below.

1. Customer Order Processing:

Flow of Actions

1. Filling up the order form
2. Deciding the specifications of the product
3. Deciding the quality check list of the product
4. Deciding the delivery schedule
5. Deciding the location of delivery

Important Factors

1. Cost of order processing
2. whether the company is capable of producing a component
3. Detailed list of specifications

Techniques

1. Electronic data Interchange (EDI)
2. E-ERP or CPFR
3. Web portal

2. Location Analysis:

Flow of Actions

1. Cost of transportation of raw materials and finished goods
 - Proximity to suppliers
 - Proximity to customers
2. Availability and type of land
3. Availability of secondary resources
4. Availability of desired manpower at affordable cost
5. Communal harmony
6. Governmental regulation and taxation

Important Factors

1. Cost of operations as a percentage of sales
2. Shelf life of product

3. Inventory Control:

Flow of Actions

1. On hand inventory analysis
2. Communicating the quantity, quality and timing of material with the supply points.
3. Getting the material of right quality, quantity and at right time

Important Factors

1. Inventory control at planning stage
2. Lead time
3. Cost vs. importance of raw material

Techniques

1. DRP and replenishment order control
2. Fixed order interval system
3. Economic order quantity with ROP system
4. Selective inventory control (ABC, VED, FSN analysis etc.)
5. Order forecasting using statistical tools

4. Material Handling:**Flow of Actions**

1. Type of material (Business significance like raw material, finished goods etc.)
2. Material handling requirements of the material (Fragile, inflammable)
3. Cost ratio of material handling to material cost.
4. Material default location, identification and traceability

Important Factors

1. Material breakage
2. Pilferage
3. Cost of material handling
4. Number of handlings

Techniques

1. Operational research
2. Material flow analysis
3. Computerized material retrieval system
4. ASRS (Advanced Storage & Retrieval System)

5. Packaging:**Flow of Actions**

1. Packaging requirement for the material (Refrigeration, Fragile etc.)
2. Primary packaging
3. Secondary packaging
4. Cost of packaging
5. Transportation requirement for packaging (Vibration proof, water or moisture tight)

Important Factors

1. Protection to product
2. Holding the product
3. Communicating the message to customers
4. Customer requirement for packaging
5. Reverse logistics for packaging
6. Recycling of packaging material
7. Cost of packaging

Techniques

1. Standardized box packaging
2. Containerization of packaging
3. Direct part marking
4. ISO 14001
5. Recycling of packaging materials
6. Reusable packaging materials
7. Eco-friendly packaging materials
8. Bar coding
9. Bumpy bar coding
10. GPS tracking system
11. RFID

6. Transportation:**Flow of Actions**

1. Mode of transportation
2. Cost of product
3. Speed of transportation
4. Ambience requirement of material (Refrigeration, Vacuum)
5. Cost of transportation
6. Urgency of the product to customers

Important Factors

1. Urgency of the product
2. Cost of product
3. Cost of transportation

Techniques

1. Containerized transportation
2. Cool Chain Transport (Refrigerated Vans/Containers)
3. Multi-modal Logistics
4. Milk Run Distribution systems
5. Cross Docking
6. Direct Shipment

7. Warehousing**Flow of Actions**

1. Location of the warehouse
2. Inventory level at the warehouse
3. Storage requirement of the product
4. Packaging and repackaging requirement of the product
5. Shelf life of the product

Important Factors

1. Availability of space
2. Availability of proper material handling systems
3. Strategic location
4. Packing and Repacking facilities
5. Information and allied services

Techniques

1. Third Party Logistics
2. Third party Warehousing

8. Customer Service:**Flow of Actions**

1. Contractual services offered to client
2. Type of customer service required for the product
3. Location of the service centre
4. Service level at the service centre
5. Cost of service vs. replacement

Important Factors

1. contractual requirement of customer service
2. Service quality
3. Reverse logistics

Techniques

1. AMC (Annual Maintenance Contracts) and free replacements
2. Limited (free) trial period
3. Guarantee & warranty
4. User clubs
5. Help lines, toll free number, call centers
6. CRM

6.4 REFERENCES

1. Logistics & Supply Chain Management (Strategies for Reducing cost & improving service) – Martin Christopher [FT financial Times/Pitman publishing, 2nd edition]
2. Logistics & Supply Chain Management (Cases & Concepts) – Raghuram & N. Rangaraj [McMillan India Ltd, 1st edition]



MODULE IV LOGISTICS MANAGEMENT

7

DISTRIBUTION MANAGEMENT AND PACKING FOR LOGISTICS

Unit Structure :

- 7.1 Distribution management warehousing (types, operations, site selection, layout and design)
- 7.2 Packing for logistics (concepts, importance, requirement, important aspects of logistics, packing Repacking & forwarding, Trends in packaging)

7.1 DISTRIBUTION MANAGEMENT WAREHOUSING (TYPES, OPERATIONS, SITE SELECTION, LAYOUT AND DESIGN)

Distribution Strategies:

Distribution strategies can be of the following types:

1. Cross docking
2. Milk runs
3. Direct shipping
4. Hub and spoke model

Cross Docking

Traditional warehouses move materials into storage, keep them till they are needed and then move them out to meet the customer demand. Cross docking co-ordinates the supply and delivery so that the goods arrive at the receiving area and are transferred straight away to the loading area, where they are put into delivery vehicles. In other words, Cross docking is the movement of materials from the receiving docks directly to the shipping docks. It is said, "Cross docking is a flow through concept and we don't want products to stop anywhere, because space, brick and mortar is getting very expensive these days[1].

Goods do not need to be placed in storage, creating a significant cost savings in inventory and material handling. Cross docking helps reduce direct cost associated with excess inventory by eliminating unnecessary handling and storage of product. Fewer inventories means less space and equipment required for handling and storing the products. This also means reduced product--damages and product obsolescence. Thus, the step of filling a warehouse with inventory before shipping it out is virtually eliminated. Cross docking shifts the focus from "supply chain" to "demand chain".

For example: stock coming into the cross docking centre has already been pre-allocated against a replenishment order generated by a retailer in the supply chain. Cross docking helps retailers streamline the supply chain from point of origin to point of sale. Cross docking also encourages electronic communications between retailers and their suppliers[2].

Two Basic Forms Of Cross Docking

1. Basic Cross Dock: In this form the packages are moved directly from the arriving vehicles to the departing ones. This form of cross docking does not need a warehouse and a simple transfer point is enough.
2. Flow Through Cross Dock: In case of the flow through concept, when the materials arrive and they are in large packages, these packages are opened and broken into smaller quantities, sorted, consolidated to deliver them to different customers and transferred to vehicles.

Cross docking can develop to a phase where nothing actually moves through a warehouse. The stock kept within vehicles is referred to as stock on wheels. Nowadays wholesalers use the method of drop-shipping, where they do not keep the stock themselves, but coordinate the movement of goods from the upstream suppliers to the downstream buyers.

Benefits of Cross Docking

1. Cross docking helps to improve the speed of flow of the products from the supplier to the store*.
2. It helps to reduce the costs as:
 - The labour is removed from the job of storage (warehouses).
 - It helps eliminate the two most expensive distribution operations i.e. warehousing and storage.
3. Cross docking helps to reduce the amount of finished goods inventory that is required to be maintained as safety stock.
4. Cross docking reduces costs and hence helps to save money.

How Cross Docking Works?

On receiving goods workers put them in lanes corresponding to the receiving doors. A second team of workers sort the goods into shipping lanes from which a final team loads them into outbound trailers.

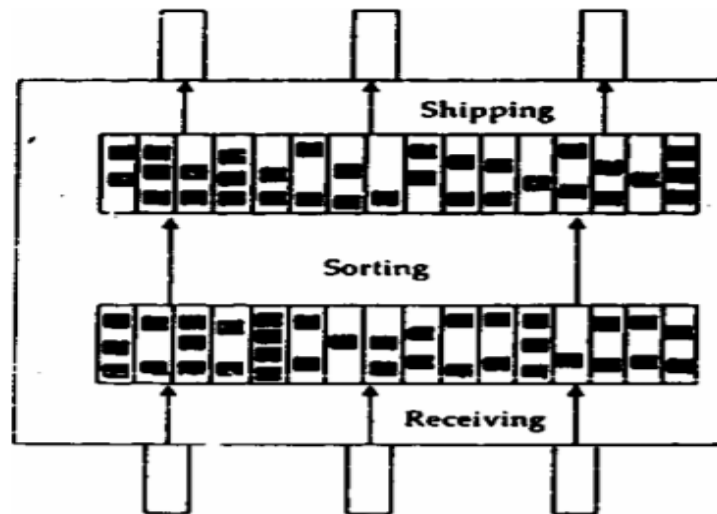


Fig: 7.1 Working of Cross Docking

Milk Runs

A milk run is a route in which a truck either delivers product from a single supplier to multiple retailers or goes from multiple suppliers to a single retailer as shown in Figures 6.3 (a) and 6.3(b). In other words, in a milk run, a supplier delivers directly to multiple retail stores on a truck or a truck picks up deliveries for many suppliers of the same retail store. The main job of the supply chain manager is to decide on the routing of each milk run.

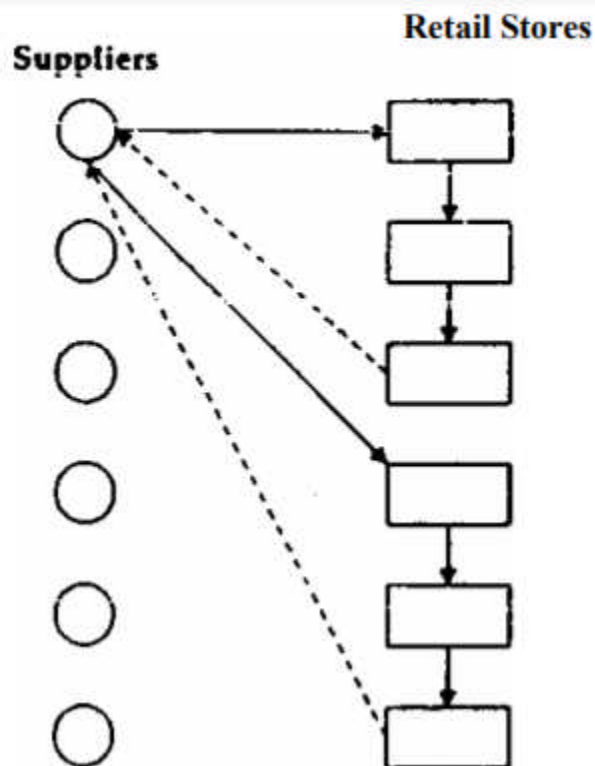


Fig: 7.2 (a) Milk runs from single supplier to multiple retailers

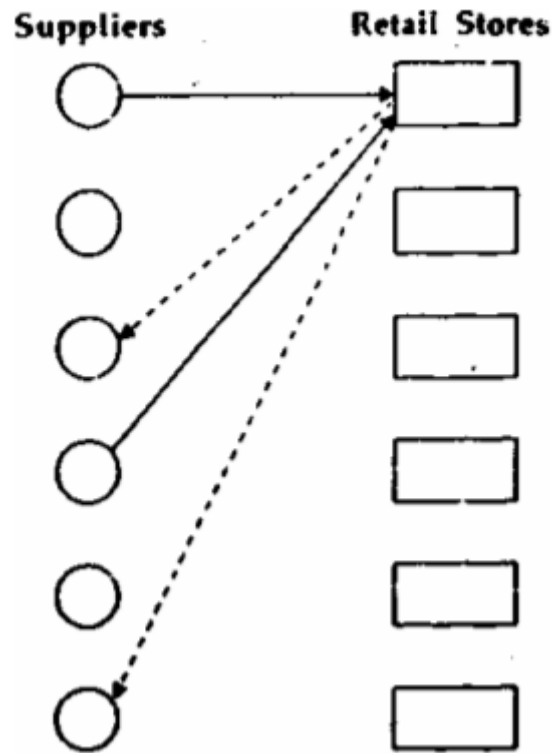


Fig: 7.2 (b) Milk runs from multiple suppliers to single retailers.
One of the major challenges faced by the milk run system of distribution is the high degree of coordination and synchronization required among the members of the supply chain.

Direct Shipping

Direct shipping refers to the method of distribution in which the goods come directly from the suppliers to the retail stores as shown in Figure. In the case of a direct shipment network, the routing of each shipment is specified and the supply chain manager only needs to decide on the quantity to ship and the mode of transportation to use. This system eliminates the need for the intermediate facilities that are otherwise required, e.g. warehouses and distribution centers. The products that are generally distributed through the method of direct shipping are certain perishable items, high volume goods, high bulk items and specialty products.

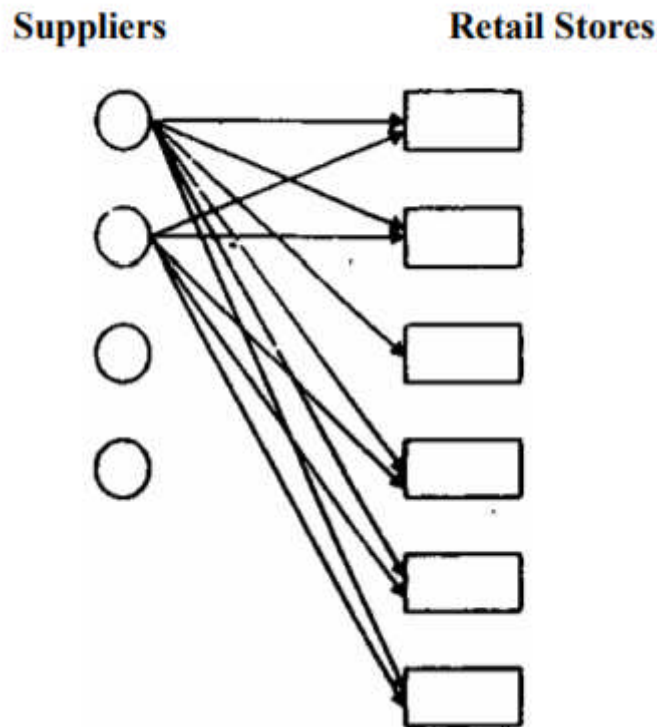


Fig. 7.3: Direct Shipping Network

Benefits of Direct Shipment

1. Elimination of intermediaries: The major advantage of direct shipment network is the elimination of intermediate warehouses and the simplicity of its operation and coordination.
2. Saves time: It saves a lot of time as the time required for distribution of goods from the supplier to the retail store would be short because each shipment goes direct.
3. Less damage: As the goods move directly from the supplier to the retailer there is less handling of the products as a result there is less product damage.
4. Improved accuracy: Since the distribution is direct

Hub and Spoke Model:

In the case of the hub and spoke model the distribution model's hub is the location that holds inventory for a large region, with each spoke leading to a smaller distribution centre, which houses inventory for a smaller region. The main driver of the hub and spoke model is the proximity to the customer, with the goal being to supply to a maximum number of customers in a minimum amount of time.

In today's distribution environment, however, this goal can be attained in many cases without a hub and spoke operation, which has very high overheads. Hub and spoke, these days, is often restricted to fulfilling the just-in-time needs of heavy manufacturing industries. For example, if a

company expands its operations, its suppliers may move to the nearby areas so as to supply it more efficiently. In this case, the company that expands is the hub and the suppliers are its spokes.

Types of Warehouses:

Companies might own private warehouses or rent space in public warehouses or both. Both have their advantages and disadvantages. Owning a private warehouse brings more control, ties up capital, and is less flexible if locations change.

On the other hand, public warehouses charge for rented space, provide additional services for inspecting, packaging, shipping and invoicing goods but at a cost and offer a wide choice of locations and warehouse types.

Basic types of warehouses are:

1. **Bonded warehouses:** Warehouses which are bonded under the Customs and Excise Act and Municipal Corporation regulations, facilitating deferred payment of customs, excise or octroi duty.
2. **Field warehouses:** Field warehouses are those which are managed by a public warehousing agency in the premises of a factory or company which needs the facility for borrowing from a bank against the certification of goods in storage or in process by an independent professional warehouseman.
3. **Cold storages:** Cold storage facilities are provided for perishables against payment of storage for the space utilized by different parties.
4. **Agricultural warehouses:** Used for storing agricultural produce grown in a certain area.
5. **Distribution warehouses:** Ones located close to the manufacturing concerns or consuming areas. These are designed to move goods rather than just store them. They are large and automated warehouses designed to receive goods from suppliers, take orders and deliver goods to customers.
6. **Buffer storage warehouses:** These are built at strategic locations with adequate transport and communication.
7. **Facilities:** Used for storing food grains or fertilizers etc. by or for the government for easy marshalling and supply to various far-off or nearby consuming areas in response to the orders of the government or government agencies.
8. **Export and import warehouses:** They are located near the ports from where international trade is undertaken.

Distribution management warehousing site selection, layout and design:

Source: <https://www.altexsoft.com/blog/business/logistics-management-systems-how-warehouse-transportation-and-distribution-software-work/>

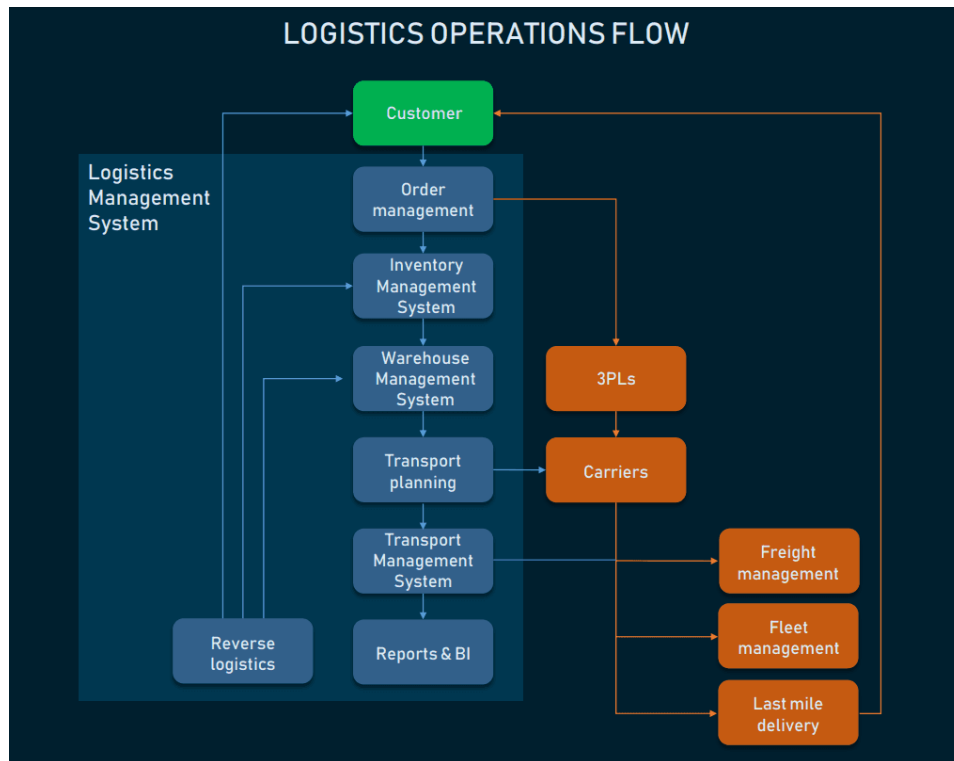


Fig: 7.4 *Logistics management system within logistics processes*

Warehouse management:

Warehouse management is a set of processes maintaining, controlling, and automating warehouse operations. This includes receiving items, moving them, managing warehouse staff using KPIs, maintaining safe work conditions, and using software and hardware to locate and track items.

A warehouse management system consists of tools that streamline the workflow of managing goods from arrival at the warehouse through storage and tracking within the location to order management and dispatching further.

Typically, WMS is responsible for the following operations.

Warehouse design: Providing a manageable 3D map of the warehouse building, this feature allows for maximizing storage space, managing inventory placement, and improving the flow of items and labor by prioritizing the areas of the shipping queue that require extra attention.

Picking: Synced with a scanning device, the software helps pinpoint items throughout the warehouse building. Tracking the barcodes assigned to items, WMS guides the order assemblers to the needed products through the optimized picking route. To ensure the correct lot is selected, pickers double check it: on scanning the attached barcode, the system verifies it. In terms of velocity, batch picking function can be a real timesaver, as it allows for picking many orders in a single run.

Packing: Orders can have specific packaging requirements to guarantee safe shipping or improve the unboxing experience. The WMS helps make sure the packing is performed in the correct order, and as efficiently as possible, according to the rules set by the business.

Labor management: Supervising the human side of warehouse operations entails the use of a labor management system integrated into WMS. First, the system assigns tasks to individual warehouse workers using workforce planning and scheduling capabilities. This allows you to track productivity, identify underperforming shifts or workers. The task history environment shows employees' entire history of activities that can be used for analyzing peak labor, optimizing workflow, and finding solutions where obstacles come into play. In the long run, it will increase productivity and efficiency while lowering labor costs.

7.2 PACKING FOR LOGISTICS (CONCEPTS, IMPORTANCE, REQUIREMENT, IMPORTANT ASPECTS OF LOGISTICS, PACKING REPACKING & FORWARDING, TRENDS IN PACKAGING)

Concepts:

Packaging is a coordinated system of preparing goods for safe, secure, efficient and effective handling, transport, distribution, storage, retailing, consumption and recovery, reuse or disposal combined with maximizing consumer value, sales and hence profit (Saghir, 2002).

Packaging is the technology of enclosing or protecting products for distribution, storage, sale and use. Packaging also refers to the process of design, evaluation and production of packages. Packaging can be described as a coordinated system of preparing goods for transport, warehousing, logistics, sale and end use. Packaging contains, protects, preserves, transports, informs, and sells. Packaging is done by private firms as well as government bodies too. Governments of UK (cow-milk) and Government of Australia (Sheep-Wool) etc. Indian companies like Uflex, ITC, Aquench etc.

Types of Packaging:

- 1) Primary Packaging
- 2) Secondary or grouped packaging
- 3) Tertiary packaging

Primary packaging is the packaging format in direct contact with the food or the containment. It is conceived so as to constitute, for the end-user or the consumer at the POS, a complete integral package. For eatables, as it always remains in direct contact with the commodity, its hygiene and edibility safety requirements are maintained throughout its life span. It is also the packaging that the consumer will retain the longest. It normally has the most information in terms of contents, branding, 'Best Before Date', instructions for use, etc.

Secondary or grouped packaging is that which is used to collate primary units for ease of handling in the selling environment. Typically this packaging can be cardboard boxes or trays, or shrink-wrapped plastic packs containing a number of primary units. The layer after primary packaging is in indirect contact with the food but may still have product safety impact. Secondary packaging plays a vital role in the marketing strategy surrounding the product. It keeps the primary packaging in its original condition during storage and logistics. The dimensions of the secondary packages are kept in accordance with its contents to fulfill space utilization. Its materials are chosen so as to keep its contents in its necessary temperature and condition(s)

Tertiary packaging is used to group secondary packaging together to aid handling and transportation and prevent damage to the products. Examples: Pallets, shrink wrap, straps etc. It facilitates the safe handling and transport of a number of sellable units or grouped packaging. The packaging prevents physical damage due to incorrect handling or transport. Transport packaging does not include road, rail, ship or air containers. It concerns, for example, pallets or (heavy) wooden crates. Economically, the tertiary packaging should be done so as to accommodate the secondary packages totally and should be able to be transported from places carrying information about the product e.g. fragility etc.

The Importance of Packaging in Logistics:

Most people don't think much about logistics and transportation packaging. After all, isn't it the commodity that matters? Although the product is critical, the packaging is also critical because it serves the product. Here are a few reasons why packaging is so important in logistics:

1. Avoid Delays Due to Non-Compliance:

There could be compliance issues to consider for your logistics packaging depending on what you're shipping and where you're shipping it to. If you're shipping to the EU, for example, there are some very strict rules for transporting palletized goods, and if you don't follow them, your shipment will almost certainly be held up at customs. It's possible that it'll be refused at the point of entry. You must be aware of packaging compliance issues, particularly if you are shipping internationally.

2. Makes Transportation Easier:

Many products would be very difficult to ship if they were not packaged properly. Consider anything as simple as a collection of building screws. Could you imagine attempting to move these items without first placing them in a box or container? You can ship the products more easily with the right packaging.

3. Protects Your Goods:

Damaged or labelled products during transportation are costly. You will have to submit a replacement in addition to losing the cost of the

item and the money you paid to transport it. Worse still, if this occurs often enough, it can cost you customers or damage your professional reputation. Your goods will arrive undamaged at their destination thanks to logistics packaging.

4. Provides Important Information:

Additionally, logistics packaging offers valuable information to those shipping the goods as well as the end user. Some of the information may be as basic as "fragile" or "this side up," but other information, such as instructions to store the object at a certain temperature or precise handling instructions, may be more detailed.

5. Makes Storage More Convenient:

Will your goods spend time in a warehouse or storage facility between initial shipment and delivery to the end customer? If that's the case, using the right packaging makes storage a lot easier. Whatever form the product takes, the right packaging will make it simple to store it on shelves or pallets.

6. Helps Sell Your Products: Did you know that your packaging can be used to sell your product? Your items will arrive at the retailer ready to be sold on store shelves if you choose retail-ready packaging. Packaging that incorporates the company's colours, graphics, and brand will help you draw more customers and boost sales.

Why do we require/need packaging?

1. Risk Elimination
2. Waste Minimization
3. Information
4. Protection
5. Hygiene and safety
6. Convenience
7. Choice
8. Preservation

Packing Repacking & forwarding:

Repackaging entails eliminating the current production packaging and replacing it with new packaging that the consumer specifies. If an item was not packaged correctly or if inspection is needed, repackaging might be necessary. Repacking goods can be cumbersome and annoying when you have a lot of other business core needs to focus on. Fast turnaround is critical in today's business environment. Allowing for post-package product inspection or repackaging should not slow down your company.

Trends in packaging:

- 1. Connected Packaging:** Anything, including packaging, can now be digitised. Incorporate QR codes or other scannable technology into your package design to make your product more interactive. It provides your interested consumers with a wealth of knowledge and

material, encouraging them to connect with your brand on a deeper level. In addition, incorporating technology enhances the product's relevance in an increasingly digital environment.

2. **Nostalgia:** There are a few different approaches to this, but nostalgia is currently high in the market. This is particularly true for millennials, owing to rapid technological advances during their formative years. This community responds well to both 8-bit designs and classic retro looks. You get a rare and convincing sight with 8-bit designs.
3. **Added Dimension:** People adore packaging that seems to be something it isn't. In the food and beverage industry, this is particularly true. Adding dimension to your design allows you to express your personality and imagination. It's an opportunity to make an impact on potential customers and differentiate yourself from the competition. Dynamic packaging, when used correctly, will take the product to the next level.
4. **Playing with Color:** Color-related patterns abound in the industry, each one more intriguing than the last. Although some brands prefer a pastel/neutral palette, others stick to black and white. Gradients with bright colours are also very common right now. When paired with an otherwise minimalist approach, using a single bold colour is a great way to make a strong brand statement.

7.3 REFERENCES

1. Logistics & Supply Chain Management (Strategies for Reducing cost & improving service) – Martin Christopher [FT financial Times/Pitman publishing, 2nd edition]
2. Logistics & Supply Chain Management (Cases & Concepts) – Raghuram & N. Rangaraj [McMillan India Ltd, 1st edition]



TRANSPORTATION PROBLEM

Unit Structure :

- 8.1 Introduction
- 8.2 Transportation Role and Functionality
- 8.3 Participant in Transportation
- 8.4 Transportation Formats
- 8.5 Transportation Mode
- 8.6 Decision and Other Formats and Transportation Documentation
- 8.7 Private Fleet Management: Process Factors and Drivers

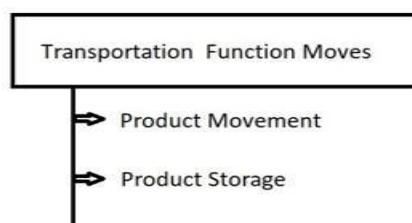
8.1 INTRODUCTION

Transportation means the movement of product from one location to another as it makes its way from the beginning of a supply chain to the customer. Transportation plays a vital role in Indian economic success by allowing for safe and efficient distribution of goods and services throughout the supply chain. Transportation is an important supply chain driver because products are rarely produced and consumed in the same location. Transportation links the various integrated logistic activities. Without the transportation link raw materials cannot flow into warehouse and plant nor can be finished products flow out of the plant to field warehouse and finally to customer.

8.2 TRANSPORTATION ROLE AND FUNCTIONALITY

Transportation is the most visible of all functions of logistics and high contributor to logistics cost. Supply chains also use responsive transportation to centralize inventories and operate with fewer facilities. For example, Snapdeal relies on package carriers and the postal system to deliver customer orders from centralized warehouses.

Transportation function moves the product to meet customer expectation at minimum cost.



A) Product Movement

What is moved?

Raw material, WIP, semi-finished items, finished goods, packaging material, rejected material movement is required up or down the supply chain.

How is this done? What resources are used?

Resources used by transportation:

- 1) **Temporal:** Product is locked up during transit hence inaccessible. Time is temporal resource that is expanded in transportation so utilized a positive amount of time in transporting material. During the time the product is locked up, cost is incurred in proportion to the time.
- 2) **Financial:** Several cost elements like administration cost, salaries, maintenance cost are expanded. Loss on account of product loss and damage also needs to be accounted for.
- 3) **Environmental:** Fuel consumed is big cost in transportation. In India transportation activities creates congestion. Environmental cost is tangible and sustainability intangible. As transportation utilized temporal, financial and environmental resources, items must move only when product value is enhanced.

B) Product Storage

Temporary storage in stationary vehicles is kept moving on a circuitous route. Product storage is expensive in a transport vehicle but sometimes keeping overall cost in mind this is adopted.

- 1) When storage space is limited.
- 2) When unloading and loading is more expensive than storage.

8.3 PARTICIPANT IN TRANSPORTATION

To understand transportation in a supply chain, it is important to consider the perspectives of all four parties. These parties have very important roles to play in transportation environment. Parties to a transportation decision are those who have stake in it. They are

- 1) **Shipper** -It is also known as consigner. The shipper is the party that requires the movement of the product between two points in the supply chain. Transportation, inventory, information, sourcing, and facility will provide to the customer with minimize the total cost that take care done by shipper. Shipper is responsible party to transport the good towards the customer in business transaction.
- 2) **Consignee** – Consignee is the party to whom the goods are sent.
- 3) **Carrier** - Carrier is the service provider who carries the consignment from the shipper to consignee. The carrier is the party that moves or transports the product.

- 4) **Government** - Government has to play a role as they are keenly interested in the transportation and have a stake in it. Transportation makes business happen which is fundamental to the economy of any society. Economic prosperity to the society is the objective of the government of the day. Government may also collect tax on the transaction. Government represents general public's interest, they have to protect.
- 5) **General Public** - General public is another party who has a large stake in the transaction involving transportation. Public wants goods produced at a different part of not only country but also the world. Those demands cannot be made without transportation.

8.4 TRANSPORT FORMAT

In addition to classifying transportation by mode another common grouping is the legal status or format of carrier operating authority. From an operating authority perspective there are 4 Carriers classes: -

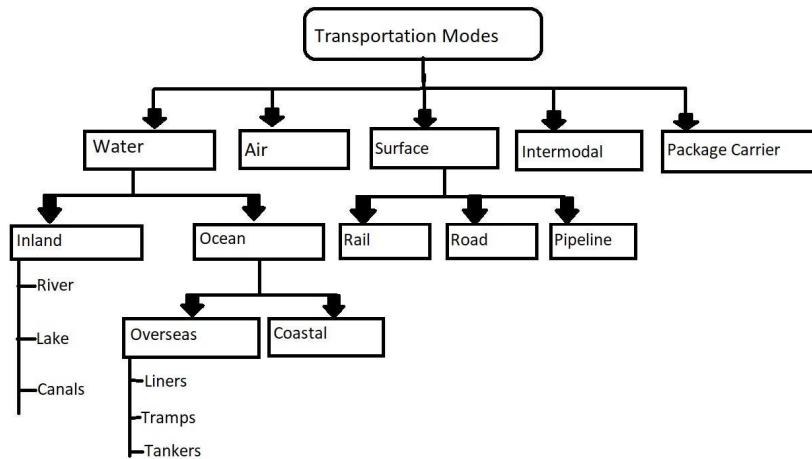
- 1) Common
 - 2) Contract
 - 3) Private
 - 4) Exempt
- A. **Common Carriers** - Public Transportation system is known as the common carrier. Common carrier has the responsibility to offer service at non-discriminatory prices to the public. They have the right to transport all commodities or it may limit transport to specialize commodities. E.g. – BEST Buses, Auto rickshaw
 - B. **Contract Carriers** - A contract carrier does not serve the general public, but rather serves one or a limited number of contracted customers. Although, contract Carriers must receive authorization, requirements are normally less restrictive than common Carriers operating authority. The basis for the contract is an agreement between a carrier and a shipper customer using the services for a specified transportation service at a previously agreed cost. They have no legal service obligation. They often provide a specialized service and usually have lower rates than common or regulated carriers.
 - C. **Private Carrier**- A firm's own transportation is termed a private carrier. Private carriers are not “for-hire” and not subject to the same universal regulations as other types of transport. However, the carrier's primary business must be something other than transportation.
 - D. **Exempt Carriers** – Exempt carriers are exempt from regulation regarding rates and services because of the type of commodity hauled or the nature of the carrier's operation. Exempt motor carriers are usually local and typically transport which is used in many sectors in India like agricultural goods, newspapers, livestock, and fish. Exempt water carriers transport bulk commodities like coal, ore, grain, and liquid. Exempt rail carriers transport piggyback shipments. Exempt air carriers haul cargo.

8.5 TRANSPORTATION MODE

Supply chains use a combination of the following modes of transportation:

- Air
- Package carriers
- Surface
- Water
- Intermodal

Transportation Mode Chart



A. Water Transport

India is surrounded by Ocean. Therefore, it has a long coastline. It has played a very significant role in bringing different parts of the world closer and is indispensable to foreign trade. This mode is the link between countries separated by water.

Kinds of Water Transport:

Water transport consists of:

1. Inland water transport
2. Ocean-transport

Inland Water Transport:

It has played a very important role in Indian Transport System since ancient times. Transportation of goods in an organised form is confined to West Bengal, Assam and in some parts of North Eastern Region and Goa.

It consists of: -

- a) Rivers:** Rivers are a natural waterway in India which can be use small boats as well as big barrages for transportation. River transport played a very important role prior to the development of modern means of land transport. E.g.- Ganga river is used for interstate transport.
- b) Canals:** They are artificial waterways made for the purpose of irrigation or navigation or both. All season canals don't have water so all month's transportation not possible. Canal's transport requires a

huge amount of capital investment in construction and maintenance of its track i.e., the artificial waterways.

c) **Lakes:** Lakes can be either natural like rivers or artificial like canals.

Ocean transport:

The sea does not require any investment in the construction and maintenance of its track. It is one of the cheapest modes of transport which is indispensable for foreign trade. It has brought the different parts of the world closer through which product supply can be done easily.

Ocean transport includes:

1. Coastal Shipping
2. Overseas Shipping
1. Coastal Shipping:

It is one of the most important means of transport for carrying goods from one part to another in a country. It is a cheaper and quicker mode of transport and is most suitable for carrying heavy, bulky and cheap traffic like coal, iron ore, etc. to distant places. But it can serve only limited areas.

2. Overseas Shipping:
There are three types: -
 - 1) Liners
 - 2) Tramps
 - 3) Tankers

Liners: - Liners are ships which have regular fixed routes, time and rates.

Tramps: - Tramps are ships which have no fixed routes, rules and rate.

Tankers: - Tankers are vessels which are specially design to carry oil, petrol, liquids etc.

Advantages:

1. Water transport is the cheapest modes of transport. Oceans and rivers are the natural resource so no cost is involved in their construction unlike that of railways and roads.
2. Heavy and bulky goods can be transported at little cost through water transport.
3. Natural disaster comes like flood, heavy rain only water transport is possible at same time rail or road transport is disrupted.
4. Maintenance cost of water transport is very less Compared to other modes of transport.

Disadvantages:

1. Speed of Inland water transport is very slow and therefore this mode of transport is unsuitable where time is an important factor. It is a slow means of transport. Failure of monsoon results into fall in the water-level of rivers making navigation difficult.

2. Area of water transport is restricted. Rivers and oceans are free gifts of nature. Accordingly, the operational area remains fixed. Unlike railways and roads, man cannot construct waterways.
3. Rivers and canals cannot be operated for transportation throughout the year as water may freeze during winter or water level may go very much down during summer.
4. The inland water transport by rivers is unreliable. Sometimes the river changes its course which causes dislocation in the normal route of the trade.
5. Inland water transport by rivers and canals is not suitable for small traders, as it takes normally a longer time to carry goods from one place to another through this form of transport.
6. As against other means of transport, it is less safe. Danger of sinking of boats and ships always looms large.

B. Air Transport

Fastest mode of transport is Air Transport. In 1953, three corporations were set up by India which is listed below: -

- (i) Air India International Corporation
- (ii) Indian Airline Corporation
- (iii) Private Airline

Main advantages of air transport are:

1. It is a high-speed means of transport. Passengers and goods can be transported speedily from one place to the other.
2. It is convenient to send costly, light and perishable goods through air transport.
3. Unlike railways and road transport there is no need to spend any money on the construction of any track or road. One has only to construct air-ports.
4. Mountain's oceans and rivers create no obstruction to air transport.
5. It has great strategic significance. Soldier, arms and ammunition can be airlifted to the troubled spots.

Disadvantages or Problems of Air Transport:

Air transport faced undernoted problems/disadvantages:

1. Air transport in India is becoming very costly day by day with rising operational costs.
2. Creation of aviation facilities requires huge investments. The Government is least capable of increasing the number of planes and airports in the country. The private sector has its own limitations.
3. There are no adequate facilities to train a large number of pilots in the country. On privatization of airlines, we are again facing the problem of sufficient trained staff.
4. In air transport, risks are increasing day by day due to crime and terrorism, violence, hijacking, etc. all over the world.

C. Rail Transportation

Rail transport is used in supply chains now a days. Making the total supply chain more sustainable means decreasing road transport usage. Rail transport is being looked at as a solution for road traffic congestion problems. It is one of the most important, commonly used and very cost-effective modes of commuting and goods carriage over long, as well as, short distances. It has fixed routes and schedules. Its services are more certain, uniform and regular compared to other modes of transport.

Main advantages of Rail transport are: -

- 1) It has fixed routes and schedules. Its services are more certain, uniform and regular.
- 2) High Speed over long distance.
- 3) It is economical, quicker and best suited for carrying heavy and bulky goods over long distance.
- 4) Cheaper Transport.
- 5) Safety Transport.

Disadvantages of Rail transport are: -

- 1) Requires large investment of capital.
- 2) Its routes and timings cannot be adjusted to individual requirements.
- 3) Lacks of Door to Door step services
- 4) Unsuitable for short distance and small loads
- 5) No Rural services.

D. Road Transportation

Road is a route between two destinations, which has been either paved or worked on to enable transportation by way of motorised and non-motorised carriages. The major advantage of road transport is that it can enable door-to-door delivery of goods and materials and can provide a very cost-effective means of cartage, loading and unloading. Delivery of goods between cities, towns and small villages is made possible only through road transport.

Main advantages of Road transport are: -

- 1) Requires less investment of capital.
- 2) Door to Door services
- 3) Services in Rural Area
- 4) Its routes and timings can be adjusted to individual requirements.
- 5) Suitable for short distance with rapid speed.
- 6) Less Cost
- 7) Lesser Risk of Damage in Transit

Disadvantages of Road transport are: -

- 1) Seasonal Nature means rainy or flood season, road become unsafe.
- 2) Unsuitable for Long Distance and Bulky Traffic.
- 3) Slow Speed of transportation compared to others.
- 4) The rates charged for transportation are also unstable and unequal.

E. Pipeline Transportation

Pipeline is used primarily for the transport of crude petroleum, refined petroleum products, and natural gas. In India, Gas Pipeline e.g.- Mahanagar Gas Pipeline is a service provider who provides gas to consumer safely. It may be an effective way of getting crude oil to a port or a refinery. Pipeline pricing usually consists of two components –

- 1) fixed component: - It is related to the shipper's peak usage.
- 2) A second charge relating to the actual quantity transported.

F. Intermodal Transportation

Intermodal transportation is the use of more than one mode of transport to move a shipment from sender to its destination. A variety of intermodal combinations are possible, with the most common being piggyback= Road + Rail, Fishy Back= Road + Water, Birdy Back= Road + Air, Land Bridge= Sea + Rail.

G. Package Carrier

Package carriers are transportation companies such as DHL and the Indian Postal Service, which carry small packages ranging from letters to shipments weighing about 100-1000 kg. Package carriers use motor cycle, air, truck, and rail to transport time-critical smaller packages. The major service they offer shippers is rapid and reliable delivery. Hence, It use package carriers for small and time-sensitive shipments.

8.6 DECISION AND OTHER FORMATS AND TRANSPORTATION DOCUMENTATION

In supply chain management, organization uses different software's to take a transportation decision like Oracle Transportation Management (OTM). Transportation Software's provides a single platform for companies to manage all transportation activity throughout their Supply Chains. Software supports the companies to minimize cost, optimize service levels, and create flexible business process automation within their global transportation and logistics network.

When transportation software developed that time used powerful algorithms and optimization engines to optimize orders and shipments based on cost, service level, and asset utilization. Scenarios for multi-stop consolidation, pooling, cross-docking and three-dimensional load configuration are supported. Create a transportation dashboard for operational and strategic performance indicators by leveraging the operational data.

Transportation Documentation: - Transportation Documentation is any document that is required for an item to clear customer. A bill of lading, commercial invoice, insurance certificate, original certificate, package list is the best example of transportation documentation. Transportation Documentation for import-export are commercial documents, transport document, financial documents, government documents.

1. Commercial document –

- a) Agreement between buyer and seller for every details of transaction is known as sales contract.
- b) Performa Invoice is an invoice provided by supplier to the shipment of merchandise, informing the buyer about the characteristics of goods.
- c) Commercial Invoice is used for customer clearance of goods and foreign exchange purpose.
- d) Packaging List is list of goods information details.
- e) Inspection certificate is report issue by independent surveyor or exporter on the specification of the shipment including quantity, quality and price required by buyer or country
- f) Insurance policy – Full details of insurance coverage, evidencing insurance has been taken out on the good shipped.
- g) Product Testing certificate- The product are confirmed to certain international standard such as product quality, specification and safety.

2. Transport Document

- a) Shipping Order – Documents with the details of cargo and the shipper requirements.
- b) Dock Receipt – To confirm the receipt of cargo or warehouse pending shipment.
- c) Bill of Lading – Contract between shipper of good and carrier. The customer usually needs the original as proof of ownership to take possession of goods.
- d) Sea way-bill – A receipt for cargo which incorporates the contract of carriage between the shipper and the carrier.
- e) Packaging List – A List providing information needed for transportation purpose, such as details of invoice, buyer, consignee, vessels. country of origin.
- f) Airway Bill -Used for the carriage of goods by air, it serves as a receipt of goods for delivery.

3. Financial Document

- a) Bill of Exchange – An unconditional written order, in which the importer addressed to and required by the exporter to pay on demand or at future date a certain amount of money to the order of person or bearer.
- b) Standby Credit – An arrangement between a customer and his bank by which the customer may enjoy the convenience of cashing cheques, up to a value.
- c) Collection Instructions – An instruction given by an exporter to its bankers, which empowers the bank to collect payment subject to the contract term on behalf of the exporter.

- d) Trust Receipt – A document release a merchandise by bank to a buyer.

4. Government Document

- a) Import Export Declaration – A statement made to director of customer at port of entry/exit, declaring full particulars of the shipment.
- b) Import Export Licence – A document issue by relevant government department authorising the import and export of certain controlled goods.
- c) International import certificate – A statement issue by the government of country of destination, certifying the imported strategic goods will be disposed of in the designated country.

8.7 PRIVATE FLEET MANAGEMENT: PROCESS FACTORS AND DRIVERS

Private fleets can come in many different shapes and sizes. Nationally-operating trucking company and a small, locally-operating delivery company are considered fleets. Fleet management covers the practices of overseeing, organizing, and recording all aspects of a company's fleet.

Primary Responsibilities-

- 1) Recording and maintaining accurate data and information on all aspects of the fleet. Example: Fleet managers are often responsible for keeping detailed maintenance histories for all vehicles in the fleet.
- 2) Assessing, managing, and mitigating all associated risks at every level of your organization. Example: Fleet management programs should include advanced screening policies for all drivers, as well as rigorously enforced safe-driving policies and training programs, to lower the risk of traffic incidents involving its fleet vehicles.

Followings are the fleet drivers: -

- 1) **HIRING:** - There are a number of different qualifications and characteristics that you should look for when hiring fleet employees. These qualifications will vary based on the classifications of vehicles in your fleet.
- 2) **TRAINING:** - Company-sponsored training programs could include instructions for driving on different types of terrain, first aid training, education on the dangers of distracted and impaired driving.

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8.9 QUESTION BANK

Q.1) What are the roles and functionalities of transportation?

Q.2) What are the different participants in transportation process?

Q.3) Write a short note on

A. Transportation Format

B. Private Fleet Management

C. Modes of Transport with its merits and demerits-

i. Water Transport

ii. Road Transport

iii. Rail Transport

iv. Air Transport

v. Pipeline Transport

Q.4) What are the different transportation documents?



MODULE VI: BENCHMARKING THE SUPPLY CHAIN

9

BENCHMARKING THE SUPPLY CHAIN

Unit Structure

- 9.0 Objectives
- 9.1 Introduction
- 9.2 An Overview
 - 9.2.1 What is Benchmarking?
 - 9.2.2 Importance of Benchmarking in SCM
 - 9.2.3 Benchmarking Process
 - 9.2.4 Types of Benchmarking
 - 9.2.5 Reasons for Benchmarking
- 9.3 Benchmarking the logistics process
- 9.4 Mapping Supply Chain Process
 - 9.4.1 Benefits of Supply Chain Mapping
- 9.5 Supplier and Distributor Benchmarking
 - 9.5.1 Benchmarking
 - 9.5.2 Logistics performance indicators
- 9.6 Case study

9.0 OBJECTIVES

- After going through this unit, you will be able to:
- Learn about the concept of Benchmarking.
 - Learn how to achieve the target of business and become best in market.
 - Learn about the product metrics & quality.
 - Learn about supplier and distributor benchmarking in supply chain.
 - Learn about the improvements needed in SCM process.

9.1 INTRODUCTION

In the supply chain management, delivering a quality product at right time and right place to the customer plays very important role. When market grows, various competitors are also entered in the market, so to retain the customers and for healthy competition suppliers and distributors

need to more focus on the quality of the product with less operation cost. They have to also revise their product time to time as per the market need. To check the performance of the company with respect to quantity, market value and time, a manager can use the benchmarking with logistics performance indicators. Using benchmarking the company manager will come to know that exactly where they need to do the improvements for achieving the business goal of the company.

9.2 AN OVERVIEW

The concept of Benchmarking was established by Xerox Corporation in the 1981 and after that the other international companies started to use it in their business. For e.g. Motorola. There are some international organizations like Global Benchmarking Council, American Productivity and Quality Center, Asian Benchmarking Clearinghouse, Hong Kong Benchmarking Clearinghouse who are specialized in the benchmarking service and these organizations helps the other organizations to benchmark their products & services against their competitors. There is a need of benchmarking in all the businesses to make them successful. But here we are going to focus on benchmarking in supply chain management and how it is useful in logistics process of SCM.

9.2.1 What is Benchmarking?

Benchmarking is defined as the process of measuring products, services, and business processes against the competitive organizations which are well known in the market for their quality product and operations.

Benchmarking is also known as goal setting which allows a company to set their goals and assess for logistic control areas in their supply chain process. These areas include productivity, inventory accuracy, shipping accuracy and storage volumes.

Benchmarking helps the organization to compare their goals, policy and strategies with other leading organization to adapt the changes and become a top level organization in the same market.

Example: Comparing a delivery speed of your product from source to destination with other companies having same type of product or service. (Comparing Mc Donald's Burger with KFC's Burger in terms of taste, hygiene and service)

9.2.2 Importance of Benchmarking in SCM

Benchmarking plays very important role in the supply chain management. Without benchmark the organization cannot survive in the marketplace. Because using benchmarking a supply chain company can evaluate their products, processes and practices with competitive

companies and take an advantage to become a best one in the market. Supply Chain Council suggests SCOR (Supply Chain operations reference) who provide a common framework to facilitate cross organizational benchmarking.

With the help of benchmarking, a manager can verify the goals and objectives of the company to gain profits and customer satisfaction. And then make the improvements as per requirement. After the improvements, a manager will again check the impact of those improvements.

Benchmarking has measures the performance of the logistics in terms of service delivery time, product quality and features and costing. The company can focus on benchmarking metrics result and works on particular area where they need to work. For e.g. if a service delivery is not reliable or the product is having worst quality or the cost of the product is higher than other competitors product then supply chain team of the organization including manager will find out the root cause of it and can provide the solution to the customer.

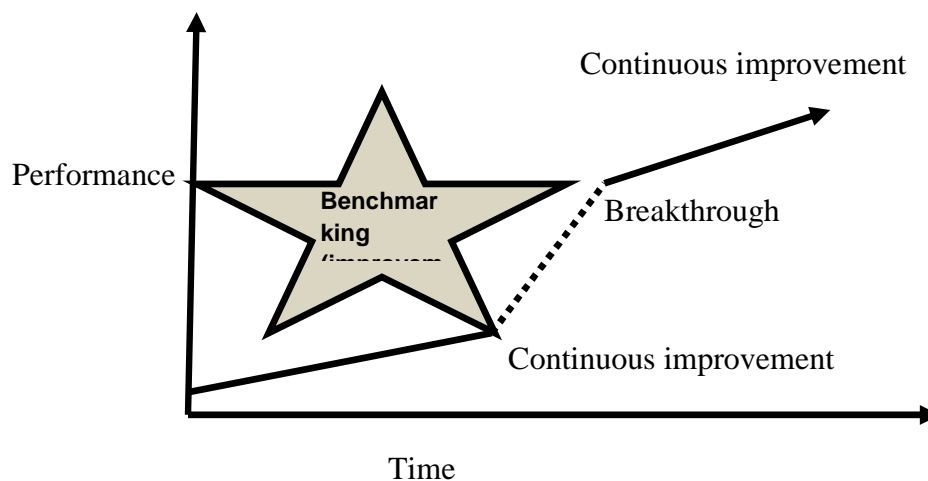


Figure 1.0 Benchmarking accelerates improvement & change

Benchmarking also helps the organization to find out storage capacity & turnover, frequency of delivery, total time required to travel & its cost, productivity and return on investment (profit) of the company.

9.2.3 Benchmarking Process

Benchmarking process includes five basic steps to find out the best solution for the company.

The steps are:

- 1) Planning
- 2) Collection
- 3) Observation and Analysis
- 4) Implementation
- 5) Evaluation

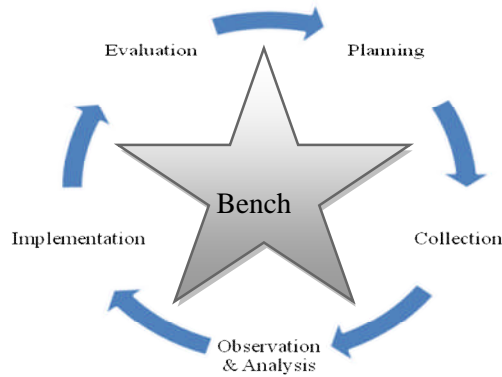


Figure 1.1 Benchmarking Process

- 1) **Planning:** In this step the organization do the proper planning to start the benchmarking process. Identify the list of inputs and expected outputs prior the actual process start. The organization's strategic goals, policy and standards are applied for the further comparison & evaluation. Organization planning to search their competitors in the market to know their strengths and weaknesses so that they can work on it.
- 2) **Collection:** After the planning and searching, organization collects all the information of other competitors who are having the top brand in the market. This information includes the data about competitor's products, effective process and customer's positive feedback about the products or service.
- 3) **Observation and Analysis:** From the collection of data, an organization does the analysis by observing - what makes the other organization's product popular in the market or world? What are competitor's strengths? What actually makes the customer delight? What are our weaknesses? How we can improve our product & services? How to become a successful brand in the same business industry?
- 4) **Implementation:** After the root cause analysis, the actual work out get implemented. The organization starts the improvement in the product & services. Also find out the alternative solutions for the problem areas & select whichever is best one. Put efforts to increase their brand value in the market.
- 5) **Evaluation:** Evaluation plays very crucial role in the benchmarking process. This is the last step of the process which monitors and evaluates the final outcome of the implementation. This step assess whether the organization has achieved their strategic goal or not? If not then what to do? Is there any need of more efforts or the goal need to be reset? If yes, then again the process gets repeated from planning step for rework. Else the organization has achieved their goals & objectives and the benchmarking process gets stopped.

9.2.4 Types of Benchmarking:

There are two main types of benchmarking which are used by organizations.

- Internal Benchmarking.
- External Benchmarking.

➤ Internal Benchmarking: This is used by the organization for comparison metrics like services, performance & practices between their own different products, departments and branches having same outcome.

For e.g. Yewale tea brand comparing the performance and profits of their product (tea) of Pune branch with Mumbai branch.

➤ External Benchmarking: This is used by the organization for comparison metrics like services, performance & practices with other organization's products, departments and branches having same outcome.

For e.g. In the market Surf Excel Company comparing their product's (washing powder) performance and profits with the same type product of Tide Company.

Other Types of Benchmarking:

- Performance benchmarking
- Practice benchmarking

➤ Performance Benchmarking: This is used by the organization to gather the data and do the comparison of quantitative data using KPI (i.e. Key Performance Indicators). This data is useful for decision making after identify the performance gaps. It measures the performance of the company's supply chain by considering quantity in terms of inventory turnover, warehousing cost, supply chain cost, return on investment, order rate, delivery time etc.

➤ Practice Benchmarking: This is used by the organization to gather the data and do the comparison of qualitative data about the activities of business process conducted by people, processes, and technology using surveys, observations & research. This data is useful for the improvement of organization's business process quality in terms of product quality, customer satisfaction, supplier performance etc.

9.2.5 Reasons for Benchmarking:

Benchmarking helps the organization to achieve their business goals & objectives in the right way. But if the organization does not apply the benchmark then it can create failures and loss in their business.

Here are some reasons why you need to use benchmark in your business:

1. Benchmarking gives the information about the top successors of your industry. Why they are successful in the market? What are the secrets

of their success? What process or activities they are following? So that you can adopt that information in your business to become successful.

2. Benchmarking helps you to find out your own strengths and weaknesses in your business. So that you can work on your weaknesses for the improvement.
3. Benchmarking allows you to evaluate your business goal. So that you come to know how to achieve it or need to make a changes into it.
4. Using Benchmarking you will get right information to take a strategic business decisions. And it will really help you for the correct investment in your business.
5. Benchmarking can also help you for the assessment of your supply chain management. So that you can efficiently save the cost of staffing, inventory & other expenditures.
6. Benchmarking help you to compare your overall business performance & infrastructure with your competitors. So that you can do the necessary improvements and put more efforts in performance gap to become best in your industry.
7. It can also helps you to retain your customers with you for a longer time by understanding their needs, feedbacks and supplying them the best products & services which they are expecting.

9.3 BENCHMARKING THE LOGISTICS PROCESS

In the logistics process, there are certain steps that need to follow for benchmarking:

- ❖ Understand the structure of the supply chain in logistics process.
- ❖ Try to find out the critical paths in the process where the supply chain manager has to give more attention.
- ❖ Apply the benchmark on such critical processing paths by comparing it with the best leaders in the same industry.
- ❖ Measure the performance of the supply chain starting from supplier to customer delivery.
- ❖ Procure the best effective solution for the problematic area of the process with the help of control and measurement tools.

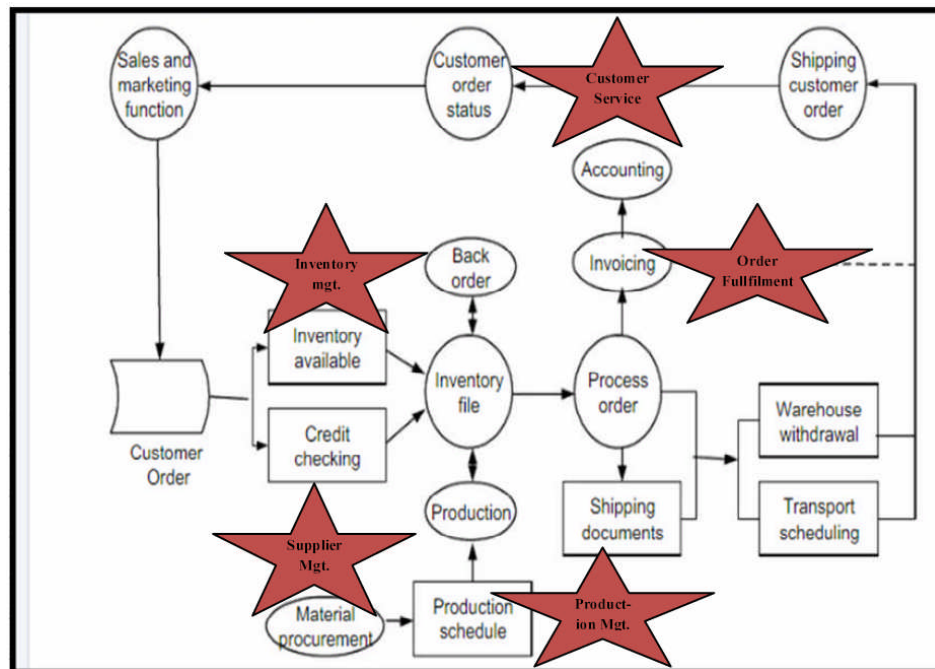


Figure 1.2 Logistics Management Process with Benchmarking

The figure 1.2 depicts logistics management process structure. The organization first needs to understand the supply chain of this process starting from the customer order → Inventory checking → Production → Order processing → Accounting & billing → Transportation → end with successful Shipping of that order.

After that the Managers have to find out the critical processes where the benchmarking is needs to be applied. The critical processes are Inventory Management, Supplier Management, Production Management, Order Fulfillment and Customer Service (represented in fig.1.2 with star shape).

Then managers have to measure the performance of the logistics process and also compare the benchmarking critical processes with the best competitors in the market. So that they come to know whether they meet their objectives or there is a need of some improvement in one or more activities of supply chain.

If a specific activity of logistics process is required to make certain changes then managers have to do proper analysis by using different approaches like matrix technology, comparison tables, graphs (pie chart / bar chart) , SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis , life cycle analysis, market growth & attractiveness and spider web diagram.

At the end of the process, a suitable best solution gets implemented in the supply chain to become a 'Best class' in the market.

9.4 MAPPING SUPPLY CHAIN PROCESS

The mapping of supply chain process is very important to know about the complete flow of the process, stakeholders, value-added steps and bottlenecks of the supply chain process. This information is useful for the management team to take a correct decision regarding the fulfillment of the customer needs and the demands of the supplier.

It produces a flow chart to identify value adding time and non-value adding time for the activities which are carried out by supply chain process.

- Value-adding time:-This is the time which is utilized on activities by the organization to increase the benefits / values for the customers. For e.g. providing 24/7 online support to the customers.
- Non Value-adding time:- This is the time which is utilized on activities by the organization to eliminate them without decreasing the benefits / values to the customers. For e.g. Over production, Rework caused due to any defect of the product.
- Throughput Efficiency is calculated as:-

$$\frac{\text{Value-added time}}{\text{Total Supply Chain Processing time}} \times 100$$

For e.g. Assume that organization is spending daily 60 minutes for solving customer's issues which are faced by them and 120 minutes to deliver the service to them. Then throughput efficiency for one day will be calculated as:

$$\begin{aligned}\text{Total Efficiency} &= \frac{60}{120} \times 100 \\ &= 50\%\end{aligned}$$

- Utilization is defined as the amount of capacity used by the organization out of total capacity which is designed to fulfill the customer's requirement.

For e.g. If your organization's warehouse is having inventory capacity of 500 tones materials and if you are stocking 300 tones material then,

$$\begin{aligned}\text{Utilization} &= \frac{\text{Amount of Capacity used}}{\text{Amount of Capacity designed}} \\ &= \frac{300}{500} \\ &= 0.6 \text{ or } 60\%\end{aligned}$$

- In general, Productivity is defined as the amount of work completed by each employee. But in case of supply chain process, the total

productivity is defined as the total throughput achieved by the amount of resources used.

For e.g. Total throughput achieved by the company is 50% and the number of resources used are 5, then

$$\begin{aligned}\text{Total Productivity} &= \frac{\text{Total throughput}}{\text{Total resources used}} \\ &= \frac{50}{5} \\ &= 10\%\end{aligned}$$

9.4.1 Benefits of Supply Chain Mapping :

Supply Chain Mapping provides following benefits to the organization:

- It helps to reengineer the logistics management projects.
- It shapes the end to end pipeline process and its related inventory management.
- It helps to measure value added & Non value added time and total productivity of the supply chain process.
- It also focuses on the consequences of rules and policies of the company which are applied on the sub processes like inventory, production, purchasing, vendor management, shipping etc.

9.5 SUPPLIER AND DISTRIBUTOR BENCHMARKING

It is used to verify the supply chain relationship between suppliers and distributors of the organization and benchmark it against 'Best Class' in the market. It simply checks the contribution of suppliers and distributors to make the supply chain performance efficient and reliable. Some of the key issues are:

- Willingness to work as a partner / co-maker.
- Commitment to continuous improvement.
- Acceptance of innovation and change.
- Focus on throughput time reduction.
- Utilization of quality management procedure.
- Use regular and formal benchmarking processes themselves.
- Do they seek to improve communication with you?
- Are they flexible? Customer-focused?

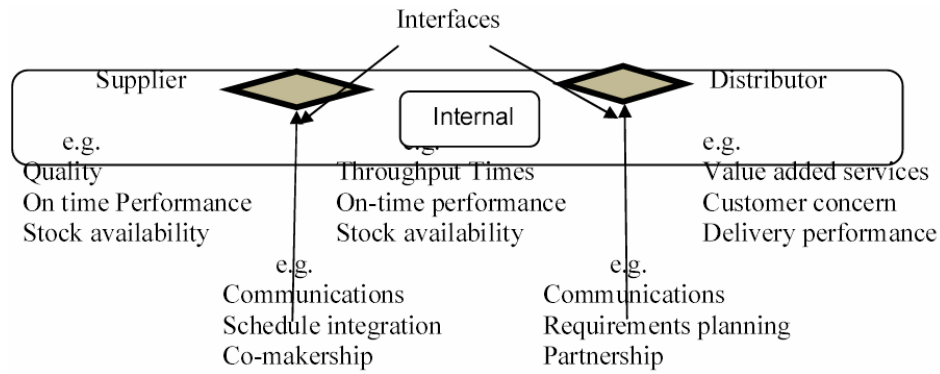


Fig. 1.3 Supplier and Distributor Benchmarking –some typical measures

This figure depicts that how the suppliers and distributors need to come up with quality performance and efforts by using interfaces to make the supply chain process successful.

We can measure their performance and work on it to reduce the operational cost, prevent from future risk and for continuous improvement in the supply chain process.

1.3.1 Setting the Benchmarking Priorities :

While setting the priorities for benchmark, one needs to know the information about:

- Which processes and entities are having strategic importance in the supply chain? (For e.g. inventory management, order shipment, customer service etc.)
- Which processes and entities are having direct impact on the business economics? (For e.g. assets performance, human productivity, cost, revenue etc.)
- Where we need to decide about the product 'build' or 'buy'?
- Where we are internally ready to make the changes?

9.5.1 Benchmarking is defined as the process of measuring products, services, and business processes against the competitive organizations which are well known in the market for their quality product and operations.

- Supply Chain Council suggests **SCOR (Supply Chain operations reference)** who provide a common framework to facilitate cross organizational benchmarking.
- Benchmarking has measures the performance of the logistics in terms of service delivery time, product quality and features and costing.

- Benchmarking process:
 - Planning
 - Collection
 - Observation and Analysis
 - Implementation
 - Evaluation
- Types of Benchmarking:
 - Internal Benchmarking.
 - External Benchmarking.
 - Performance benchmarking
 - Practice benchmarking
- Supplier and Distributor Benchmarking: It is used to evaluate the performance of suppliers and distributors of the organization and benchmark it against 'Best Class' in the market.

9.5.2 Logistics Performance Indicators and Metrics :

Logistics key performance indicators are useful to the manager to control and enhance the logistic processes efficiently by keeping a well track of it.

Logistic processes like transportation, warehousing, Supply chain process etc. are required to be handled carefully. So here some important logistics metrics are given:

- Shipping & Delivery Time: This is the time which measures from the customer's order placement till the delivery of that order. This time is not supposed to be too long. Otherwise benchmarking shows that what is the issue? How it is to be fixed? It also helps to find out the required average delivery time to ship the products on time.
- Order Accuracy: It measures the total number of orders which are processed, shipped and delivered without any failure in the supply chain. Here the benchmarking shows that whether the delivered order is correct or not? Customers are satisfied with the orders or not?
- Transportation Costs: It calculates the overall expenses starting from order processing till the final transportation cost of delivery. Here benchmarking helps to reduce the transportation cost with a high quality of the product to increase a profit of the organization.
- Warehousing Costs: It calculates the overall expenses related to warehouse process like loading & unloading of materials, labor cost etc. Here benchmarking helps to evaluate this cost on regular basis to improve the operations of the business.
- Number of Shipments: It identifies that how many number of orders are shipped regularly and in particular occasions. Benchmarking helps to find out the actual need of resources to deal with the shipment type, locations etc.

- **Inventory Turnover:** It keeps a track of entire inventory sold over a certain period of time. Here benchmarking shows that the organization is having efficient planning, production, marketing and sales management. A high turnover rate represents the growth of revenue where as the low turnover rate represents that there is a problem with your stocks.
- **Inventory to Sales Ratio:** It indicates the ratio in between the inventory available in stock and the inventory which is sold out. It is a part of inventory turnover. If the sales ratio is low then the benchmarking helps to know about how to improve the selling process. It also helps to find out the overstock & its carrying cost.

Key performance Indicators:

- **The Balance Scorecard :-**
 - Highlight issues regardless of measurability that have high impact on the organizational success.
 - Articulate the logistics & strategic objectives to personnel.
 - Understand measurable outcomes of success.
 - Communicate importance of key processes.
 - Highlight and focus attention on key performance indicators.
 - Better faster Cheaper Closer.
- **Supply Chain Operations Reference Model (SCOR):**
 - This Model uses a reference of five major processes which are Plan, Source, Make , Deliver and Return.
 - This model provides cross-industry standard for the supply chain management to measure the performance of the supply chain against the competitors.
 - It supports for business process reengineering.
 - It defines practices for achieving the competitive advantages and to implement the changes required to become best in class.

9.6 CASE STUDY

Case 1: Ford Motor Company

- High profile examples of the cost of poor supplier performance abound.
- In 2000, Ford Motor Company had to recall over 13 million Firestone tires at a cost of \$3 billion after learning that design and quality glitches were putting certain tire models at risk of shedding their treads.

Case 2: Coca Cola

- In 2000, Coca Cola was forced to recall 15 million cans and bottles of its beverages in key European markets after several consumers became ill.
- The problem was traced to contaminated chemicals used at specific Belgian bottling plant that failed to inspect or monitor the quality of

the incoming chemicals used in its products. The incident cost Coca-Cola \$60 million in lost sales.

Case 1& 2 Conclusion:

- Both examples demonstrate the impact of the upstream supply chain can have on an enterprise's costs, performance, customer service and perception in the marketplace.
- These examples also illustrate the critical importance of effectively measuring and managing supplier performance.

Case 3: Benchmarking healthcare logistics processes – a comparative case study of Danish and US hospitals

- Logistics processes in hospitals are vital in the provision of patient care. Improving healthcare logistics processes provides an opportunity for reduced healthcare costs and better support of clinical processes.
- Hospitals are faced with increasing healthcare costs around the world and improvement initiatives prevalent in manufacturing industries such as lean, business process reengineering and benchmarking have seen an increase in use in healthcare.
- This study investigates how logistics processes in a hospital can be benchmarked to improve process performance. A comparative case study of the bed logistics process and the pharmaceutical distribution process was conducted at a Danish and a US hospital.

Conclusion:

- The case study results identified decision criteria for designing efficient and effective healthcare logistics processes. The most important decision criteria were related to quality, security of supply and employee engagement.
- Based on these decision criteria, performance indicators were developed to enable benchmarking of logistics processes in healthcare.

Case 4: Benchmarking agri-food supply chains: a case of Pakistan and New Zealand milk systems

- A benchmarking study aimed to examine the causes of poor performance of the milk supply chain in Pakistan was undertaken. For this purpose the performance of key players of milk supply chain in Pakistan was benchmarked against those of New Zealand.
- For this purpose existing frameworks were evaluated against five criteria characterizing performance measurement in agri-food supply chains and not a single framework qualified.
- This research gap was abridged by developing a framework based on supply chain operations reference (SCOR) model but with certain modifications to food quality. Pragmatic approach was used to select appropriate research design.

- Cross-sectional data was collected using survey strategy. A total of 490 respondents were accessed through personal interviews (430 in Pakistan) and online questionnaires (60 in New Zealand).
- A three-step approach was proposed to address the individual objectives of the overall study. The first-step was to conduct value chain analysis of both the milk supply chains. The second-step was to measure the performance of key players of both the milk supply chains using the performance measurement framework developed as a result of literature review. The third-step was to perform gap analysis of the SCOR metrics for key players of both the milk supply chains and suggest appropriate policy measures for the improvement of milk Supply chain in Pakistan.
- The data were analyzed with statistical package for social scientists (SPSS) and Microsoft Excel. The value chain analysis was performed to explore the benchmarking milk supply chains as well as to gauge the level of value addition.
- The value chain maps discussed the primary functions, activities, operators, facilitators, and enablers in the milk supply chains in Pakistan and New Zealand.
- Moreover, the analysis of value distribution along the entire chain indicated that the informal chain of milk (unprocessed milk) in Pakistan had 22.39% ex-farm gate value addition, with the largest (almost 82%) share of the value captured by the dairy farmers. Whereas, the formal chain of milk (processed milk) in Pakistan had 104.23% ex-farm gate value addition, with the largest (51%) share of the value captured by the dairy farmers.
- The milk supply chain in New Zealand had 216.83% ex-farm gate value addition, with the largest (55.6%) share of value captured by the retailers.

9.7 CONCLUSION

- Pakistani dairy farmers under performed in supply chain reliability, cost of production, and return on working capital as compare to NZ dairy farmers. The majority of the Pakistani dairy farmers were smallholders and due to diseconomies of the scale of their operation they could not afford modern dairy farming technologies such automatic milking, milk storage at controlled temperature, and other precision dairy farming (PDF) technologies.
- The Pakistani milk collectors underperformed in perfect order fulfillment, flexibility and cost of milk sold and outperformed in value at risk, SCM cost and return on assets as compared to NZ dairy companies.

- The Pakistani milk shops underperformed in cost of milk sold and outperformed in order fulfillment cycle time, flexibility, value at risk, SCM cost and return on assets as compared to NZ dairy companies.
- On the basis of findings of the value chain analysis, SCOR analysis, and gap analysis, promotion of agricultural cooperatives as a phased-out medium to long term policy intervention was recommended.

9.8 QUESTIONS

- 1) What is benchmarking? Explain the importance of it in the supply chain process.
- 2) Explain the process of benchmarking in detail.
- 3) What are the different types of benchmarking?
- 4) Explain the mapping of supply chain with its benefits.
- 5) Explain the supplier and distributor benchmarking.
- 6) Write a short note on logistics KPIs and metrics.
- 7) How benchmarking is work in logistics process?

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MODULE VII: IT FOR SCM

10

CONCEPT AND APPLICATIONS OF IT IN SCM

Unit Structure:

- 10.0 Objectives
- 10.1 Concept of IT
- 10.2 Role of IT
- 10.3 Need for IT & its applications
 - 10.3.1 Electronic Records Management
 - 10.3.2 Bar code and Scanner
 - 10.3.3 Radio Frequency Identification (RFID)
 - 10.3.4 Electronic Data Interchange (EDI)
 - 10.3.5 Enterprise Resource Planning (ERP) Systems
 - 10.3.6 Distribution Requirement Planning (DRP)
 - 10.3.7 Electronic Supply Chains
 - 10.3.8 Electronic Commerce (e-Commerce)
- 10.4 Advantages of IT in SCM
- 10.5 Evolution of IT in SCM
- 10.6 Benefits of Digital Supply Chain management
- 10.7 Summary
- 10.8 Sample Questions
- 10.9 References

10.0 OBJECTIVES

After reading this chapter, you will be able to:

1. Understand the importance of information and IT in a supply chain.
2. Understand various IT tools used for Business purpose
3. Understand the major applications of supply chain IT and the processes that they enable.
4. Understand the Evolution of IT in SCM
5. Understand the benefits of using digital supply chain management

In this chapter we will explore the importance of information, its uses, and the technologies as well as IT tools that enable supply chain managers to use information to make better decisions.

We will understand the concepts of IT and how is it useful in context of Supply Chain Management and what all are the various application areas wherein IT can be applied and SCM process would be benefitted.

10.1 CONCEPT OF IT

The exponential growth of Information Technology (IT) along with communication technology in Supply Chain Management (SCM) is playing a very important role in optimizing decisions of the supply chain network flow for achieving:

- organizational competitiveness
- improving higher service level
- lowering inventory supply chain costs
- Reducing electronic risks (e-risks).

The sharing of information among supply chain networks allows the supply chain drivers to work jointly with the aim of integrated and coordinated supply chains for effective supply chain management.

Information also enhances the performance and reduces the risks of supply chains because it provides processes executed transactions and it creates opportunity for decision makers when they want it and in the particular format they require it.

This is where IT comes into role and it consists of hardware and software applications. IT also plays an important role in providing a platform for integrating suppliers, manufactures, distributors and customers to satisfy both the quantity as well as quality of products.

Therefore, to achieve integration and effective information sharing across and beyond the organizations, IT in SCM is required.

10.2 ROLE OF IT

The software as well as the hardware part needs to be considered when we look to the advancement and maintenance of supply chain information systems. The hardware part comprises of the computer's input/output devices like the screen, printer, and mouse and storage media. The software part comprises of the entire system and application program used for transactions processing, management control, decision-making and strategic planning.

Within supply chain, there are a variety of tools and software that are required in order to effectively reduce cost, eliminate waste, and optimize efficiency within the manufacturing operation. Without utilizing

these tools, the simplest or smallest mistake could add up to large amount lost in revenue or cost, which is where your competitors will take advantage of the situation and ultimately get ahead.

10.3 NEED OF IT AND ITS APPLICATIONS

Supply Chain Management (SCM) is the management of a network of interconnected businesses involved in the ultimate provision of product and service packages required by end customers.

Following are the reasons that contribute to the need of IT in SCM:

- Organizations can gather fundamental information along the entire supply chain and respond quickly to any predictable market changes, in this manner gaining competitive advantage by effectively utilizing SCM.
- Providing information accessibility and visibility, enabling a single point of contact for data, allowing decisions based on total supply chain information and enabling collaboration with partners are the objectives of IT in SCM.
- IT systems such as data integrity, real time availability, visibility and processing capability of information and standardization of business process are expected to facilitate better matching of supply and demand between supply chain members and to integrate with external partners in the supply chain.

The organizations are heading towards the virtual supply chain with help of rapid changes in IT applications and underlying technology through: Electronic Data Exchange (EDI), Radio Frequency Identification (RFID), Bar Code, Electronic Commerce, Decision Support system, Enterprises Resource Planning (ERP) package, etc. This critical role of IT in SCM is also decreasing the risks involved in electronically.

Let's see the details of these IT applications:

10.3.1 Electronic Records Management

Paperless business transactions through Enterprises Resource Planning (ERP) Systems, Automatic Identification (Auto ID) and Electronic Data Interchange (EDI) are collectively known as Electronic Records Management (ERM). The objective of ERM implementation in SCM is to ensure the accountability of process flow, which is fruitful to reduce cybercrime risks (e-risks) generate during the e-communication.

10.3.2 Bar code and Scanner

In Bar code data is stored in magnetic or optical form as a part of communication system. The organizations are using it in supply chain networks to automate tracings and tracking products and services at each process flow. It also provides necessary accurate and timeliness of information which is useful to trim down errors.

Bullwhip effect, which is commonly being experienced by the consumer goods industries which lead to tremendous inefficiencies such as excessive inventory investment, poor customer service, lost revenues, misguided capacity plans, ineffective transportation, and missed production schedules has been reduced where bar codes and scanners have been developed and applied in the portions of supply chain to remove inaccuracy.

Bar code helps to reduce risk in supply chain which is rising due to manual oversight or fraudulent data entry by insider. Bar codes duplicity in process generates e-risks, which can be eliminated by application of biometric authenticity and authorizations.

10.3.3 Radio Frequency Identification (RFID)

Radio Frequency Identification (RFID) is a technology which is based on the use of tags that emit and receive the identity in the form unique serial number of an object through wireless using radio signals and on readers that collect the data transmitted by the tags and forward them into the company's information system for further evaluation and analysis. RFID and bar code are based on Auto ID technology but in bar code, the reading device scans a printed label with optical laser or imaging technology and in RFID the reading device scans a tag by using radio frequency signals.

By adopting RFID technology, supply chain can be enhanced by visibility into customer needs, efficient business process, reliable and accurate order forecasts, productivity improvement, operating cost reduction, better tracking, counterfeit identification, and theft predication. RFID helps the organization to avoid duplication of items, as the tags are unique and authenticated. It can also reduce the chances of fraud generated by manipulation in entry, authorization from the supplier to customer.

10.3.4 Electronic Data Interchange (EDI)

Electronic Data Interchange (EDI) is the computer to computer interchange of business documents and/or information in standard, structured, machine retrievable data format .It is used for the paperless communication within supply chain network to share transactional data ,order processing, inventory controlling, accounting, transportation, quick access to information, better customer service, increased productivity, improved tracing and expediting, cost efficiency, competitive advantage, and improved invoicing within in bound and out bound supply chain.

The major advantages of EDI are as follows:

- Instant processing of information
- Improvised customer service
- Limited paper work
- High productivity
- Advanced tracing and expediting

- Cost efficiency
- Competitive benefit
- Advanced billing

10.3.5 Enterprise Resource Planning (ERP) Systems(e.g. SAP, Oracle, PeopleSoft)

It has all logical interfaces to achieve seamless flow of information through the entity within the supply chain context, often interfaced to external systems. It is “not a system, but a framework that includes administrative (finance, accounting), human resources (payroll, benefits), and Manufacturing Resources Planning (MRP) (procurement, production planning) and it is a common term for a co-operating software that manages and co-ordinates much of a company’s resources, assets and activities .ERP system is an enterprise information system designed to integrate and optimize the business processes and transactions in a corporation .ERP systems help the organizations for automating and integrating their Supply Chain Management and business. Basically, they allow data capture without manual interference for the whole business into a single software package from raw material to customers with all information flow. Some of the benefits ERP systems could bring include cost-cutting in internal operations, efficiency across the extended supply chain, enhanced customer service, and network relationships.

10.3.6 Distribution Requirement Planning (DRP)

Distribution Requirement Planning (DRP) is a management process that provides a linkage between warehouse operations (store, distribution center, or warehouse that carries product for sale) and transportation requirement that ensures that supply sources (third party supplier, a regional distribution point, or a factory) which be able to meet the demand.

10.3.7 Electronic Supply Chains

Electronic Supply Chain (ESC) is a supply chain that is electronically managed in form of EDI-based or Internet based between or among participating organizations. Basically it is a Virtual Supply Chain, which links organizations to allow them to buy, sell and move products, services and cash by using Internet-based applications to transact and exchange information with their downstream or upstream

10.3.8 Electronic Commerce (e-Commerce)

Electronic Commerce (e-commerce) means tools and techniques to manage business in a paperless environment. E-commerce includes electronic data interchange (EDI), email, electronic funds transfers, electronic publishing, image processing, electronic bulletin boards, shared databases, and magnetic/optical data capture (such as bar coding), the Internet, and websites in form of B2B (Business to Business) , B2C (Business to Customer) as Amazon.com, Wal-mart.com, C2B (Customer to Business) as priceline.com, C2C (Customer to Customer) as e-Bay auction, P2P (Peer to Peer) and Mobile, or m-Commerce.

Hence it plays a major role for integrated supply chain management (SCM) and changing the dynamics of business in form of following:

1. e- Procurement: An e-procurement is done with a software application that includes features for supplier management and complex auctions with value chain consisting Indent Management, e-Tendering, e-Auctioning, Vendor Management, Catalogue Management, and Contract Management. The forms of e-procurement are web-based ERP (Enterprise Resource Planning): creating and approving purchasing requisitions, placing purchase orders and receiving goods and services by using a software system based on Internet technology.
2. e-sourcing: Identifying new suppliers for a specific category of purchasing requirements using Internet technology
3. e-tendering: sending requests for information and prices to suppliers and receiving the responses of suppliers using Internet technology
4. e-reverse auctioning: using Internet technology to buy goods and services from a number of known or unknown suppliers; and e-informing: gathering and distributing purchasing information both from and to internal and external parties using Internet technology.
5. e-Auctions The electronic auction (e-Auction) is carried out in real time, where participants log in to an auction site using a browser at a specified time and bid for an article as conventional auctions. This is a transparent process and reduces the malpractices
6. e-tailing An e-tailing is a use of the Internet for selling goods over the Internet. The Amazon Company is renowned for the fact that it only sells books over the Internet and doesn't even take telephone orders.
7. Wireless Internet: Wireless Internet enables wireless connectivity to the Internet via radio waves rather than wires on a person's home computer, laptop, smartphone, or similar mobile device.
8. Smart Cards : A smart card can generally be defined as a plastic card with dimensions similar to traditional credit/debit cards, into which an electronic device has been incorporated to allow information storage. Frequently, it also has an integrated circuit with data processing capacity.
9. Digital Signature : The Information Technology Act, 2000 provides for use of Digital Signatures on the documents submitted in electronic form in order to ensure the security and authenticity of the documents filed electronically. This is the only secure and authentic way that a document can be submitted electronically
10. Secure Electronic Transaction/Trading/Technology (SET): It is a proposed industry standard for payment card acceptance over the Internet.
11. XML (Extensible Markup Language): Structured information contains words, pictures, etc. which play an important role in Supply Chain

Networks data flow and a markup language is a mechanism for identifying structures in a document.

12. Spread Sheet (Microsoft Excel): Organizations are using Microsoft Excel as standard desktop software and decision making tools in their supply chains, because in comparison to the total cost of ownership with commercial software-based decision making supporting tool, it is less. It is also useful to apply in Supply Chain Networks (SCN), because it has many build-in capabilities to perform and execute quantitative modeling techniques.
13. Data Warehouse and Data Mining: Data Warehouse (DW), which provides a combination of many different databases across an entire enterprise, aids management in the decision-making process with specific characteristic as subject-oriented, integrated, non volatile, time variant, accessible and process oriented. Data mining combines data analysis techniques such as statistical analysis and modeling to uncover hidden patterns and subtle relationships in data and to infer rules that allow for the prediction of future results.
14. Intranet/Extranet: The computer networks inside an organization are often connected via Internet based protocols (HTML:HTTP, FTP, Mail: SMTP, POP3) and are not accessible from outside. By using Web browsers and server software with their own internal systems, organizations can improve internal information systems and link otherwise incompatible groups of computers within supply chain networks for reducing manual intervention. Extranet provides secured access to its Intranet and to additional information and services that may not be part of its intranet and it is secured via a firewall
15. Internet: Good supply chain management is essential for a successful company. Supply chain management can reach beyond the boundaries of a single organization to share that information between suppliers, manufacturers, distributors, and retailers. This is where the Internet plays a central role.
16. World Wide Web: The World Wide Web (WWW) is the Internet system for hypertext linking of multimedia documents, allowing users to move from one Internet site to another and to inspect the information available without having to use complicated commands and protocols. The number of websites relevant to supply chain management is growing at a rapid pace.
17. Decision Support Systems: Supply chain management involves several decisions like demand planning, logistics network design, sales and marketing region assignment, distribution resource planning, material requirements planning, inventory management, production scheduling, workforce scheduling.
18. E-business : e-business consists of three areas: (1) consumer oriented activity i.e. business-to-consumer, consumer-to-consumer, and government-to-consumer activities, (2) business oriented activity i.e. business-to-business, business-to government and government-to-

business activities, and supported by (3) the e-business technology infrastructure i.e. network infrastructure, network applications, and respective software tools and applications.

19. Software Agents: A software agent is a software system, which has attributes of intelligence, autonomy, adaptability, perception or acting on behalf of a user proactively. The intelligence of an agent refers to its ability of performing tasks or actions using relevant information gathered as buyer agents or shopping bots (retrieving information about goods and services from networks), monitoring and surveillance agents (used to observe and report on equipment, usually computer systems), user agents or personal agents and data mining agents (finding trends and patterns from information gather from many different sources). Software agents provide security to the information.
20. Web Services: Web service is a software system designed to support interoperable machine-to-machine interaction over a network.

10.4 ADVANTAGES OF IT IN SCM

It is commonly acknowledged that information technology (IT) is and increasingly will be an essential element of managing logistics operations in networks.

If we look for the main benefits then following key points have to be considered:

- First, successful companies have developed focused e-business solutions for improving customer service elements that are most important in their business.
- Second, efficiency has improved which allows company personnel to focus more on business critical activities.
- Third, the use of e-business solutions improves information quality.
- Fourth, e-business solutions that are based on planning collaboration improve agility of the supply network.
- Finally, for receiving strategic benefits, the use of IT has to be coupled with process re-design.

The key enabling factors have been the proliferation of Internet technology and emergence of 3rd party service providers in information transmission.

In practice the benefits from the use of IT in supply chain relations are mostly related to operational efficiency: to single supply chain processes, such as order information exchange.

The main objectives of IT in SCM are:

- Providing information availability and visibility
- Enabling single point of contact of data

- Allowing decisions based on total supply chain information
- Enabling collaboration with supply chain partners

The operational use of IT has proceeded in the last few years. Especially Internet technology and 3rd party transaction integration services have provided companies with increased possibilities to network with supply chain partners. However, in most cases the solutions used are quite individualistic as they are developed from a single company's point of view. Of course user aspects (customer and supplier) have been taken into consideration when planning for example buy-side and sell-side portals but the driving force has been to increase effectiveness of the company executing the e-business application. These applications are relatively general with clear specifications and the solutions do not technically differ much from each other. Further, implementing IT only as such, for example in invoicing automation, is not likely to lead to business level impacts. Stating this, it is interesting to observe that in the SCM context the main body of companies views IT primarily from operational side of view. A reason for this might be the relative novelty of IT, meaning that larger scale and strategic solutions are still yet to come, after companies have installed a basic IT infrastructure.

When we talk about information access for the supply chain, retailers have an essential designation. They turn out to the position of importance with the help of technologies. The advancement of inter organizational information system for the supply chain has three distinct benefits. These are –

- **Cost reduction** – The advancement of technology has further led to ready availability of all the products with different offers and discounts. This leads to reduction of costs of products.
- **Productivity** – The growth of information technology has improved productivity because of inventions of new tools and software. That makes productivity much easier and less time consuming.
- **Improvement and product/market strategies** – Recent years have seen a huge growth in not only the technologies but the market itself. New strategies are made to allure customers and new ideas are being experimented for improving the product.

It would be appropriate to say that information technology is an essential organ of supply chain management. With the advancement of technologies, new products are being introduced within fraction of seconds increasing their demand in the market.

10.5 EVOLUTION OF IT IN SCM

The evolution of supply chain management has been characterized by an **rising degree of integration** of separate tasks, a trend that was underlined in the 1960s as a key area for future productivity improvements since the system was highly fragmented.

Although the tasks composing logistics have been relatively similar, they initially consolidated into two distinct functions related to **materials management** and **physical distribution** during the 1970s and 1980s. This process moved further in the 1990s as globalization provoked a functional integration and the emergence of logistics in a true sense; all the elements of the supply chain became part of a single management outlook.

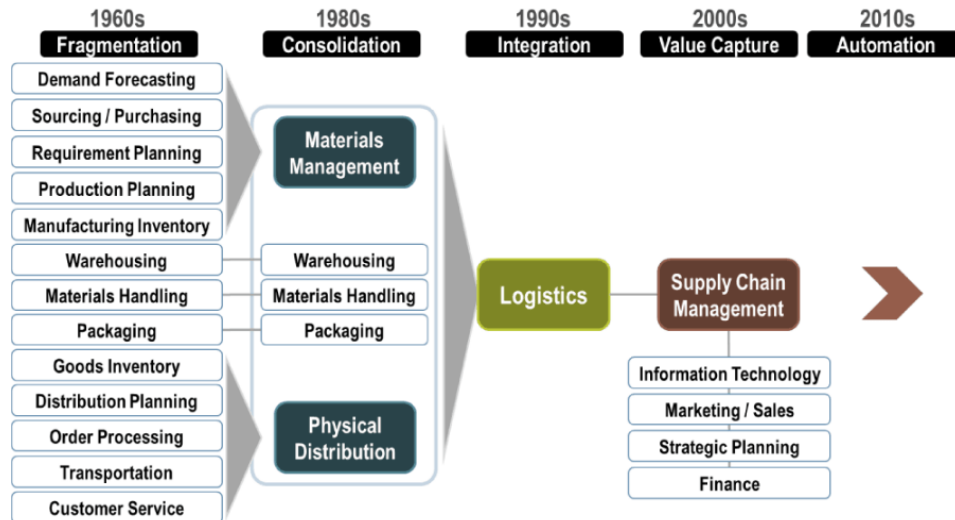


Fig 10.1 The Evolution of Supply Chain Management

However, only with the implementation of modern information and communication technologies complete integration became achievable with the emergence of **supply chain management**. It allows for:

1. The integrated management and control of information
2. Flow of finance and goods
3. Made possible a new range of production and distribution systems.

Supply chain management has become a complex succession of activities aiming at value capture and competitiveness. More recently, the growing level of automation of supply chains has been a dominant element of the evolution of both physical distribution and materials management.

This **digitalization** is particularly notable within distribution centers that have experienced a remarkable push towards automation such as storage, materials handling, and packaging. Automation may eventually lead to automated delivery vehicles.

Stepwise and according to improvements in information and communication technologies, the two ends of the assembly line became integrated into the logistics of the supply chain: the timely supply of raw materials and components from outside, and the effective organization of distribution and marketing.

High rack storage, which later became automatically driven, or the internal movements of packages by flat robots were early expressions of logistical engineering. Initially, logistics was an activity divided around the supplying, warehousing, production, and distribution functions, most of them being fairly independent of the other. With the new organization and management principles, firms were adopting a more integrated approach, thus responding to the upcoming demand for flexibility without raising costs. At the same time, many firms took advantage of new manufacturing opportunities in developing economies through outsourcing and offshoring. As production became increasingly fragmented, activities related to its management were consolidated. Spatial fragmentation became a by-product of economies of scale in distribution.

10.6 BENEFITS OF DIGITAL SCM

The digitization of the typical supply chain is the most significant change in society and history. The true way of adaption requires insight into :

- process automation
- KPIs
- process management
- data collection and analysis
- organizational design
- and the full integration of IT applications across an organization

Above mentioned all are the factors which make up the Digital Supply Chain Network.

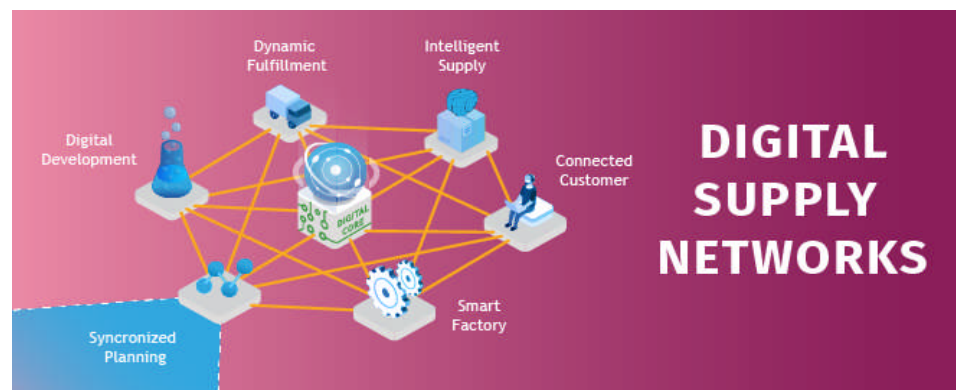


Fig10.2 Benefits of DSN

Looking to some of the benefits of Digital Supply Chain Management:

10.6.1 Become More Forward-Looking

Supply chain entities have created bad habits when it comes to maintaining a backward-looking approach but becoming more forward-looking is the greatest opportunity for use of the digital supply network.

10.6.2 Connect and Relate Data Sources

The Internet of Things (IoT) has become a fundamental aspect of a successful, modern supply chain. The IOT is responsible for many improvements in processes, preventive maintenance, and identification of better ways to move products. However, the IOT relies on the sharing of data, and the DSN can catalyze the current limitations of the IOT exponentially. For example, connected devices in the IOT can be used to deliver its data across multiple site, processes, and even organizations. As a result, a more connected system will naturally lead to more connections and sharing of such data.

10.6.3 Generate Data-Driven Plans through Data Visualization

As data becomes more available, this data will be applied to advanced analytics opportunities. Additionally, the use of data visualization capabilities will make applying data simpler. For example, providing a manager with data from yesterday's transactions is great, but giving a manager a graph with what time performance faltered will go much further in allowing the manager to change today's operations to avoid the failures of yesterday.

10.6.4 Improve Collaboration

Since data visualization tools help make changes in both the digital and physical aspects of the supply chain, collaboration will be improved.

10.6.5 Enter the World of Digital Products and Services

Modern services and products are not necessarily physical. Apps, Netflix, Pandora, and Uber represent real enterprises that are based on the Internet. As a result, the need for embracing change is essential. The manufacturer, a third-party between the seller and the customer, needs to receive customer- or seller-generated data and apply it to production.

10.7 SUMMARY

- To achieve integration and effective information sharing across and beyond the organizations, IT in SCM is required.
- Supply Chain Management (SCM) is the management of a network of interconnected businesses involved in the ultimate provision of product and service packages required by end customers.
- The organizations are heading towards the virtual supply chain with help of rapid changes in IT applications and underlying technology through: Electronic Data Exchange (EDI), Radio Frequency Identification (RFID), Bar Code, Electronic Commerce, Decision Support system, Enterprises Resource Planning (ERP) package, etc.
- The main objectives of IT in SCM are: Providing information availability and visibility, enabling single point of contact of data,

allowing decisions based on total supply chain information and enabling collaboration with supply chain partners

- Supply chain management has become a complex succession of activities aiming at value capture and competitiveness. More recently, the growing level of automation of supply chains has been a dominant element of the evolution of both physical distribution and materials management.

10.8 SAMPLE QUESTIONS

- What is role of IT in Supply Chain Management
- Explain how IT plays important role in SCM
- What are trends in IT relevant to SCM

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MODULE VII : IT FOR SCM

11

IT TOOLS FOR BUSINESS AND DATA WAREHOUSE AND MINING CONCEPTS

Unit Structure:

- 11.0 Objectives
- 11.1 IT tools for Business
 - 11.1.1. Shipping Status Tools
 - 11.1.2. Order Processing Tools
 - 11.1.3. Lean Inventory Tools
 - 11.1.4. Warehouse management Tools
 - 11.1.5. Supplier Management Tools
 - 11.1.6. Demand Forecasting Tools
 - 11.1.7. Analytics and Reports Tools
 - 11.1.8. Security Features Tools
 - 11.1.9. Compliance Tools
 - 11.1.10. Specialized Freight Handling Tools
 - 11.1.11. Bid and Spend
 - 11.1.12. Collaboration Portals
 - 11.1.13. Transportation and Logistics
- 11.2 Role of internet in SCM
- 11.3 Issues with SCM systems
- 11.4 Concept of Data warehouse
 - 11.4.1 Standard warehouse Elements
 - 11.4.2 Routine Management Functions
 - 11.4.3 Types of Warehouse
 - 11.4.4 Importance of warehousing
- 11.5 Concept of Data Mining
- 11.6 Use of Data Mining tools in SCM
- 11.7 Summary
- 11.8 Sample Questions
- 11.9 References

11.0 LEARNING OBJECTIVES

After reading this chapter, you will be able to:

1. Understand the IT tools used for business in a supply chain.
2. Understand the role of internet in perspective of SCM
3. Understand the issues of SCM system.
4. Understand the concepts of data warehouse.
5. Understand the concepts of data mining.
6. Understand the use of data mining tools in SCM.

In this chapter we will explore IT tools which can be used for business in a supply chain, and the role of internet. We will then focus the issues faced by the supply chain management system and how then atomization overcomes them.

Then we will be introduced to the concepts of data warehousing and data mining. Data Warehouse is electronic storage of a large amount of information by a business which is designed for query and analysis instead of transaction processing. It is a process of transforming data into information and making it available to users for analysis. Data mining is looking for hidden, valid, and potentially useful patterns in huge data sets. We will understand the use of data mining tools which can be used in supply chain management for having organized data and the information that can be further used

11.1 IT TOOLS FOR BUSINESS

Supply chain management tools and software enable users to reduce errors while also optimizing the entire supply chain process with ease, which is why utilizing these software are a must. Among the supply chain tools and techniques, there are many types that stand out that every manufacturing facility should utilize. Therefore, here are few types of supply chain tool packages that every supply chain should utilize in order to enhance their manufacturing operation.

As supply chains continue to become more complex, supply chain managers will need to take advantage of every tool at their disposal. These are among the most important supply chain management tools:

11.1.1 Shipping Status Tools

Shipping status tools are a simple way to keep track of all your shipments, keeping you up to date on their progress. One can also schedule alerts to let you know when the shipment is complete, or if the estimated time of delivery has changed so that you can make necessary adjustments. With high volume supply chains that have various types of cargo being shipped to customers around the world, it is important to always be aware when something goes down or when there is a problem.

An increasingly popular tool, real-time alerts provide timely information on all shipping activities.

11.1.2 Order Processing Tools

From billing to order fulfillment, the order process has plenty of areas to keep track of. Some software will also go beyond simple order processing. For example, SAP ERP system allows for complete sales channel integrations, meaning that you can keep track of all your inventory and orders in one easy location. This variety of tools supports all functions across order processing, such as sales order processing, order management, order fulfillment, and more. Ultimately, this will lead to time reduction among the traditional processes pertaining to orders that were needed to be manually generated.

Order fulfillment tools help supply chain centers streamline the fulfillment process from inquiry through quote, invoice, shipment, and delivery. Fulfillment options within these systems can manage several order types and configurations like engineer-to-order (ETO), build-to-order (BTO), assemble-to-order (ATO), make-to-stock (MTS), or digital copy (DC). These systems also include features for processing returns and tracking payment through revenue recognition. It also reduces the opportunity for human error since there's no need to manually take down order information and re-enter it into a different system.

11.1.3 Lean Inventory Tools

Lean production is a concept that dates back to the 1940s, created by Toyota and inspired by Henry Ford's just-in-time production. The idea is that companies create only what's needed at the moment determined by current and projected customer demand. Before lean production, manufacturers would create and house large surpluses of goods. This resulted in massive inefficiencies, wasting time and effort. Lean inventory is particularly useful for small parts that don't need to be supplied year-round. Some lean inventory tools, such as our JIT system, use sharp forecasting tools to provide the most cost-effective solution. The overall goal of the practice is to optimize your production planning by cutting down on warehouse space, inventory costs, and the different procedures of storing excess inventory. While lean production principles can be implemented without these tools, this type of supply chain management takes efficiency to the next level. By using demand forecasts, materials planning, scheduling and simulation tools, you're able to gain a much deeper insight into the future of your supply chain. These tools make planning production in alignment with lean manufacturing principles much easier.

11.1.4 Warehouse Management Tools

Amazon revolutionized the way supply chains view warehouses, including how individual companies manage their warehousing. Because of the rising costs of warehousing and Amazon's consistent pressure, many companies are beginning to find that outsourcing is the most cost-efficient solution. Outsourced warehousing gives you different options for

your supply chain, such as the option of private or public warehousing, both of which are scalable and emphasize efficiency to keep your supply chain running smoothly. These features track goods and materials within a warehouse or distribution center as a closed environment. The items can then be located quickly in any step of the process, including stock picking, shelving, shipping, and receiving. Warehouse staff can then move items to an intermediate storage location, a store, or directly to a customer. This feature sometimes comes as its own dedicated warehouse management system, and it is especially important for companies with larger networks of warehouses in multiple locations. Some solutions provide advanced supply chain planning tools, allowing users to handle complex logistics related to receiving, product tracking, cycle counting, route planning and more. Moreover, warehouse management tools help manages the kitting and bundling process as well as multiple warehouse locations. This is especially helpful when you need to bundle multiple products that are kept at different warehouses.

11.1.5 Supplier Management Tools

Tying in strongly with bid and spend tools, supplier management is a must-have when it comes to procurement. Along with assistive features for cost issues, supply chain management tools can also help businesses get a better understanding of how they relate to their suppliers. These tools show the history of a business partnership and how it affects the supply chain. Using supplier performance analysis, users can see how any given supplier has contributed to a business model. With the ability to continually assess your partners' contributions, decision makers can act more confidently to change or otherwise manage supplier relationships. Furthermore, supplier management tools often offer a workspace to perform bids, auctions and negotiations for more centralized procurement.

11.1.6 Demand Forecasting Tools

To run an effective lean inventory operation, you need to meet the ever-changing demand for goods from clients and consumers. The most efficient way to do this is with a demand forecasting tool. Demand forecasting takes into account past trends to generate an accurate estimate of future needs. Forecasts are generated quickly, letting you adjust your supply strategy before it becomes an issue. Demand forecasting tools prevent both a shortage of stock when demand is high, and overstocking when demand wanes. Thanks to the massive amounts of data that SCMS collects, demand forecasting is typically spot-on with its predictions. SCM solutions can use algorithms based on sales history, supply levels, and customer variables to help companies anticipate fluctuations in supply and demand. When companies can match inventory levels with projected demand, they can prevent over or under-stocking, which results in waste, lost sales, or in the worst case, lost customers.

Using analytics, today's supply chain tools are capable of processing huge amounts of data in a fraction of the time it would take a team of analysts. Not only does analytics provide insight into past practices, but it can also create forecasts to predict future demand.

11.1.7 Analytics and Reports Tools

After your supply chain software collects information, you need analytics and reporting tools to tell you the most effective way to move forward. Analytics is one of the most important technologies in an effective supply chain. Data collected is comprehensive and can give you information on just about every sector of a company, beyond inventory and shipment. In conjunction with demand forecasting, analytics can also find any errors or gaps in your supply chain, ensuring that you're not just meeting demand, but that you're doing so in the most efficient way possible.

Reports are the end result of analytics. Different tools may offer different reporting methods, including tables, charts, dashboards and more. Dashboards are one of the most common methods, as they offer quick information as soon as a user logs into the system. Supply chain dashboard tools can be configured to show the most relevant key performance indicators (KPIs) as determined by the user.

In addition to analyzing consumer demand and your suppliers' performance, this type of supply chain analytics tool performs analyses of your data from the entire supply chain. Analysis tools allow users full visibility not just into the physical location of inventory, but also into the health and performance of the company.

11.1.8 Security Features Tools

Supply chain managers are generally focused on the supply chain, so security can go overlooked. But ignoring safety can expose your business to threats. Data theft is a serious problem among businesses, potentially driving partners and customers away and affecting your reputation. Anyone who purchased goods from you is also at risk of having passwords, credit cards, and personal information stolen.

In order to prevent these security failures, implementing defensive features is a must. Most vendors today offer security assurances to let their clients know what efforts have been made to safeguard their information. These might include avoiding third-party vendors with low security standards, forbidding backdoor creation, aggressive patch management and response procedures in the case of a breach. There are also security measures your company can take in order to further protect your data. For example, dashboard reporting can be restricted based on the user to ensure only approved personnel have access to certain company data. Many tools also allow a system administrator to set file permissions. Further, you can integrate biometric devices to provide further accountability.

11.1.9 Compliance Tools

Knowing where products are made and how they're produced is a growing concern among consumers and, as a result, suppliers. Suppliers are feeling more and more pressure to ensure that their standards comply with industry, government, and consumer expectations.

Compliance tools in SCMS analyze suppliers to prevent you from ordering noncompliant products. Also, because management software is designed with ease of use in mind, you'll be able to easily access records to prove compliance in the event of an audit.

Consumers, now more than ever, want their products to be well-made, safe and ethical. Thankfully, today's tools give users the means to adhere to both environmental and ethical regulations with ease. For instance, some solutions allow users to closely inspect suppliers to ensure minerals obtained are conflict-free.

Auditing tools make it easier for your business to remain transparent during third-party investigations. These inclusions may collect and store data related to relevant policies and regulations.

11.1.10 Specialized Freight Handling

In addition to various shipping features, tools can also incorporate different types of industry-specific freight handling functionality. For example, the evolution of cold chain logistics and new regulations concerning perishable goods has changed compliance standards. To handle this, some platforms have integrated technology that can verify that those goods were kept at the proper temperature right up to the last mile of delivery. This tool is also offered by vendors as a standalone product but can be neatly integrated with a larger solution.

If you ship goods in this industry, it's imperative you implement this tool. Maintaining product quality across the supply chain will help you reduce costs associated with perished goods. This includes the cost of a recall, item disposal, legal response and more. For example, think about Chipotle's E. coli outbreak in 2015. Stock prices still fell throughout as late as 2018, with customer reviews worse than they were during the initial outbreak. Further, a whopping 37% of customers report eating at Chipotle less often due to issues surrounding food safety.

11.1.11 Bid and Spend

Sourcing and procurement are a major part of supply chain operations for many businesses. Therefore, tools that support these activities should be a top priority as well. Sophisticated tools for supply chain management can help you dig down and take a granular look at what you're spending on each item that you take in and send out during production. Bid and spend tools also automate much of the procurement process, reducing errors and resources spent. For instance, top tools can automate the entire procure-to-pay process.

These tools can also assist you in evaluating bids from different suppliers by helping you spot opportunities for improvement. Many of today's tools incorporate automated spend analysis to help users better understand their overall procurement processes and come up with ways to improve them. For procurement teams with many members, these tools

allow procurement officers to set limits for employees by creating approval processes and spending limits.

11.1.12 Collaboration Portals

In addition to providing a hub for procurement, modern supply chain monitoring tools also allow companies and their suppliers to collaborate in other ways through a designated portal. Supply chain portals can eliminate several collaboration challenges including communication issues, bottlenecks in requisition and order, and other issues.

Using portals, all parties may have access to production progress, order forecasts, product specifications, purchase orders, shipment history, schedules and more. Collaborating directly on certain documents eliminates the need for continuous emailing back and forth to get the right information and the errors commonly associated with this form of communication. Collaboration portals support full supply chain visibility, allowing both companies and their suppliers to stay up-to-date.

Collaboration portal tools allow you to communicate issues pertaining to the supply chain. This includes communicating issues such as bottlenecks, order issues, and various others. Utilizing portals will aid all parties that have access to production progress, order forecasts, product specifications, purchase orders shipment history, and more. Collaboration portals allow for full supply chain visibility.

11.1.13 Transportation and Logistics

In order to achieve a complete solution, you need to have some sort of transportation management. Transportation and logistics tools help users manage the movement of inventory and materials from one location to the next. With a solution equipped with transportation management, users can plan multi-stop trips, consolidate shipments to maximize space and plan for less than load (LTL) shipping.

In addition to planning transportation, these features help users address issues as they arise. Through inventory tracking, individuals can see when inventory is slowing down and intervene to find the cause. There are also collaborative options within transportation modules which enable all supply chain players to manage the shipping process.

11.2 ROLE OF INTERNET IN SCM

There are at least five roles the internet that has played important role when it comes to various Supply Chain management areas. Below are the different areas in which this has happened:

➤ Inventory Management

Definitely one aspect of supply chains that is most costly is inventory management. And, the internet has made it possible for business firms

to quickly set up EDI information programs with their clients. Before the emergence of the internet, EDI will usually take a longer time to be implemented in a supply chain. Then, every channel member had to massively invest in software, equipment, as well as training before EDI systems could be made operational.

➤ **Purchasing**

The internet has also made it possible for cost associated with purchasing to be reduced. In the United States, business firms have been able to make use of the internet to streamline the purchasing function. With it there is reduction in paper-flows as well as order-cycle times- the time it takes for purchased order to be delivered. Today, face-to-face negotiations, which might be considered the order of the day in the past, are not frequently used as bargaining, re-negotiations, term and price agreements, etc. can now be done via the internet.

➤ **Transportation**

Transport management is probably the most popular use of the internet in supply chains. This is so important for any business since the tracking of shipments to regional depots will provide the firm with data that shows how reliable or otherwise the performance of its carriers is, making it possible for transport managers to confirm whether their motor carriers are meeting the promised arrival time. And, it also enables them to inform carriers about shipment delays as this occurs rather than wait for days or even longer before informing them.

➤ **Order processing**

This critical role of order processing is one that the internet has helped to dramatically reduce costs. And, reduction in paperwork is a major item of this cost saving when compared to conventional practices. Okay another major benefit that the internet has bestowed on this process is the increase in speed with which order processing is now done. Since there is now a reduction in the time it takes for orders to be placed and received by clients.

➤ **Vendor relationships**

A critical factor when it comes to vendor relations for a business is being able to rate the performance of its vendors. This will be based on elements agreed by both parties (the company and its vendors). And, such performances include factors like deliveries to the company's warehouses including depots; vendor raw material inventory among others. The internet has been used to monitor these areas.

➤ **Customer service**

The internet has made it possible for customers to have 24-hour access to a business firm's customer service department making it possible for companies to be notified of any problem or service issue. Now apart from providing another option for customers to contact a

company concerning service issues this has helped improve communication flow between business firms and their customers.

11.3 ISSUES WITH SCM SYSTEMS

When we talk about the major issues or challenges that any supply chain management system faces are:

- **Procurement issues:** Issues related to slow workflow, lack of transparency, time wastage, and high costs are some of the problems faced during procurement.
- **Mismanaged Inventories:** While maintaining an inventory, there is a chance of either running out of stock or adding too much stock in an already existing storage. Other problems include storing damaged goods or mismanagement of unrepaired goods.
- **Problems related to Logistics:** Damaging or losing goods during transport, delivering the load behind schedule, delivering at the wrong location, are some of the issues in the logistics part of the supply chain process management.
- **Difficulty in planning the resources:** Demand supply is quite a tricky aspect for any enterprise. The only way this problem can be tackled is by planning the resources efficiently.
- **Providing quality customer services:** The supply chain management is focused on the needs of the customers. It is about giving the right quantity and the right quality of the product for the right amount of money that too in perfect timing and setting.
- **Risk management:** Due to the constant change in the market, coming from a variety of sources such as consumer demands, political agendas and global sourcing, would cause major issues to the operations.
- **Unforeseen delays:** Procurement of materials and products may be easy, but the delivery may not always be 100% on time, especially with time differences and a variety of shipping time frames. When items are sourced from different countries, delays like this are very common.
- **Fast Changing markets:** With technological advancements changing our markets every day, it is quite difficult to stay in pace and adapt to the variety of innovations in the market. But because the goal is to stay efficient in these changing times, companies would have to be more flexible.

11.4 CONCEPT OF DATA WAREHOUSE

A **warehouse management system (WMS)** is a software application, designed to support and optimize warehouse or distribution center management. They facilitate management in their daily planning, organizing, staffing, directing, and controlling the utilization of available

resources, to move and store materials into, within, and out of a warehouse, while supporting staff in the performance of material movement and storage in and around a warehouse.

Warehouse management solutions are primarily tactical tools, purchased and used by businesses to satisfy the unique customer demand requirements of their supply chain(s) and distribution channel(s), when the inventory and workload is larger than what can be handled manually, with spreadsheets. Motivation to purchase generally comes from a need to support sales growth or improve performance, and occasionally both.

11.4.1 Standard warehouse Elements

A WMS uses a database configured to support warehouse operations, containing detail describing a variety of standard warehouse elements including:

1. ***Individual stock keeping units (SKUs)*** that are handled and stored, e.g., weight, dimensions, case pack, automatic ID labels (bar codes, etc.), and inventory by location with manufacture date, lot code, etc. SKUs may include basic materials, fabricated parts, assemblies, and industrial and consumer finished goods, etc.;
2. ***Warehouse storage locations***, e.g., individual location number, picking sequence, type of use (picking, reserve storage, etc.), type of storage (each, case, pallet), location size or capacity, storage restriction (flammable, hazardous, high value materials, outdoor, etc.), etc.;
3. ***Dock doors***, e.g., individual number, etc.; and
4. ***Expected labor productivity rates by function or activity***, e.g., cases picked per man-hour, etc.

11.4.2 Routine Management Functions

Daily management functions include:

1. ***Planning*** - finalizing the daily plan for receiving dock activity, selecting the workload/orders to be processed in the day or shift, (this may also be done by the business system), and calculating an estimate of the labor and vehicles required to pick and ship the orders to ensure the staffing is appropriate, and carriers are notified in time to meet the daily requirements.
2. ***Organizing*** - sequencing the orders to be picked. Organizing orders for picking can be accomplished in many ways, meeting the needs of the user. The primary objective is to be intentional, and not to pick the orders in the sequence in which they were received unless the company wants to pay a carrier make sense for transportation and delivery. The initial way of organizing was called Wave Planning or Wave Picking, with two objectives, a. to minimize need for dock staging space, by having orders arrive at the shipping dock in trailer load sequence, and b. to create an order of flow that will support monitoring the progress through the day and eliminate/reduce last minute requests for overtime or delay of carrier departure, etc.

3. **Staffing** - assign staff to work functions and areas, by Wave, to minimize staging.
4. **Directing** - ensuring the documented processes and procedures are embedded in the WMS and are consistently applied, used and appropriate for the nature of the work and service level intentions of the company (e.g., International Standards Organization 9000 (www.iso.org)). This function may also be used to divide individual orders into logical work units and the ability to assign them to separate individuals for performance, consistent throughput requirements and physical layout, e.g., separating individual case picking from each unit picking, and individual pallet load picking, to improve productivity and supporting Control.
5. **Controlling** - providing milestones for management to monitor progress through the day, providing the opportunity to respond to problems in a timely way, and report data for performance analysis.

11.4.3 Types of Warehouses:

1. **Private Warehouse:**

This type of warehouse is owned and operated by channel suppliers and resellers and used in their own distribution activity. For instance, a major retail chain may have several regional warehouses supplying their stores or a wholesaler will operate a warehouse at which it receives and distributes products.

2. **Public Warehouse**

The public warehouse is essentially space that can be leased to solve short-term distribution needs. Retailers that operate their own private warehouses may occasionally seek additional storage space if their facilities have reached capacity or if they are making a special, large purchase of products. For example, retailers may order extra merchandise to prepare for in-store sales or order a large volume of a product that is offered at a low promotional price by a supplier.

3. **Automated Warehouse**

With advances in computer and robotics technology many warehouses now have automated capabilities. The level of automation ranges from a small conveyor belt transporting products in a small area all the way up to a fully automated facility where only a few people are needed to handle storage activity for thousands of pounds/kilograms of product. In fact, many warehouses use machines to handle nearly all physical distribution activities such as moving product-filled pallets (i.e., platforms that hold large amounts of product) around buildings that may be several stories tall and the length of two or more football fields.

4. **Climate-Controlled Warehouse**

Warehouses handle storage of many types of products including those that need special handling conditions such as freezers for storing frozen products, humidity-controlled environments for delicate products,

such as produce or flowers, and dirt-free facilities for handling highly sensitive computer products.

5. *Distribution Center*

There are some warehouses where product storage is considered a very temporary activity. These warehouses serve as points in the distribution system at which products are received from many suppliers and quickly shipped out to many customers. In some cases, such as with distribution centers handling perishable food (e.g., produce), most of the product enters in the early morning and is distributed by the end of the day.

11.4.4 Importance of Warehouses

Warehousing and warehouse management are part of a logistics management system, which is itself a component in supply chain management. Although viewed by some as simply a place to store finished goods, inbound functions that prepare items for storage and outbound functions that consolidate, pack and ship orders provide important economic and service benefits to both the business and its customers.

- **Central Location**

A warehouse provides a central location for receiving, storing and distributing products. As each inbound shipment arrives, responsibility for the goods transfers to warehouse personnel; products are identified, sorted and dispatched to their temporary storage location. Storage isn't a static "thing" but rather a process that includes security measures and maintaining an environment that preserves the integrity and usefulness of the items. Once it's time to move items, each order is retrieved, grouped, packaged and checked for completeness before being dispatched to their new destination.

- **Value-Adding Operation**

The objective of a logistics system is to reduce cycle times and overall inventories, lower costs and most importantly, improve customer service. Warehousing increases the utility value of goods by providing a means to have the right products available at the right place in the right time. Operations such as order consolidation, order assembly, product mixing and cross-docking that take place within the warehouse structure also add value to the overall logistics system.

- **Economic Benefits**

Warehouses provide a economies of scale through efficient operations, storage capacity and a central location. Economic benefits are realized, for example, through consolidation and accumulation operations. Consolidation operations cut outbound delivery costs for both the business and its customers. Instead of shipping items individually from multiple sources, items are delivered to a central warehouse, packaged together and shipped back out as a complete order. Accumulation operations allow a warehouse to act as a buffer, balancing supply and demand for seasonal and long-term storage. This can be vital to business profitability when

demand for a product is year-round but the product may only be available at certain times of the year.

- **Service Benefits**

Warehouses can serve as part of a contingency plan to ensure outbound orders are filled in full and on time. A practice called safety stocking allows businesses to maintain a predetermined number of inventory items at its warehouse. On the inbound side, safety stocking means that an emergency such as a transportation delay or a shipment containing defective or damaged goods won't delay filling and shipping customers order. On the outbound side, safety stocking is insurance against out-of-stock items.

11.5 CONCEPT OF DATA MINING

Supply chain comprises the flow of products, information, and money. In traditional supply chain management, business processes are disconnected from stock control and, as a result, inventory is the direct output of incomplete information. The focus of contemporary supply chain management is to organize, plan, and implement these flows. First, at the organizational level, products are manufactured, transported, and stored based on the customers' needs. Second, planning and control of component production, storage, and transport are managed using central supply management and replenished through centralized procurement. Third, the implementation of the supply chain involves the entire cycle from the order entry process to order fulfillment and delivery. Data mining can create a better match between supply and demand, reducing or sometimes even eliminating the stocks.

Data mining has become an indispensable tool in understanding needs, preferences, and behaviors of customers. It is also used in pricing, promotion, and product development. Conventionally, data mining techniques have been used in banking, insurance, and retail business. This is largely because of the fact that the implementation of these techniques showed quick returns. Data mining is being used for customer profiling where characteristics of good customers are identified with the goals of predicting new customers and helping marketing departments target new prospects. The effectiveness of sales promotions/ product positioning can be analyzed using market-basket analysis to determine which products are purchased together or by an individual over time, which products to stock in a particular store, and where to place products in each store. In addition, data mining is used in a variety of other industries such as the financial, healthcare, and telecommunications industry, among others.

11.6 USE OF DATA MINING TOOLS IN SCM

Now we will see the main applications of data mining in the supply chain as a whole:

- **Selection of Cooperation Partners**

The principal problem for an enterprise to carry out supply chain management is to select cooperation partners. The enterprise can analyze all resources and historical data with the tool to determine its core competency and competitive strategy, and select its partners and the alliance pattern accordingly; then the enterprise can also analyze its upstream suppliers and their suppliers, downstream retailers and logistic services with the tool to find out their competitive strengths and individual characteristics, so as to select the best partners with the foregoing analytical results.

- **Construction of Supply Chains**

During the construction of supply chains, data mining can help the enterprise analyze its organizational structure, information flow, fund flow and logistics as well as those of its selected partners. With the technique of variance analysis in data mining, the enterprise can analyze and process various data information to find out the existed problems in the flows, thus to lay a solid foundation for the construction of supply chains.

- **Timely Processing and Prediction of Mass Information in the Supply Chain**

The problem in supply chain management, in the final analysis, is whether the information in the chain can be analyzed and processed in time and whether the acquired knowledge and decision information can be transferred to every nodal enterprise and organization without obstruction. Data mining technology can search models in the data base, quickly and automatically find out the models and useful information hidden in the data, and help users understand reasons and make predictions. The enterprise can analyze and process the massive relative data accumulated in the supply chain, such as logistics, information flow, fund flow, etc.

- **Risks Control for the Supply Chain**

As the supply chain is basically a virtual enterprise system between enterprises and markets, various risks from all parties exist in the supply chain. Data mining can help extract their characteristics according to plenty of historical statistic information from each nodal enterprise or organization in the supply chain and make association analysis to provide an objective evaluation on these partners. The results will be demonstrated after induction and summary, so as to minimize the risks in the supply chain.

11.7 SUMMARY

- Supply chain management tools and software enable users to reduce errors while also optimizing the entire supply chain process with ease, which is why utilizing these software are a must. Some of the tools are

supplier management, lean inventory management, collaboration tools, bid and spend etc.

- There are few roles the internet that has played important role when it comes to various Supply Chain management areas like inventory management, purchasing, transportation, order management, vendor relationships.
- A **warehouse management system (WMS)** is a software application, designed to support and optimize warehouse or distribution center management. They facilitate management in their daily planning, organizing, staffing, directing, and controlling the utilization of available resources, to move and store materials into, within, and out of a warehouse, while supporting staff in the performance of material movement and storage in and around a warehouse.
- **Data mining** has become an indispensable tool in understanding needs, preferences, and behaviors of customers. It is also used in pricing, promotion, and product development.
- Data mining is being used for customer profiling where characteristics of good customers are identified with the goals of predicting new customers and helping marketing departments target new prospects. The effectiveness of sales promotions/ product positioning can be analyzed using market-basket analysis to determine which products are purchased together or by an individual over time, which products to stock in a particular store, and where to place products in each store.

11.8 SAMPLE QUESTIONS

- Explain the role of IT in business.
- Why is warehousing becoming an essential service for industries?
- What are various IT tools that are used in SCM
- Explain warehousing in detail and its types used significantly in SCM industries
- Explain how internet plays a important role in SCM
- Explain data mining tools

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MODULE VIII : DISTRIBUTION NETWORKS OF SUPPLY CHAIN

12

DESIGNING DISTRIBUTION NETWORK

Unit Structure:

- 12.0 Objectives
- 12.1 Introduction
- 12.2 Role of Distribution Networks
- 12.3 Factors influencing Distribution Network design
- 12.4 Design choices for a Distribution Network
 - 12.4.1 Manufacturer storage with direct shipping
 - 12.4.2 Manufacturer storage with direct shipping and in-transit merge
 - 12.4.3 Distributor Storage with Carrier Delivery
 - 12.4.4 Distributor Storage with Last Mile Delivery
 - 12.4.5 Manufacturer or Distributor Storage with Consumer Pickup
 - 12.4.6 Retail Storage with Customer Pickup
- 12.5 Summary
- 12.6 Sample Questions
- 12.7 References

12.0 LEARNING OBJECTIVES

After reading this chapter, you will be able to:

1. Identify the key factors to be considered when designing a distribution network.
2. Discuss the strengths and weaknesses of various distribution options
3. Understand how e-business has affected the design of distribution networks in different industries.

In this chapter, you will be able to have an understanding of the role of distribution within a supply chain and identify factors that should be considered when designing a distribution network. Identification of several potential designs for distribution networks and evaluation of the strengths and weaknesses of each option. We apply these ideas to discuss the evolution of distribution networks in various industries since the initiation of e-business. The goal is to provide managers with a logical framework for selecting the appropriate distribution network given product, competitive, and market characteristics.

12.1 INTRODUCTION

Distribution management in general language means the complete process which looks into movement of goods from supplier or manufacturer to point of sale. The process includes various activities and processes such as *packaging, inventory management, warehousing, supply chain, and logistics*.

The distribution management process is an important aspect of the business cycle for distributors or wholesalers. The profit percentage of the business depends on the turnaround time of the goods. The more goods sold, the higher the envelope salary along with increased profits leads to a better future for the business. Having an effective delivery management system is also important for businesses to stay competitive and keep customers happy.

Distribution refers to the steps taken to transfer products from the supplier stage to the customer stage in the supply chain. Allocation occurs between each pair of stages in the supply chain. Raw materials and parts are transferred from the supplier to the manufacturer, and the finished product is transferred from the manufacturer to the end customer. Distribution is the main driver of the company's overall profitability because it directly affects the cost of the supply chain and customer experience.

12.2 ROLE OF DISTRIBUTION NETWORKS

Distribution management is very important for a business or organization because it attracts customers and operates profitably. Successful execution of a distribution strategy requires effective management of the entire distribution process. The larger the organization or the more supply points a business has, the more automation it needs to rely on to effectively manage the delivery process.

Supply chain distribution is required to balance your supply and demand. Your distribution strategy should be capable enough to

- handle market changes,
- include supply disruptions and
- Manage increase in demand.

The distribution chain aims to reduce the number of transactions needed to get a product from supplier to customer.

The right distribution network can be used to achieve a variety of supply chain goals, from low cost to high responsiveness. As a result, companies in the same industry often choose very different distribution networks.

In a supply chain, a distribution network is a group of storage facilities and transportation systems that are interconnected to receive inventory and then ship it to customers. It is the intermediary to bring products from the manufacturer to the end customer, either directly or through the retail network.

A commodity supply chain can include an extensive distribution network depending on the product and the location of the end customer. A manufacturer may have a distribution network to serve wholesalers, who have their own network to ship to distribution networks operated by retailers, who are at the end of the chain. Along the supply chain will sell the product in retail stores.

Location (proximity to the customer) and **infrastructure quality** are two important attributes of a distribution network. In addition, the storage, handling, and shipping functions at the distribution site are designed to be tailored to the specific needs of the company in order to serve its customers in a specific geographic area. There can be a high level of complexity in one location - and by extension, the entire distribution network - to optimally handle the flow of orders for finished goods, which can be some bulky items like farm tractors or thousands of storage units for a chain retail business.

For the entire distribution network, a company must plan out needs for equipment, workers, information technology systems, and transportation fleets.

The role of the distribution network occurs in the post-production portion of the supply chain, the flow of goods and services, and includes all stages of delivering the final product to the consumer.

12.3 FACTORS INFLUENCING DISTRIBUTION NETWORK DESIGN

One needs to ensure if these network choices are justified and appropriate. The channel of distribution has to be decided keeping in mind the cost and time factors.

At the highest level, performance of a distribution network should be evaluated along two dimensions:

1. Customer needs that are met
2. Cost of meeting customer needs

Thus, a firm must assess the impact on customer service and cost as it compares different distribution network options. The needs of satisfied customers affect a company's revenue, which, along with costs, determines the profitability of the delivery network. Although customer

service has many components, we focus on metrics that are influenced by the structure of the distribution network. These include:

- Response time: Response time is the total time between when a customer places an order and receives delivery.
- Product variety: Product variety is the number of different products / configurations that a customer desires from the distribution network.
- Product availability: Availability is the probability of having a product in stock when a customer order arrives.
- Customer experience: Customer experience includes the ease with which the customer can place and receive their order.
- Order visibility: Order visibility is the ability of the customer to track their order from placement to delivery.
- Returnability : Returnability is the ease with which a customer can return unsatisfactory merchandise and the ability of the network to handle such returns.

In other words, it can be said that the customer always wants the highest level of performance in all of the above parameters. In fact, this is not always the case. Customers who order books from Amazon.com are willing to wait longer than customers who go to a nearby store to receive the same book. On the other hand, customers can find a greater variety of books on Amazon than in the nearby store. Customers have a better choice.

Supply chain costs affected by network structure:

- Inventories
- Transportation
- Facilities and handling
- Information

Businesses that target customers who can tolerate high response times require few locations that are far from the customer and can focus on increasing the capacity of each location. On the other hand, businesses targeting customers who value short response times should locate nearby. These companies must have multiple facilities, each with low capacity. Thus, reducing the response time desired by the customer increases the number of installations required in the network, as shown in figure 12.1

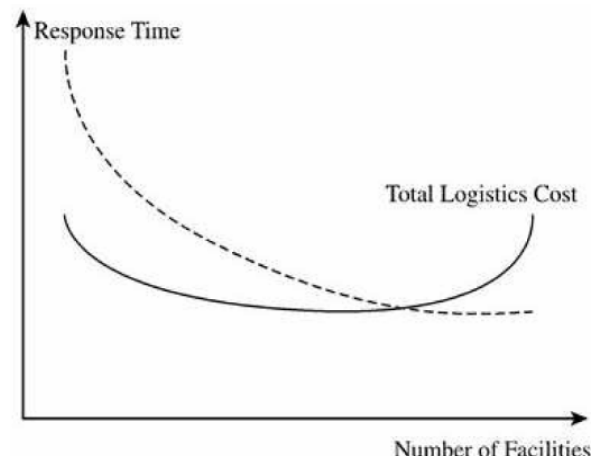


Figure 12.1 variation of Response time with number of facilities

As the number of facilities in a supply chain increases, the inventory and resulting inventory costs also increase as shown in Figure 12.2. For example, Amazon, which has fewer installations, can rotate its inventory about twelve times a year, while Borders, which has about 400 installations, can only rotate about two times a year. As shown in the Figure 12.2, as long as the economies of scale of inbound transportation are maintained, increasing the number of facilities will reduce the total cost of transportation. If the number of facilities is increased to a point where there is a significant loss of economies of scale in inbound transportation, increasing the number of facilities increases total transportation cost. A distribution network with multiple warehouses allows Amazon.com to reduce shipping costs compared to a single warehouse network. Facility costs decrease as the number of facilities decreases, as shown in Figure 12.2, as facility consolidation allows a business to exploit economies of scale.

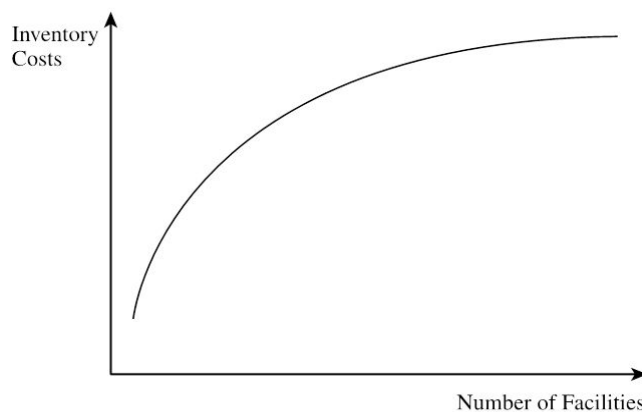


Figure 12.2 Inventory Costs and number of facilities

Total logistics costs are the total costs of inventory, transportation, and facilities for a supply chain network. As the number of installations increases, the total logistics costs first decrease and then increase, as shown in Figure 12.3. Each company should have at least the number of

facilities to minimize total logistics costs. Since a business wants to further reduce response times for its customers, it may need to increase the number of installations beyond the point to minimize logistics costs. A business should only add facilities beyond its cost minimization point if managers believe that the increase in revenue due to better responsiveness outweighs the increase in costs due to the additional facilities.

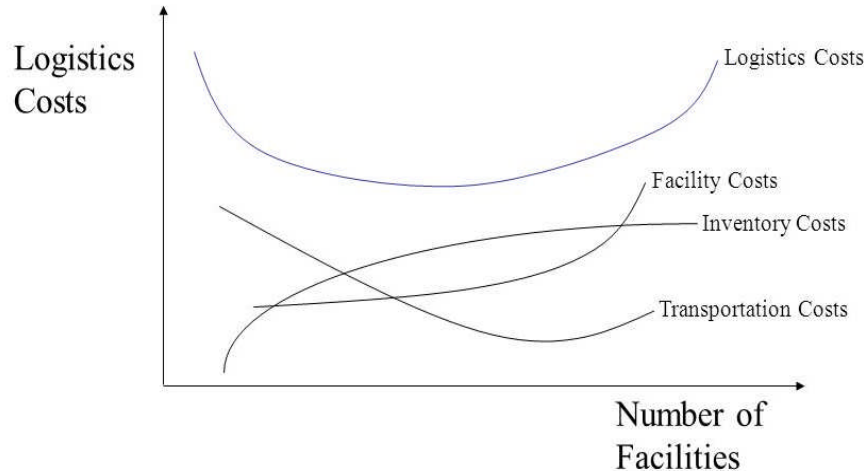


Figure 12.3 Logistics costs and number of facilities

12.4 DESIGN CHOICES FOR A DISTRIBUTION NETWORK

We will discuss distribution network choices in the context of distribution from the manufacturer to the end consumer. When considering distribution between any other pair of stages, such as supplier to manufacturer, many of the same options still applies.

There are two key decisions when designing a distribution network:

1. Will the product be delivered to the customer location or picked up from a predetermined site?
2. Will the product flow through an intermediary (or intermediate location)?

Based on the choices for the two decisions, there are six distinct distribution network designs that are classified as follows:

1. Manufacturer storage with direct shipping
2. Manufacturer storage with direct shipping and in-transit merge
3. Distributor storage with package carrier delivery
4. Distributor storage with last mile delivery
5. Manufacturer / distributor storage with customer pickup
6. Retail storage with customer pickup

Let's now discuss each distribution option and discuss its strengths and weaknesses:

12.4.1 Manufacturer storage with direct shipping

With this option, the product is delivered directly to the end user by the manufacturer without going through the retailer (the person who takes the order and initiates the shipping request) as shown in figure 12.4. This option is also known as direct shipping. All inventories are stored in the manufacturer. Information is passed to the manufacturer through the customer's retailer, while the product is shipped directly from the manufacturer to the customer. In the case of Dell, the manufacturer sells directly to the customer. Online retailers like eBags and Nordstrom.com use drop shipping to ship goods to end consumers. eBags delivers directly to you from manufacturers that do not have bags in stock. Nordstrom uses a direct delivery model for slow-moving shoes to bring some products into stock. W W. Grainger also uses direct shipping to ship slowly moving items that are not in stock.

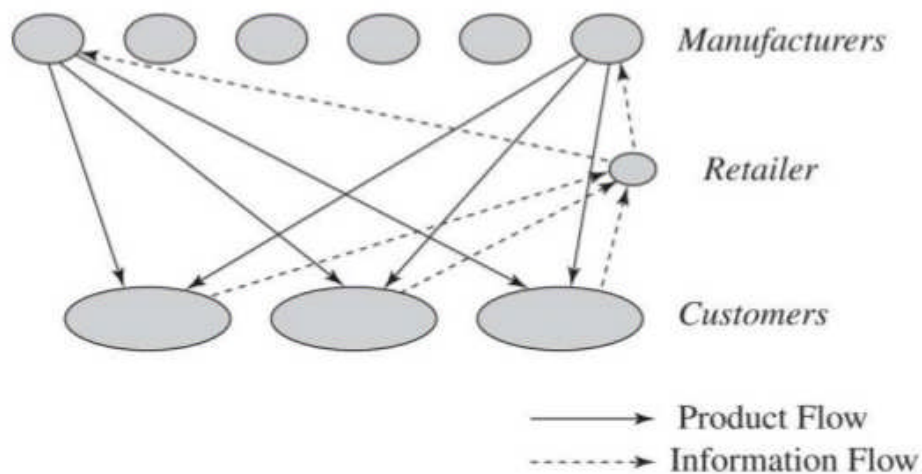


Figure 12.4 Manufacturer storage with direct shipping

➤ **Advantages of drop shipping**

- The ***biggest advantage*** of drop shipping is that you can concentrate the manufacturer's inventory. Manufacturers can aggregate the demand of all retailers they supply. As a result, supply chains can provide high levels of product availability for low levels of inventory. The main issue associated with direct shipping is the ownership structure of the manufacturer's inventory. If a manufacturer's particular inventory portion is assigned to an individual retailer, there is little benefit to aggregation when the inventory is physically aggregated. The benefits of aggregation are only achieved if the manufacturer can allocate at least a portion of the available inventory to the retailer as needed. The benefits of centralization are greatest for elevated and low-demand items with unpredictable demand. For items with predictable demand and low value, the benefits of aggregate inventory are diminished. Therefore, direct delivery does not offer inventory benefits to online grocery stores that sell key items such as detergents. For slow-moving items, using direct delivery instead of retail storage can increase inventory turnover by, an increase of 6 times or more.

- Drop shipping also gives businesses the opportunity to further reduce inventory by deferring users until the customer's order is complete. Build-to-order firms such as Dell keep inventory as a common factor and the level of inventory that is transported to defer customization of their products drops.
- The supply chain saves the fixed cost of storage facilities when using packaging as all inventory is unified across the manufacturer. Since there is no movement from the manufacturer to the retail store, processing costs can also be reduced somewhat. Processing costs can be significantly reduced if the manufacturer ships the order directly from the production line.
- Manufacturer's storage along with drop shipping allows a wide variety of products to be available to customers.

➤ **Disadvantages of drop shipping**

- The average transmission distance to the end consumer is large and the package carrier is used to ship the product, so the shipping cost is high for drop delivery. Package carriers have higher shipping costs per unit than truck loading (TL) or less than truck (LTL) carriers. With direct shipping, customer orders with items from different manufacturers will be shipped to the customer multiple times. Aggregate losses on these outbound shipments add to the cost.
- Packaging typically requires a significant investment in information infrastructure. Even if inventory is a manufacturer, you need a good information infrastructure so that retailers can provide customers with inventory information of their products. Even when an order is placed in a retail store, the customer needs to visualize the manufacturer's order processing. Information infrastructure requirements are rather straightforward for direct sales like Dell, since there is no need to integrate the two phases (retailer and manufacturer).
- Response times tend to be longer when using drop shipping, as orders have to travel from the retailer to the manufacturer and the average delivery distance is longer from the manufacturer's central location.

With its performance characteristics, manufacturer's batch storage is best suited for a wide range of low demand, high value items where customers are willing to wait for delivery and accept multiple shipments one at a time. part. Manufacturer stocking is also suitable if it allows manufacturers to delay customization, thereby reducing inventory. For drop shipping to be effective, there must be fewer delivery locations per order. Therefore, it is ideal for direct sellers who can build to order. Drop shipping is difficult to do if there are more than 20-30 sourcing locations that need to ship directly to the customer on a regular basis. However, for products with very low demand, reduced shipping may be the only option.

12.4.2 Manufacturer storage with direct shipping and in-transit merge

Unlike pure direct shipping, where each product is sent directly from each manufacturer to the end consumer, merging in transit is a one-time shipment of customers because parts of the order are combined at various locations. The flow of information and products for the merged network in transit is shown in Figure 12.5

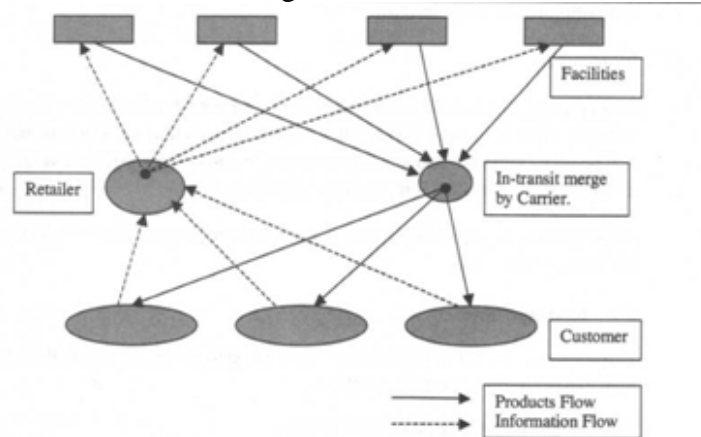


Figure 12.5 Manufacturer storage with direct shipping and in-transit merge

The ability to defer customization of products by consolidating inventory as well as drop shipping is a huge advantage of merging in transit. By merging in transit, Dell and Sony can consolidate all inventory at the factory. This method provides maximum benefits for high value-added products where demand is difficult to predict, especially if product customization is postponed.

The main advantages of in-transit merges for drop shipping are that shipping costs are somewhat lower and the customer experience is improved. The main downside is that extra work takes place between the merges themselves. Let's look at them in detail:

Advantages:

- Shipping costs are lower than direct, as integration takes place into the carrier's hub prior to delivery to the customer. So, an order with products from 3 manufacturers will end up with 1 delivery compared to 3 needed for packaging. Less deliveries saves on shipping costs, making it easier to receive.
- The customer experience is probably better than drop shipping because customers receive only one delivery for their order instead of multiple partial shipments.

Disadvantages:

- The consolidating part that ships has a higher installation cost due to the consolidation required. The cost of receiving the goods at the customer is lower because only one delivery is received. Overall,

supply chain facilities and handling costs are somewhat higher than retail shipping.

- A very complex information infrastructure is required to enable consolidation in transit. In addition to information, the activities of retailers, manufacturers and carriers need to be coordinated. Investment in information infrastructure will be higher than in drop shipping.
- Response time, product diversity and availability are similar to direct delivery. Response time can be slightly longer because you need to perform a merge.

So, we can say that in view of its performance characteristics, the combined manufacturer storage in transportation is most suitable for the high-value, low-to-medium-demand goods that the retailer purchases from a limited number of manufacturers. Compared with direct transportation, in-transit consolidation requires each manufacturer to provide more quantities to be effective. If there are too many sources, it is difficult to coordinate and implement in transportation and consolidation. If there are no more than four or five purchasing locations, and each customer order has products from multiple locations, it is best to implement transportation consolidation.

12.4.3 Distributor Storage with Carrier Delivery

This option allows stocks to be held by intermediate warehouse distributors/retailers rather than by factory manufacturers, and package carriers are used to transport products from intermediate locations to end consumers as shown in figure 12.6.

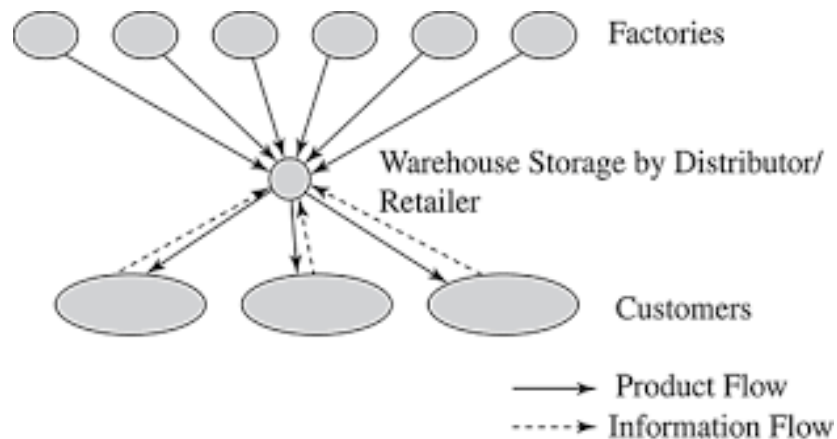


Figure 12.6 Distributor Storage with Carrier Delivery

When it comes to the manufacturer's warehouse, the distributor's warehouse requires a higher level of inventory, as distributor / retailer warehouses usually pool the uncertainty of demand at a lower level than manufacturers. From an inventory standpoint, stocking dispensers makes sense for products that are slightly more in demand.

Advantages:

- Shipping costs are somewhat lower compared to manufacturer storage. This is because customers are employing economical means of transport (eg, truck loads) that are put into warehouses close to them. Unlike manufacturer's warehousing, where multiple shipments are likely to be required for a single customer's order containing multiple goods, seller's warehousing allows customers to bundle outbound orders into one shipment, further reducing shipping costs.
- The information infrastructure required with the storage distributor is significantly less complex than the infrastructure required with the manufacturer's storage. The distributor's warehouse acts as a buffer between customer and the manufacturer, reducing the need for to fully coordinate the two.
- The response time in the distributor's warehouse is better than in the manufacturer's warehouse because, on average, the distributor's warehouse is closer to the customer and the entire order is aggregated to the warehouse prior to shipment. be shipped.
- Customer convenience is high with distributor storage because a single shipment reaches the customer in response to an order.
- Compared with warehousing from a manufacturer, order visibility becomes easier because there is only one shipment from the warehouse to the customer, and only one stage in the supply chain is directly involved in completing the customer's order.
- Returnability is better than manufacturer storage because all returns can be processed internally. Even if the product comes from multiple manufacturers, the customer only needs to return one package.

Disadvantages:

- Compared to manufacturer storage, dealer (warehouse) storage facilities cost slightly more, this is due to loss of aggregation. Unless the factory can ship directly from the production line to the end customer, the processing and handling costs are comparable to the manufacturer's warehousing.
- Due to the need for inventory at another stage in the supply chain, the time to market under distributor storage is slightly longer than the time to market under manufacturer storage.

12.4.4 Distributor Storage with Last Mile Delivery

Last mile delivery refers to the distributor / retailer delivering the product to the customer's home instead of using a package carrier as shown in figure 12.7. Unlike package career delivery, last mile delivery requires the distribution warehouse to be closer to the customer to increase the number of warehouses required.

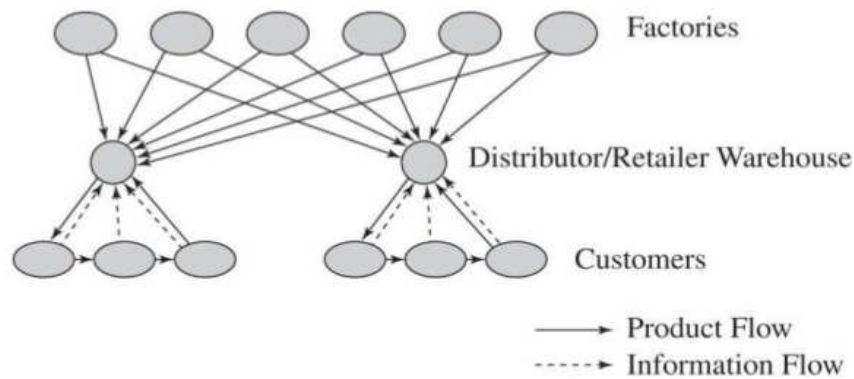


Figure 12.7 Distributor Storage with last mile delivery

Distributor inventory with last mile delivery requires a higher inventory level than any non-retail option because it has a lower aggregate level. From an inventory perspective, warehousing with last-mile delivery is suitable for relatively fast-moving items whose segregation doesn't lead to a significant increase in inventory. Grocery industry staples fit this description.

Advantages:

- Response times are faster than the use of package carriers
- The customer experience is very good using this option, particularly for bulky, hard to carry items.
- Of all the options discussed, the possibility of a final mileage return is the most recommended. Delivery trucks can also receive returns from customers.

Disadvantages:

- Shipping costs are highest when using last mile delivery. This is because aggregators deliver across multiple retailers and may gain a greater scale advantage than a single distributor / retailer trying to deliver last mile.
- Installation and handling costs are very high using this option due to the large number of vehicles required. The costs of the installations are slightly lower than those of the network with retail, but much higher than those of hosting the manufacturer or hosting the distributor with parcel shipping. However, the processing costs are much higher than in a network of retail stores because all customer involvement is eliminated.

12.4.5 Manufacturer or Distributor Storage with Consumer Pickup:

With this approach, inventory is stored in the manufacturer's or agency's warehouse, but customers specify a pick-up point to collect the next order placed online or by phone. Your order will be delivered to the pick-up point from the storage location as needed as shown in figure 12.8. Inventory costs using this method can be kept low through the manufacturer's or distributor's warehouse to take advantage of aggregation

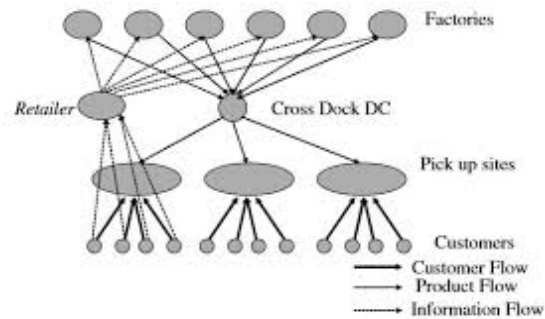


Figure 12.8 Manufacturers or Distributor Storage with Consumer Pickup

Advantages:

- Shipping costs are lower than any solution using parcel carriers, as there can be significant aggregation when the order is delivered to the pick-up location. This allows the use of full or semi-truckload carriers to transport the order to the pick-up location.
- For customers, returning a product is easy because they have a physical location to pick it up. Overall, the rendering is pretty good using this option.

Disadvantages:

- Facility costs are high if new pickup sites have to be built. A solution using existing sites will lower the additional facility costs.
- Pick-up location handling costs are high because each order must be associated with a specific customer upon arrival. This capacity building can significantly increase processing costs if appropriate information and storage systems are not provided. The biggest obstacle to the success of this approach is the increase in disposal costs at the collection site.
- There is some loss of customer experience because unlike the other options discussed, customers have to come and take their order.

So, we can say that in view of its performance characteristics, the main advantage of a network with consumer collection locations is that it can reduce delivery costs, thereby expanding the set of products sold as well as customers served online. The main obstacle is the increase in handling costs at the pick-up location. Such a network is likely to be more efficient if existing locations such as convenience stores or grocery stores are used as pickup locations because such a network improves the economics of the existing infrastructure. Unfortunately, these sites are often designed to allow customers to prepare orders and will need to develop the customer's ability to select a specific order.

12.4.6 Retail Storage with Customer Pickup

In this option, the inventory is stored locally on retailers. Customers enter the retailers or online or online and import them from retailers as can be seen in figure 12.9. Local storage increases

inventory costs because of lack of aggregation. For very fast moving items, however, there is marginal increase in inventory even with local storage.

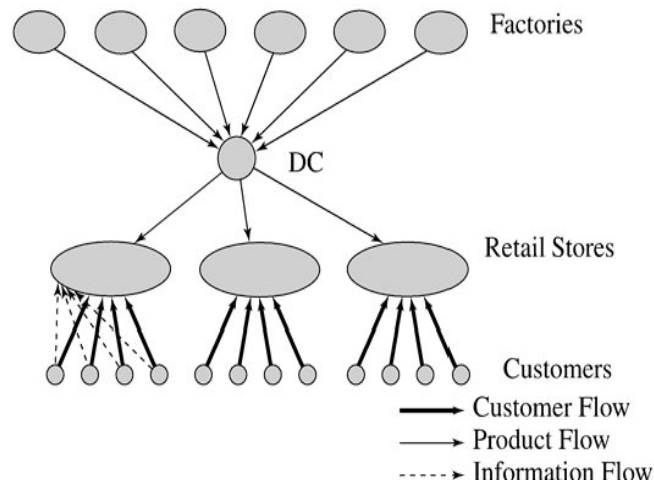


Figure 12.9 Storage with Customer Pickup

Advantages:

- Transportation cost is much lower than other solutions because inexpensive modes of transport can be used to replenish product at the retail store.
- A minimal information infrastructure is needed if customers walk into the store and place their order.
- Very good response times can be achieved in this case because of local storage.
- Returns can be handled at the pickup site. Overall, returnability is fairly good using this option.

Disadvantages:

- Facility costs are high because many local facilities are required.

Overall it can be said that the main advantage of a network with local storage is that it can reduce delivery costs and provide a faster response than other networks. The main drawback is increased inventory and installation costs. Such a grid is best suited for fast-moving items or items where customers appreciate a quick response.

12.5 SUMMARY

- Reduction in inbound transportation cost because of truckload shipments from manufacturers to distributor
- Reduction in outbound transportation cost because the distributor combines products from many manufacturers into a single outbound shipment

- Reduction in inventory costs because distributor aggregates safety inventory rather than disaggregating at each retailer
- A more stable order stream from distributor to manufacturer (compared to erratic orders from each retailer) allows manufacturers to lower cost by planning production more effectively
- By carrying inventory closer to the point of sale, distributors are able to provide a better response time than manufacturers can
- Distributors are able to offer one stop shopping with products from several manufacturers.

12.6 SAMPLE QUESTIONS

- Identify factors to be considered when designing the distribution network
- Discuss the strengths and weaknesses of various distribution options
- What is the role of distribution Network

12.7 REFERENCES

1. Supply Chain Management (Concepts & cases) – Rahul V. Altekar – [Prentice Hall of India, 4th edition]
2. Supply Chain Management (Strategy, planning and operation) – Sunil Chopra, Peter Meindl, D.V. Kalra – [Pearson, 3rd edition]



MODULE VIII: DISTRIBUTION NETWORKS OF SUPPLY CHAIN

13

APPLICATIONS OF DISTRIBUTION NETWORKS TO E-BUSINESS

Unit Structure:

- 13.0 Objectives
- 13.1 Impact of e-business on customer service
 - 13.1.1 Response time to customers
 - 13.1.2 Product variety
 - 13.1.3 Product availability
 - 13.1.4 Customer experience
 - 13.1.5 Faster Time to Market
 - 13.1.6 Order visibility
 - 13.1.7 Return ability
 - 13.1.8 Direct sales to customers
 - 13.1.9 Flexible pricing, product portfolio, promotions
 - 13.1.10 Efficient funds transfer
- 13.2 Impact of e-business on cost
 - 13.2.1 Inventory
 - 13.2.2 Facilities
 - 13.2.3 Transportation
 - 13.2.4 Information
- 13.3 Distribution Networks in Practice
- 13.4 Summary
- 13.5 Sample Questions
- 13.6 References

13.0 LEARNING OBJECTIVES

After reading this chapter, you will be able to:

1. Understand how e-business has affected the design of distribution networks in different industries.

2. Understand the impact of E-Business on Customer Service
3. Understand the impact of E-Business on Cost
4. Understand the distribution networks in practice

This chapter includes an in-depth discussion of the design of distribution networks in the context of e-business. We apply the potential design ideas of distribution network design to discuss the evolution of distribution networks in various industries since the advent of e-business. The goal is to provide managers with a logical framework for selecting the appropriate distribution network given product, competitive, and market characteristics.

13.1 IMPACT OF E-BUSINESS ON CUSTOMER SERVICE

As with the distribution networks discussed earlier, we begin by investigating how e-commerce affects customer service factors such as response time, product variety, uptime, and customer service. Yes, customer experience, time to market, visibility and profitability. We also take into account factors such as direct selling and the ability to offer flexible pricing that helps e-commerce.

13.1.1 Response time to customers

When selling physical products that cannot be downloaded, an ecommerce without a physical reseller will take longer to respond to customer inquiries than a retail store due to shipping delay concerns. Therefore, customers who require short response times may not be able to use the Internet to place an order. However, there is no such deadline for downloadable products. Going online can save time in many cases. To verify, any prospectus or score can be downloaded from the web. An actual shipment of these products or even a trip to a music store will take longer.

Response time is the time from when a customer places an order to when the item is received. If customers can withstand long response times, the distribution channel will need fewer locations and focus on greater capacity at each location. However, if customers need fast response times, they must build more locations in the network. Changing the distribution network is something a business typically doesn't want to do in the short term because it directly impacts supply chain cost factors such as inventory, transportation, facilities, and handling. . But it is only a matter of time and sooner or later a business has to reshape its distribution network. As a general rule, it can be said that the more facilities there are in a network, the higher the inventory costs, but the lower the transport costs. Conversely, a smaller number of installations will result in lower overall installation costs, but more transportation costs for distant customers.

13.1.2 Product variety

E-businesses are easier to offer a wide range of products than physical stores. Amazon.com, for example, has far more books than a typical bookstore. To offer the same product in a store, you need a huge place with that massive inventory.

Examine how a manufacturer's product variety selection is affected by their distribution strategy. While offering a wide variety of products often leads to higher demand, it also has a negative impact on production costs and demand uncertainty. We investigate how manufacturers' optimal product variety decisions differ when selling directly to customers (centralized scenario) versus selling through retailers (decentralized scenario) . We find that the strength of the retailer and the impact of product variety on demand significantly influence the attractiveness of product variety and determine the distribution strategy manufacturers should offer with higher diversity.

E-commerce merchants that have traditionally operated as resellers are beginning to offer online platform services that provide a direct connection between buyers and sellers. In this sales method, e-commerce allows hundreds of thousands of manufacturers (also known as independent sellers) to reach their customers directly while charging a fee to provide that access. This format is called platform mode. On online platforms, consumers can observe product sales. When a product has more sales, more consumers buy it, and the value of the product increases with the number of users. This is called the direct network effect. As the number of users increases on one side, the number of providers also increases on the other side. Just to be clear, the platform is bilateral in the sense that consumers and suppliers must have access to the same platform to interact. Also, when the foundation value on one side is higher, there will be more members on the other side.

Recent innovations in e-commerce have led to the emergence of online retail platforms where millions of products are sold. Most of these products are sold by third party sellers, who pay a fee to the e-merchant (known as the platform owner). The e-merchant manages different products in a context of heterogeneity of consumers and economies of scale. In addition, the heterogeneity of consumers benefits e-merchants and harms suppliers.

On the one hand, the variety of products responds to consumer preferences and improves market liquidity. On the other hand, the costs of managing many categories increase with variety due to irrationality of scope. Platform owners must strike a balance between product variety and portfolio management costs to maximize their profits.

13.1.3 Product availability

One constant between an offline store and an online store is to ensure that there is a sufficient supply of products to meet consumer

demand. But many online stores have much less inventory than their traditional counterparts, which increases the likelihood of lost sales due to out-of-stock products. With the growing importance of e-commerce channels for consumer goods manufacturers, it is crucial to understand and improve the availability of products in online stores.

E-commerce can dramatically increase the rate at which information about customer needs is disseminated throughout the supply chain, resulting in more accurate forecasts. These improved forecasts and a more precise view of customer demand lead to a better match between supply and demand. In terms of inventory, that means more inventory that customers are asking for and less inventory that they are not asking for. E-commerce also allows inventory aggregation to improve product availability.

When we think about the general availability and management of categories in the offline world, this is really a model for stacking and growing.

The manufacturer's sales team sells as many new products and items as possible to retailers. Then the retailers actually help promote those items. They put them on shelves, in additional displays, organize promotions - all this to attract buyers who will think and shop in-store during this shopping journey. . Many of our portfolio management methods are based on this highly evolved push model, but as we move to the online channel, e-commerce is actually reversing that and becoming a pull model. In this model, the most important task for manufacturers is to properly configure this item on retailer websites.

Consumers use e-commerce to research and learn about products. They look for prices, product information as well as product ratings and reviews. If an item is not configured correctly or incorrectly, the buyer will not be able to find the product to review it in the first place. Or if they find the product, they may be disappointed with the content of the product. Once the manufacturer is able to convince the consumer to buy, the retailer will then decide how much stock to purchase and replenish from the manufacturer.

Online retailers tend to have fewer inventories with little to no inventory on hand, which increases the likelihood of being out of stock even if there is a small increase in demand. However, an interesting thing about the line - and a major benefit - is that manufacturers contract for store-level availability more easily and scale accordingly and faster than they otherwise would have possible. Brands that are proactive in tracking inventory and online retailer sales will really quickly gain an edge over brands that take a more passive approach.

Again, ecommerce is a lot like an attraction model, where you need the consumer to be attracted to your item, buy your item, and that

will actually trigger that retailer's purchases from the manufacturer. In this model, the manufacturer is responsible for controlling this traction. They need to attract buyers with really rich product pages and stock items that show up on search. And all of this is done with smart and proactive portfolio management.

13.1.4 Customer experience

The term e-commerce customer experience refers to the sum total of every touch point, interaction, thought, or feeling that occurs or is exchanged between your customer and your brand - like the experience from the customer's perspective. That's a broad definition by design: customer experience includes everything that happens from the moment an individual hears about your brand until the moment they actively decide to stop doing business with your company.

E-commerce influences the customer experience in terms of accessibility, personalization, and convenience. Unlike most retail stores that are only open during business hours, e-commerce provides access to customers who may not be able to place orders during regular business hours.

E-commerce also allows a business to reach geographically distant customers. Without e-commerce, only customers near the store would be likely to shop there. Access to e-commerce is limited only by the customer's access to the Internet.

The Internet offers the possibility of creating a personalized shopping experience for each customer. For example, Amazon displays products related to what customers have recently purchased or viewed. Businesses that focus on mass customization can use the Internet to help customers choose a product that meets their needs.

For consumers and businesses alike, e-commerce can increase the ease of doing business. For example, customers have the option of not having to leave home or work to make a purchase. E-commerce can also help automate the buying process, speeding up business operations and reducing ordering costs. For example, many e-merchants use past purchase data to speed up current purchases.

Overall, the goal will be to get customers to continue to buy more and buy more often from your business. For this to happen, you now need to stay in close contact with your customers. This means:

- Provide regular (and proactive) updates, announcements, promotions, etc. through a variety of channels
- Develop programs, events and other initiatives to add value to your audience
- Collect (and act on) satisfied customer feedback and your dissatisfaction

13.1.5 Faster Time to Market

Time to market (also known as TTM or time to market) is defined as the amount of time from the conception of a new idea until it is brought to market. Another definition: it is the time from the start of the team's work to the sale of the first unit. Since research has shown that new entrants to the market have a clear advantage in terms of market share, revenue growth and sales, time to market is one of the essential KPIs or metrics for growth. Many product development strategies depend on being first to market.

A business can use e-commerce to introduce new products much faster than a business using physical channels. A business that sells PCs through physical channels must produce enough units to stock the shelves of distributors and retailers before it begins to earn revenue from the new product. On the other hand, e-commerce introduces a new product by making it available on the website - there is no distribution deadline to fill real channels. A new product can be offered as soon as the first one is ready for production. This is evident in the IT industry, where Dell often introduces new products earlier than competitors using traditional channels.

13.1.6 Order visibility

The Internet can provide visibility into the status of orders. From a customer's perspective, it is important to provide this visibility because an online order has no physical equivalent to a customer purchasing an item in a retail store.

E-commerce may have changed the process of buying goods, but consumers still expect timely and undamaged goods, regardless of their origin. Whereas in the past retailers could only display the best quality merchandise on their shelves and document damaged products to complain to their suppliers, retailers are now liable for similar damage to the end consumer.

For several years, real-time visibility into the supply chain ecosystem has been a priority for shippers, service providers and logistics technology companies. This becomes important in almost every segment of the supply chain - at the supplier, on the way to the warehouse, in the warehouse, when fulfilling orders and selecting and managing resources for make deliveries to households or businesses.

It is an intelligence tool. Real-time visibility reduces costs, saves working capital and improves efficiency - all through better understanding and management of supplier performance, warehouse optimization, inventory accuracy, inventory control exceptions, management of shipping resources, speed of delivery and on-time service.

In a time of widespread uncertainty, businesses are doing all they can to survive, stay connected with customers and deliver the essential

goods they need. To make things work, businesses and consumers rely on delivery companies to deliver the customer-centric technologies, platforms, networks, resources, and tools that enable consumers reliable same-day delivery over the long haul.

This is a service and experience that is a far cry from the old “delivery” messages we all get. Instead, businesses and consumers benefit from real-time tracking that seamlessly expands visibility from order to delivery.

These systems leverage capabilities built into a GPS-enabled mobile application, integrated with a sophisticated software platform to plan, direct and manage a network of connected drivers. Connect on the go. For recipients expecting same-day delivery, the experience is similar to looking at your smartphone to track the progress of an Uber driver about to pick you up.

13.1.7 Returnability

Returns are more difficult with online orders, which often come from a centralized location. It is much easier to return a product purchased at a retail store. Profit rates are also likely to be much higher for online orders, as customers cannot touch and smell the product before purchasing it. Putting online therefore increases the cost of the backflow.

In-store shoppers can experience products in ways that online shoppers cannot.

If the pants are too tight at the calves, find another pair of pants that fit. If you usually wear a shirt that fits well but the top is still a bit loose, try downsizing. Buy a dress online and it doesn't fit? I guess you will have to send it back.

Despite best efforts, e-commerce retailers will continue to have difficulty with product returns.

A good returns management process supports customer relationship management and helps capture value by reselling and redistributing returned products. Efficient profit management in e-commerce helps to recover the value of the product. Reverse logistics is an important business process in e-commerce.

In an Internet direct sales supply chain, the customer purchases directly from the manufacturer, sacrificing the benefit of physical product inspection. This increases the likelihood that the customer is not satisfied with the product and wants to return it. A generous and well-explained return policy would then be welcomed by customers and thus increase demand. From a manufacturer's point of view, this will increase revenue, but also increase costs due to increased returns.

"Buy online, return in store" will incur unexpected additional costs. For example, companies must find more physical space in their stores to store returns and use store employees to process returns. It is also difficult for companies to integrate and develop the underlying IT system quickly enough to meet the demand for online purchases and returns.

Many companies have complex returns management procedures. With few senior managers overseeing the returns process, retailers have a difficult time determining key information such as the return rate and the cost of processing returned products.

However, only a small reduction in the rate of return and additional costs can directly increase profitability. Researchers estimate that for an average company, a 5% increase in the rate of return may actually increase the net profit margin (200 basis points). These enhancements are essential to help them provide the services customers expect (such as free shipping and returns) while maintaining price competitiveness.

Suggestions for improving return management and increasing online sales profits include:

- Develop a strategic plan to use returns as a profit center;
- understand the true cost of returns and potential opportunities to reduce these costs;
- develop lean management ideas to In exchange for an effective omni-channel organization;
- manages the growing impact of business returns by simplifying and integrating IT systems;
- makes communication between customers and employees smarter, a cost-effective measure that reduces returns Costs and increase secondary sales revenue;
- Participate in circular economy and generate net benefits in cash, corporate social responsibility and brand reputation.

13.1.8 Direct sales to customers

E-commerce enables manufacturers and other members of the supply chain to increase revenue without direct contact with customers through traditional channels, bypassing intermediaries and selling directly to customers, thus obtaining incremental revenue from intermediaries. For example, Dell sells computers directly to customers online. As a result, Dell is able to increase revenues and profits because it does not share any of its revenues with distributors or retailers. Rather, HP sold through retailers must share part of the product's revenue with distributors and retailers, resulting in HP's low revenue and profit margins.

13.1.9 Flexible pricing, product portfolio, promotions

An ecommerce store can easily change its price by changing an entry in the database associated with its website. This ability allows an electronics business to maximize revenue by pricing based on current

inventory and demand. The airlines are a prime example of this - they offer cheap last minute fares on the website on routes with unsold seats. Dell also changes prices for different PC configurations on a regular basis, depending on demand and component availability. Businesses can change e-commerce prices much more easily than most traditional channels. If Dell or L.L. Bean used the paper catalog to reduce the price, which they would have to print the new catalog and mail it to potential customers. However, with e-commerce, all they have to do is update the prices on their website. Likewise, an e-business can easily modify the product portfolio it offers as well as the promotions it offers.

The increasingly dynamic nature of business-to-business e-commerce has resulted in recent developments in fixed and flexible pricing. Flexible prices, as defined here, include arbitrage prices, where different buyers can receive different prices based on expected prices and dynamic prices, such as auctions, where prices and terms are based on bids by market players.

At first glance, the prices of raw materials in e-commerce are formed according to the classical rules of price formation. The pricing strategy is based on three components: cost, customer value, and competitors. However, the experience of the world leader in e-commerce has shown the emergence of absolutely unique flexible and personalized pricing methods. Prices in e-commerce are highly dynamic, depending on market conditions, pricing strategies can be individualized for each user and it is possible thanks to big data technology.

The promotion is characterized by a wide range of tools and functions in the electronic environment. Promotional activities allow consumers to participate in the communication process and can prompt them to take specific actions (approval, registration, download, purchase, recommendation). In addition, if the marketing campaign is successful, the dissemination of information about the company, products and services will naturally become viral, providing reports comparable to leading figures in the media.

The actual implementation of the marketing mix is a smart mechanism for personally recommending products. It has a direct impact on the improvement of the production performance of the business organization: growth of sales and profits, the commitment of consumers to the encouragement of business. This is due to the application of service recommendation of transaction. At that time, the buyer realized that the company responded to this request, and the response was personalized (personalized effect) and accurate (quality of service).

13.1.10 Efficient funds transfer

E-commerce can increase revenue by accelerating payment collection.

Electronic payment systems enable faster order processing and delivery, increasing the efficiency of the business-to-business (B2B) and business-to-consumer (B2C) models. Improved customer service, shorter delivery times, and 24-hour worldwide service ensure that your customers have a successful shopping experience. Through the electronic payment system, you can easily implement personalized services for your customers by enabling subscription services and providing timely information on special offers and promotions. Newsletters are an effective marketing strategy that can entice your customers to return to your website and buy more products.

The acceleration of electronic payment has provided support for electronic commerce and has brought significant benefits. For small businesses, the combination of electronic payments and other online tools means that it is easier to reach a broader customer base across the country or region or around the world. In turn, this also provides customers with greater convenience and options. However, although the digital world is theoretically borderless, the borders of countries and regions have not disappeared. Global e-commerce still faces a number of challenges. These include restrictions on the supply, use and international availability of electronic payment services.

The combination of the Internet and electronic payment has also promoted the buying and selling of new digital products and services. However, issues related to cross-border payments remain a major obstacle. According to a survey, exporters of electronic services report that compared to other factors, such as the establishment of online businesses, international electronic payment problems are the biggest bottleneck in the process chain

Electronic payments help overcome the complicated and extremely expensive process of collecting cash payments for products purchased or sold online. Simply put, electronic payment makes electronic commerce possible and practical.

13.2 IMPACT OF E-BUSINESS ON COST

An e-commerce business can reduce labor and other costs in many areas including: document preparation, reconciliation, mail preparation, phone calls, data entry, overtime and monitoring costs. E-commerce can help manage operating costs in many areas, thereby lowering the cost of individual transactions. The use of electronic mail and electronic invoicing represents a significant saving compared to traditional methods.

In terms of cost, e-commerce affects the costs of inventory, facilities, transportation, and information. It is important to note that the impact in each case is not necessarily positive. Lets look at the impact on each of these cases:

13.2.1 Inventory

E-commerce can reduce inventory levels and inventory costs by improving supply chain coordination and creating a better match between supply and demand. Additionally, e-commerce allows a business to gather inventory remotely from customers if most customers are willing to wait for online orders to be delivered. Due to geo-aggregation, e-commerce requires fewer inventories. A key point to note is that the relative advantage of aggregation is low for high demand items with low variability, but large for low demand items with high volatility.

An e-commerce can dramatically reduce its inventory if it can delay the introduction of a variety until the customer's order is received. The time lag between when a customer places an order and when they wait for delivery gives ecommerce the ability to delay fulfillment. For example, Dell holds inventory in the form of components and assemblies for its computers after receiving a sales order. The inventory of required components will be much lower than if Dell kept its inventory in the form of assembled PCs. As a result, its electronics business allows Dell to hold fewer inventories than a company that keeps inventory in retail stores as finished goods.

13.2.2 Facilities

There are two basic types of installation costs that should be included in the analysis: costs related to the number and location of installations in the network, and costs related to the activities that take place in those installations. An e-business can reduce network installation costs by increasing operations, thereby reducing the number of devices required.

When it comes to day-to-day operating costs, customer involvement in selection and ordering allows an e-business to reduce its resource costs. For example, when a customer visits any website, they will attempt to check product availability and then place an order. When the same customer calls to place an order, the company incurs additional costs for its staff to check product availability and place an order. An e-business can reduce its order fulfillment costs because it does not have to fulfill the order as soon as it arrives. A retail store or supermarket needs to staff its counter to have more cashiers as more customers shop. As a result, these stores require a larger number of employees on weekends and when there are no employees. In an e-commerce, if a reasonable cache of unfulfilled orders is kept, order fulfillment rates can be significantly smoother than order arrival rate, reducing peak load for order fulfillment and thus reduces resource requirements and costs.

In addition, operating costs can be reduced for a manufacturer using e-commerce to sell directly to customers, as fewer stages in the supply chain touch the product when it reaches the customer, thereby reducing the costs of treatment.

In contrast, for some products, such as groceries, e-businesses have to perform tasks that customers are performing in retail stores, which affects both handling costs and shipping costs. In such situations, an e-commerce store will incur higher handling and delivery fees than a retail store. For example, while a customer picks up on-demand items at the grocery store, an online business incurs higher processing costs because their employees must take customer orders from warehouse shelves and deliver goods to customers home.

13.2.3 Transportation

If a business can make its product downloadable, the Internet will save them cost and delivery time. Downloadable music and software, for example, offers the ability to eliminate all costs associated with transporting compact discs. For non-digital products, inventory consolidation increases shipping overseas compared to shipping in. Compared to a business with multiple retail stores, an online business with aggregated inventory tends to have higher shipping costs (throughout the entire supply chain) per unit due to outbound costs increase.

13.2.4 Information

E-businesses can share demand information throughout their supply chain to improve visibility. The Internet can also be used to share planning and forecasting information throughout the supply chain, further improving coordination. This helps reduce overall supply chain costs and better match supply and demand. Here we see that information is the catalyst for many of the benefits of e-commerce discussed so far.

However, an e-business incurs additional information costs. The software and hardware costs required to start an electronics business can often be considerable. These costs must be weighed against the benefits to be derived from them. Keep in mind that much of an electronic business's information technology (IT) infrastructure is likely already in place to operate a traditional business. This can drastically reduce the additional costs required for e-commerce.

13.3 DISTRIBUTION NETWORKS IN PRACTICE

- *The ownership structure of a distribution network can have as much impact as the type of distribution network:*

Much of this chapter deals with the different types of physical networks and the subsequent flows for successful product delivery. However, it is equally important to know who owns each step of the distribution network. Distributed networks with the same physical flow but different ownership structures can have very different performance. For example, a manufacturer who owns its distribution network can control the operations of the network. However, if the builder does not own the distribution network, there are often many problems, many

problems must be taken into account to optimize on the network. Obviously, an independent distributor wants to optimize their own business, not necessarily the entire supply chain. Trying to optimize across a distribution network with many companies requires a great ability to coordinate individual player offers and create the right relationships. Be sure to consider the impact of both physical flows and ownership structures when designing distribution networks.

- *The choice of the distribution network has very lasting consequences:*

The structure of the distribution network is one of the most difficult decisions to change. The impact often lasts for decades, amplifying the importance of choice. In the United States, for example, automakers sell almost all of their vehicles to consumers through an independent dealer network established decades ago. Because dealerships are the interface between consumers and the automotive supply chain, automakers are keen on influencing dealerships to ensure that this is a positive relationship. However, because they are independent dealers, they have a number of different goals that are not necessarily consistent with the manufacturers. What further complicates the situation is the fact that dealers often have relationships with many manufacturers and have been successful in encouraging legislation, which makes it very difficult for manufacturers to use any distribution channels. Although automakers have been trying to establish alternative distribution channels for several years, dealers have kept manufacturers trying, which remains the only channel through which cars are sold.

Another example of the long-term consequences is seen in the PC industry. In the beginning, manufacturers sold through independent distributors and retailers. Dell's arrival is a clear example that the direct model often outperforms the traditional model. Other PC makers, such as HP, have infiltrated PC sales directly. However, their current distribution channels have reacted quite negatively to this, as one would expect, as it will eat up their business. Since distributors often sell PCs from other companies, manufacturers are reluctant to actively promote their direct efforts for fear of retribution by the distributor by promoting a competitor's product. As a result, these PC makers ended up with minimal direct sales. Manufacturers are essentially chained by their old distribution networks. The only way to go straight is to break it completely, a decision that is too costly as their distributors own the relationship with their customers. These examples illustrate the long-term implications of choosing the right distribution network.

- *Determine if an exclusive distribution strategy is beneficial:*

Another important choice is whether to distribute exclusively or not. For example, a consumer electronics manufacturer such as Sony may choose to have relationships with multiple distributors such as Best Buy, Circuit City, and Wal-Mart. In this case, Sony would be interested in increasing its product offering to customers and certainly wouldn't mind if its distributors competed with each other to sell Sony products to

customers. An alternative, more affordable for a manufacturer of very high-end stereo equipment, is to establish an exclusive relationship with a distributor. In this case, the customer can only buy the products of this brand from one retailer. Retailers can take advantage of higher margins because they don't have to compete on price with a nearby store. But what's in it for the maker? Manufacturers are often able to significantly increase their sales because their exclusive distributor will be much more interested in marketing the manufacturer's products because there are higher profit margins and less competition.

- *Product price, commodity and severity affect the type of distribution system preferred by customers:*

The interaction between buyer and seller requires time and resources. Many buyers want to establish a relationship with a company that can provide a full range of products. This can be done by manufacturers with extensive product lines. However, compared to carrying products from many manufacturers, is usually done more efficiently by a distributor. Customers' desire for a one-stop shop depends not only on the convenience of the relationship, also depends on the type of products they buy. The higher the degree of product differentiation, the more likely it is for customers to establish a relationship around that particular product.

For example, a consumer might simply buy a PC directly from a manufacturer. However, very few consumers are willing to order pens directly from a pen manufacturer, paper directly from a paper manufacturer, and staplers directly from a stapler manufacturer. Most consumers prefer stationery that has a lot of products from different manufacturers. Even if a pen manufacturer could economically deliver individual pens to customers' homes, it would be difficult for consumers to deal with different units for each type of office product.

- *Integrate the Internet with your existing physical network:*

To get the most out of e-commerce, businesses need to integrate it into their existing supply chain network. The separation of the two networks often leads to inefficiencies in the supply chain. This combination of e-business with the existing physical network is called click and reality.

An example of an effective click-and-go strategy is The Gap, which allows customers to order online through a computer located in the store and also return items purchased online to stores that sell them. The Internet is used to expand the variety offered to customers in Gap stores. The Gap Store offers popular items, while customers can order online in colors or sizes that may not be available in store. This allows Gap to focus on low-demand items while increasing the variety available to customers and derive maximum benefit from integrating its e-business with its physical network.

13.4 SUMMARY

- A manager must consider the customer needs to be met and the cost of meeting those needs when designing a distribution network. Some of the key customers that need to be considered include response time, product variety / availability, convenience, order visibility, and return capability. Significant costs that managers must consider include inventory, transportation, facilities and handling, and information. Increasing the number of installations reduces response time and transportation costs, but increases inventory and installation costs.
- Direct-to-customer distribution networks are best suited for a wide range of high-value products with low demand and uncertainty. These networks have low inventory, but incur high shipping costs and offer slow response times. Distribution networks with inventory in place are suitable for products that are in high demand, especially if transportation is a large portion of total costs. These networks result in higher inventory costs but lower shipping costs and provide faster response times.
- The rise of e-commerce has affected both customer service and costs in the supply chain. E-commerce allows a business to offer a wider range of products and improve product availability by centralizing inventory. This is especially advantageous for low-volume and wide-variety products. E-commerce also improves the customer experience by providing 24-hour access and allowing for a more personalized experience. However, selling products online increases response times compared to retail stores. An e-business reduces setup costs if there is no significant loss of customer engagement. However, shipping costs are increasing, which is especially important for low-value products with predictable demand. E-commerce works best for high-value products with uncertain demand, when customers are willing to wait a certain amount of time for delivery.

13.5 QUESTIONS

- What types of networks are best suited to highly differentiated products?
- What is the impact of e-business on customer service
- What is the impact of e-business on cost

13.6 REFERENCES

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MODULE 9: NETWORK DESIGN IN SUPPLY CHAIN

14

ROLE OF NETWORK DESIGN AND FACTORS INFLUENCING THE DESIGN

Unit Structure:

- 14.0 Objectives
- 14.1 Introduction
- 14.2 Overview
- 14.3 Goals of Network Design
- 14.4 Role of Network Design in Supply Chain
 - 14.4.1 Facility role
 - 14.4.2 Facility Location
 - 14.4.3 Capacity Allocation
 - 14.4.4 Market and Supply allocation
- 14.5 Factors influencing the network design decisions in Supply chain management
- 14.6 Summary
- 14.7 Sample Questions
- 14.8 References

14.0 LEARNING OBJECTIVES

After reading this chapter, you will be able to:

1. Understand the role of network design in a supply chain.
2. Identify factors influencing supply chain network design decisions

In this chapter, we start with the general supply chain design discussed in previous chapters and provide an understanding of the role that network design plays in the supply chain. After assigning roles to each facility as discussed earlier and at the start of this chapter, we focus on the basic questions regarding facility location, capacity allocation, and market allocation within the supply chain. We identify and discuss the various factors that influence facility location, capacity, and market allocation decisions.

14.1 INTRODUCTION

What is Supply Chain Network Design?

The process of building and modelling a supply chain which helps in better understanding the costs and time associated with bringing goods to market with the resources and locations available is known as Supply Chain Network Design. The biggest trend of supply chain network design is to create systems that are flexible enough so that they can stay efficient with constantly changing market needs. A supply chain network that is not flexible and doesn't adjust to the changing business requirements can create a lot of problems for a transport company and certainly is a source of raising costs that could've been prevented otherwise.

The location of all the supply chain's facilities for e.g. production sites, warehouses and distribution centres require to be optimized so as to increase the efficiency of the whole system.

Network design decisions determines the supply chain configuration and then decides constraints within which the other supply chain drivers can be used for decreasing supply chain cost or increasing the responsiveness that's why they have a significant impact on performance. All network design decisions should be taken by looking to the fact that all decisions are interdependent and affect each other.

14.2 OVERVIEW

It is very essential to recognize that a company's network determines its supply chain efficiency as well as customer satisfaction. Designing an optimal supply chain network signifies the network should be able to meet the long term strategic objectives of the company. Most business units or functional domains within a company are impacted by a network design project.

Designing the supply chain network in the best way will help you ensure that the right combination of the best transportation method, best route, and intermediate assets (such as warehousing, inventory, etc.) is used to transport your products. To achieve your business goals. The icing on the cake is that this is a relatively easy and profitable process.

The success of any supply chain network depends on how factories, suppliers, warehouses, and products flow from each source to the end customer. For any successful supply chain, the number of facilities and their location is a key factor. In fact, 80% of supply chain network operating costs depend on the location of facilities and the flow of products between them. To reduce costs, you need a more systematic engineering approach to be able to plan and design your network effectively. This is why the design of the supply chain network is so important.

While designing a supply chain the following steps must be followed:

- 1) Defining the business objectives,
- 2) Defining the project scope
- 3) The form of analysis to be done must be determined
- 4) Determine what tools to be used
- 5) Finally, Project completion, the best design.

Once the path onwards is determined and the design approach has been completed correctly, the business will lead to many significant benefits.

14.3 GOALS OF NETWORK DESIGN

Goals of Network Design are as follows:

- To create the most efficient network possible
- Meet the continuous demand of customers
- To make sure that the lowest possible cost is incurred to serve your network

14.4 ROLE OF NETWORK DESIGN IN SUPPLY CHAIN

Supply chain network design decisions include:

- The assignment of facility role
- Location of manufacturing, storage, or transportation-related facilities
- The allocation of capacity and markets to each facility.

It is important to realize that a company's network determines the efficiency of its supply chain and customer satisfaction.

Designing the best supply chain network means that the network must be able to meet the long-term strategic objectives of the company. Most of the business units or functional areas within the company are affected by the network design project.

Supply chain network design decisions include the assignment of facility role, location of manufacturing storage, or transportation-related facilities, and the allocation of capacity and markets to each facility. On the above basis the roles in Supply chain network design decisions are classified as follows:

1. *Facility role:* The questions addressed would be what role should each facility play and what processes are performed at each facility. Roles of facility and processes performed would be taken care.

2. *Facility location:* The location of facility would be decided i.e. Where should facilities be located.

3. *Capacity allocation*: What is the capacity that can be allocated to each facility. i.e. How much capacity should be allocated to each facility

4. *Market and supply allocation*: What markets should each facility serve? Which supply sources should feed each facility?

Now we will see all the roles in detail:

14.4.1. Facility role:

Supply Chain Network decisions concerning the role of each facility are important as they determine the amount of flexibility the supply chain has in changing the way it meets demand. This decides the perspective of how the change in demand is going to be dealt with and how much flexible the system is to adapt this change. A very good example in this context is of Toyota Plants which are today located everywhere worldwide. Earlier in 90's each and every plant had the capability of serving the local market only. In late 90's the economy was in recession and the Toyota plants were idle although other markets had excess demands. So then Toyota added the flexibility that all its plants were able to serve the other markets as well other than the local one. This helped in dealing with more efficiently and adapting to change in the Global market conditions.

So when it comes to role of facility it is the decidable factor for flexibility for change in global market conditions with respect to demand and supply and dealing with demand and then bringing in corresponding change in the supply chain network.

14.4.2. Facility location:

The way role of facility is important in the similar fashion the location of facility and the decisions related to that have long-term impact on a supply chain's performance because it is very expensive to shut down a facility or move it to a different location.

Decisions about the location of facilities have a lasting impact on supply chain operations, as closing or moving a facility to another location is costly. A good location decision can make the supply chain agile while keeping costs low. For example, Toyota built the first assembly plant in the United States in Lexington, Kentucky in 1988 and has used the plant ever since. The Lexington factory proved very profitable for Toyota as the yen strengthened and cars made in Japan were too expensive to compete with cars made in the United States. The Lexington plant has allowed Toyota to meet the US market while keeping costs low.

Conversely, poor facilities make it difficult for supply chains to operate effectively close to the border. For example, Amazon.com found it very difficult to make a profit by delivering books across the United States when it had only one warehouse in Seattle. As a result, the company added warehouses in other parts of the country.

So deciding the location plays a very important role in the responsiveness of the supply chain .If the location is good then whole network turns out to be prompt and cost effective as well.

14.4.3. Capacity allocation:

Capacity allocation decisions also have a significant impact on supply chain performance. While capacity allocation can be more easily changed than location, capacity decisions tend to persist for several years. Allocating too much capacity to one location leads to poor utilization and thus higher costs. Allocating too little capacity leads to poor responsiveness if demand is not met, or high costs if demand is met from a remote installation.

When it comes to capacity allocation to a particular location it has to be done in such a way that the resources are used up to their capacity and there's no lag in the supply chain.

The distribution of supply sources and markets to facilities has a substantial impact on performance because it affects total production cost, inventory cost, and transportation cost acquired by the supply chain to satisfy the demand of the customer.

So the decision related to capacity should be reviewed on a regular basis so that the allocation can be altered as market situations or capacities of the plant change.

14.4.4. Market and supply allocation:

Allocating supply and market resources to facilities has a significant impact on operations because it affects the total production, inventory, and transportation costs the supply chain incurs to meet customer demand. This decision should be reviewed regularly so that the allocation can be changed according to market conditions or plant capacity. Of course, the distribution of markets and supplies can only change if the facilities are flexible enough to serve different markets and receive supplies from different sources.

Definitely, the allocation of markets and supply sources can only be altered if the facilities are flexible enough to serve different markets and receive supply from different sources.

As it was mentioned earlier, Amazon.com has built new warehouses and changed the markets supplied by each warehouse as its customer base has grown. Consequently, additionally it has lowered costs and improved the responsiveness.

Network design decisions must be reviewed as a business grows or as two businesses merge. Given the redundancies and differences in the markets served by one of the two separate companies, consolidating some facilities and changing the location and role of others can often help reduce costs and improve responsiveness. .

❖ Advantages of Supply Chain Network Design:

1. It can improve customer service and satisfaction.
2. It can balance the costs and service.
3. It can help a company achieve competitive advantage.

We focus on developing frameworks and methods that can be used in supply chain network design. In the next section, we have identified several factors that influence network design decisions.

14.5 FACTORS INFLUENCING THE NETWORK DESIGN DECISIONS IN SUPPLY CHAIN MANAGEMENT

To design a supply chain network for each industry or company, in addition to evaluating alternatives that suit your specific business needs, you also need to achieve a satisfactory design framework, including products, markets, processes, technologies, costs, external environments and factors, its influence and other elements. No two supply chain designs are the same. Network design will vary based on many factors, including location and whether you are considering a national, regional, or global business model.

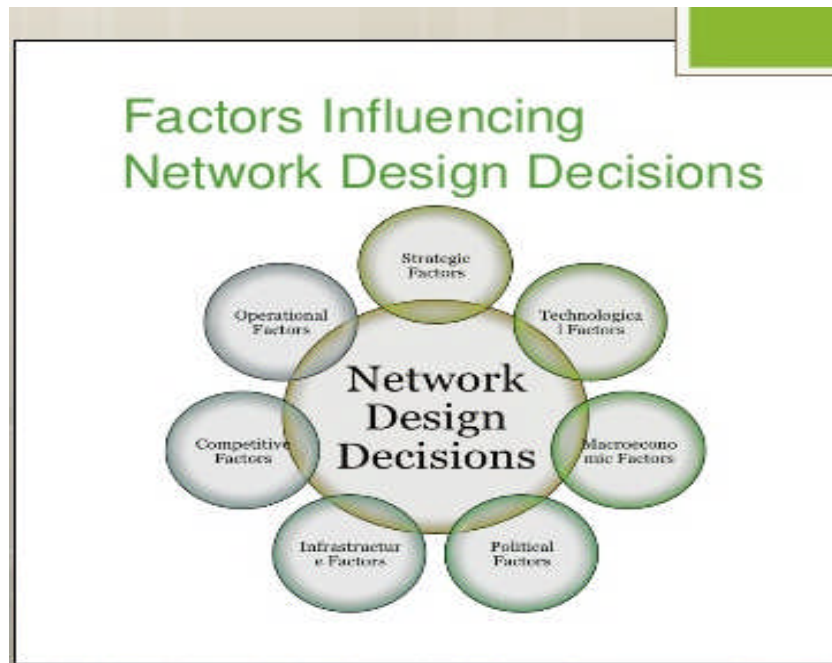
Obviously, supply chain network design represents a major departure from traditional supply chain planning, which usually focuses on factors such as reducing product costs and punctual delivery. Because it analyses and affects the entire supply chain of the organization, SCND must be handled in a professional and organized manner. Many factors must be considered, such as goals, objectives, costs, support, and how to best model the organization to closely reflect actual performance.

The design of supply chain network is the core of supply chain management and is affected by many variables, which correspond to various factors. Many studies have evaluated the importance of these influencing factors, namely political and social characteristics, supply characteristics, product characteristics, demand characteristics, and service requirements to evaluate the choice of strategic locations in the supply chain system. Use structural equation modelling methods to analyse the influence of these factors. The results show that supply characteristics, product characteristics, demand characteristics and service demands have a positive impact on the design of strategic supply chain networks. Does not support the influence of political and social factors on the choice of strategic location.

There are many factors involved which influence the network design decisions. Some of them are as follows:

- STRATEGIC FACTORS
- TECHNOLOGICAL FACTORS

- MACROECONOMIC FACTORS
- POLITICAL FACTORS
- INFRASTRUCTURE FACTORS
- COMPETITIVE FACTORS
- CUSTOMER RESPONSE TIME AND LOCAL PRESENCE
- LOGISTICS AND FACILITY COSTS



1. STRATEGIC FACTORS

A company's competitive strategy has a significant impact on network design decisions in a supply chain. Companies that focus on cost leadership tend to find the cheapest locations for their production facilities, even if this means they are very far away from the markets they serve. For example, in the early 1980s, many clothing manufacturers moved their entire production operations outside of the United States to countries with lower labour costs, in the hope of lowering costs. With clothing quotas reduced in 2005, most manufacturing is now shifting to low-cost countries like China.

Businesses that focus on responsiveness tend to locate facilities closer to the market and may choose a high cost location if this option allows the business to respond quickly to changing customer needs. Zara, the Spanish clothing manufacturer, has a significant share of its production capacity in Portugal and Spain, although costs are higher there. Local competence allows the company to react quickly to changing fashion trends in Europe. Zara's ability to respond to changing fashion trends has made it one of the fastest growing clothing retailers in the world.

Convenience store chains objective is to provide easy access to clients as part of their competitive strategy. Convenience store networks

thus include many stores that cover an area, with each store being relatively small. On the contrary, discount stores use a competitive strategy that focuses on providing low prices. Thus, their networks have very large stores and customers often have to travel many far to get to one.

Global supply chain networks can best support their strategic objectives with facilities in different countries playing different roles. For example, Nike has production facility located in many Asian countries. Its facilities in China and Indonesia focus on cost and produce mass-market lower-priced shoes for Nike. In contrast, facilities in Korea and Taiwan focus on responsiveness and produce higher-priced new designs. This differentiation allows Nike to satisfy a wide variety of demands in the most profitable manner.

It is significant for a firm to identify the mission or strategic role of each facility while designing its global network. Kasra Ferdows (1997) suggested the following cataloguing of all possible strategic roles for various facilities in a global supply chain network:

- i. Offshore facility
- ii. Source facility
- iii. Server facility
- iv. Contributor facility
- v. Outpost facility
- vi. Lead facility

i. Offshore facility: low- cost facility for export production.

An overseas facility serves as a low-cost source of supplies to markets outside of the country in which the facility is located. The location selected for overseas installation must have low labour and other costs to facilitate low-cost production. Since many developing countries in Asia are exempt from import duties if all of a factory's products are exported, these are the main locations for overseas production facilities.

ii. Source facility: low-cost facility for global production.

Its main objective is low-cost power installation, but its strategic role is broader than that of overseas installations. The source base is often the main source of product supply for the entire global network. Source facilities tend to be located in places with relatively low production costs, well-developed infrastructure, and availability of skilled workforce. Good settings abroad will migrate over time to the power setting. Many clothing manufacturers have been trying to convert to source facilities since clothing quotas were cut some years back.

iii. Server facility: regional production facility.

The goal of installing a server is to make it available to the market where it is located. The server base was built due to tax incentives, local content requirements, tariff barriers, or high logistical costs to deliver to

the region from elsewhere. In the late 1970s, Suzuki partnered with the Indian government to create the Maruti Udyog. Initially, Maruti was a server installation and only made cars for the Indian market. The installation of Maruti helps Suzuki overcome high tariffs on cars imported into India.

iv. Contributor facility: regional production facility with development skills.

A contributor facility also serves the local market along with that it constantly improves by adapting to customization and constant improvement. It serves the market where it is located but also assumes responsibility for product customization, process improvements, product modifications, or product development. Most well-managed server facilities become contributor facilities over time. The Maruti facility in India today develops many new products for both the Indian and the overseas markets and has moved from being a server to a contributor facility in the Suzuki network.

v. Outpost facility: regional production facility built to gain local skills.

Outpost bases are primarily located to access knowledge or skills that may exist in a certain area. Considering its location, it also acts as a server installation. The main goal remains to be the source of knowledge and skills for the entire network. Many global companies have established outpost production facilities in Japan despite the high operating costs.

vi. Lead facility: facility that leads in development and process technologies.

A lead facility creates new products, processes, and technologies for the entire network. Lead facilities are located in areas with good access to a skilled workforce and technological resources.

2. TECHNOLOGICAL FACTORS

The characteristics of available manufacturing technology have a significant impact on network design decisions. While manufacturing technology exhibits significant economies of scale, some high-capacity locations are most efficient. This is the case for the production of computer chips, whose factories require huge capital investments. As a result, most semiconductor companies build several large capacity facilities.

In contrast, if facilities have lower fixed costs; many local facilities are preferred because this helps lower transportation costs. For example, bottling plants for Coca-Cola do not have a very high fixed cost. To reduce transportation costs, Coca-Cola sets up many bottling plants all over the world, each serving its local market.

The flexibility of manufacturing technology affects the degree of consolidation that can be achieved in the network. If production technology is very demanding and product requirements vary from country to country, a company should establish local facilities to serve the market in each country. Conversely, if technology is flexible, it will become easier to consolidate production into a few large facilities.

3. MACROECONOMIC FACTORS

Macroeconomic factors include taxes, tariffs, exchange rates, and other economic factors that are not internal to an individual firm. As global trade has increased, macro- economic factors have had a significant influence on the success or failure of supply chain networks. Thus, it is imperative that firms take these factors into account when making network design decisions.

- ***Tariffs and Tax Incentives***

Tariffs refer to all fees payable when products and/or equipment are moved across international, state, or urban borders. Price has a strong influence on location decisions in the supply chain. If a country has very high tax rates, companies will not serve the local market or set up manufacturing plants in that country to save taxes. High tariffs lead to more production sites in the supply chain network, with each site having a lower allocation capacity. As a result, companies began to consolidate their global production and distribution facilities. For global companies, lower tariffs have resulted in fewer manufacturing facilities and an increase in the capacity of each built.

Tax incentives are a reduction in tariffs or taxes that countries, states and cities often provide to encourage firms to locate their facilities in specific areas. Such incentives are often a key factor in the final location decisions of many factories. Developing countries often create trade zones in which tariffs and duties are relaxed as long as production is mainly used for export. This creates a strong incentive for global companies to locate factories in these countries so that they can exploit their low labor costs. Many developing countries also offer additional tax incentives based on the training, meals, transportation and other facilities provided to the workforce. Prices can also vary depending on the technology level of the product. Many countries also have minimum local content requirements and restrictions on imports. Such policies force companies to set up multiple facilities and source local suppliers.

- ***Exchange rate and demand risk***

Fluctuations in exchange rates are common and have a significant impact on the interests of any supply chain operating in the global market. Currency risk can be managed by using limited financial instruments or by hedging losses due to volatility. However, a well-designed supply chain network offers an opportunity to capitalize on exchange rate fluctuations and increase profits. One effective way to do this is to create some excess capacity in the network and make the capacity flexible so that it can be

used to supply different markets. This flexibility allows the business to respond to exchange rate fluctuations by altering the flow of production in the supply chain to maximize profits.

4. POLITICAL FACTORS

The political stability of the country in question plays an important role in the choice of location. Companies prefer to locate their bases in politically stable countries where the rules of trade and ownership are clearly defined. Countries have clear and independent legal systems that make companies feel they can go to the courts if they need to. This makes it easier for companies to invest in facilities in these countries. As with any factor that is difficult to quantify, a company makes a subjective assessment of this factor when designing its supply chain network.

5. INFRASTRUCTURE FACTORS

The availability of a good infrastructure is an important prerequisite for the placement of a facility in a given area. Weak infrastructure adds to the cost of doing business from a given location. Key infrastructure factors to consider when designing a network include site availability, human availability, and proximity to transport terminals, rail service, and distance from airports and seaports, road access, congestion and local utilities.

6. COMPETITIVE FACTORS

Companies must consider the strategy, size and location of their competitors when designing their supply chain networks. A fundamental decision that companies make is to locate their facilities near or far from their competitors. The form of competition and factors such as the source of raw materials or labor influence this decision.

- ***Positive externalities between firms***

Positive externalities are situations where the common position of some firms benefits all. Positive externalities lead to closer competitors. For example, gas stations and retail stores tend to be located close to each other as this increases overall demand, thereby benefiting all parties. By moving together into one mall, competing retail stores make it easier for customers who need only one place to find everything they're looking for. This increases the total number of customers visiting the mall, increasing demand for all the stores located there. Another example of a positive externality is when the presence of a competitor leads to the development of appropriate infrastructure in a developing region.

- **Locating to split the market**

When there is no positive externality, the company positions itself as able to occupy as much of the market as possible. When companies don't control prices but compete for distance with customers, they can maximize their market share by being close to each other and dividing the market.

7. CUSTOMER RESPONSE TIME AND LOCAL PRESENCE

Companies targeting customers who value short response times should be close to them. For example, if customers have to travel a long distance to reach a convenience store, they are less likely to come to the convenience store. Therefore, it is better for chain convenience stores to distribute many stores in one area, so that most people have a convenience store nearby. Instead, customers buy a lot of products in the supermarket and are willing to travel long distances to get there. Therefore, supermarket chains tend to have larger stores than convenience stores and are not so densely distributed. There are fewer supermarkets in most cities than convenience stores. Discounts are offered to target customers who are less time-sensitive. These stores are even bigger than supermarkets, and there are fewer in one area.

If the company has delivered products to customers, you can create facilities with less use of fast transport and still provides short response times. However, this option raises the cost of transport. In addition, there are many situations in which the existence of facilities close to customers is important. For example, the cafeteria can attract clients that live near or to work. Instead, fast transport modes are used and used to attract customers away from the cafeteria.

8. LOGISTICS AND FACILITY COSTS

The logistics and facilities costs generated in the supply chain vary depending on the number of facilities, location and capacity allocation. Companies must consider inventory, transportation, and facility costs when designing their supply chain network.

Inventory and facility costs increase as the number of facilities in the supply chain increases. Transportation costs decrease as the number of vehicles increases. If the number of installations increases to the point where economies of scale are lost, transportation costs will increase.

The design of the supply chain network is also influenced by the transformation that occurs at each facility. In cases where the weight or volume of ingredients is significantly reduced due to processing, it may be advisable to locate facilities closer to the source of the material than to the customer.

Total logistics costs are the total costs of inventory, transportation, and installation. The number of installations in the supply chain network should be at least equal to the number that minimizes total logistics costs. Businesses can increase installs beyond this time to improve response times for their customers. This decision is justified if the increased revenue resulting from the improved response outweighs the increased costs of the additional facilities.

Optimization is widely used to create the best production plan or find the shortest delivery route. At the strategic planning level, it is used to find the best way to establish a supply chain network, such as

- how many warehouses should a company have?
- The location and size of each warehouse?
- Distribution of products in each warehouse?
- Inventory management for each warehouse?
- How to manage purchasing activities?
- What customer received what product from where?

After collecting the above data, you need to create a basic model and verify it. The output of the model (such as total cost) should be almost the same as in actual operations management. Only after the basic model has been successfully verified can you create and compare possible alternatives to help you reduce costs or increase profitability.

Because optimization software generally runs proprietary algorithms, it is difficult to make true comparisons except for other product features, user interfaces, and computational time.

Therefore, the key to success of supply chain network design projects lies in experienced consultants who can help you collect high-quality data, validate models, and propose alternative supply chain structures that are critical to your international business.

14.6 SUMMARY

- The goal of network design is to maximize the long-term profitability of the supply chain. The process begins with defining the supply chain strategy, which must be consistent with the company's competitive strategy. Supply chain strategy, regional demand, cost, infrastructure, and competitive environment are used to define the configuration of regional facilities. For the area where the facility is located, select a potentially attractive location based on the infrastructure available. The best configuration is determined from the potential sites according to the needs of different markets, logistics costs, factor costs, and profit margins. Use optimized facility location and capacity allocation decisions.
- Network design decisions include determining facility functions, locations, and capabilities, and allocating markets served by different facilities. These decisions define the physical constraints that the network must operate as market conditions change. Good network design decisions will increase supply chain profits, while poor network design will hurt profits.
- Network design decisions are influenced by strategic, technological, macroeconomic, political, infrastructure, competitive, and operational factors.

- Supply Chain Network Design (SCND), also known as "strategic supply chain planning", is the process of constructing and modelling a supply chain to understand the cost and time of delivering goods and services to the market within the organization's available resources.
- SCND covers all movement and storage of raw materials, work-in-process inventory and finished products from the place of origin to the place of consumption. Covers the planning, implementation and control of supply chain operations.

14.7 SAMPLE QUESTIONS

- What are the different roles played in network design in supply chain management?
- What are different roles played by production facilities within a global network?
- What are the factors influencing network design decisions in supply chain management?
- What are the goals for designing a network in supply chain management?

14.8 REFERENCES

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2. Supply Chain Management (Strategy, planning and operation) – Sunil Chopra, Peter Meindl, D.V. Kalra – [Pearson, 3rd edition]



MODULE IX: NETWORK DESIGN IN SUPPLY CHAIN

15

FRAMEWORK FOR NETWORK DESIGN AND MODELS

Unit Structure:

- 15.0 Objectives
- 15.1 Framework for network design decisions
 - 15.1.1 PHASE 1: DEFINE A SUPPLY CHAIN STRATEGY/DESIGN
 - 15.1.2 PHASE 2: DEFINE THE REGIONAL FACILITY CONFIGURATION
 - 15.1.3 PHASE 3: SELECT A SET OF DESIRABLE POTENTIAL SITES
 - 15.1.4 PHASE 4: LOCATION CHOICES
- 15.2 Models for Facility Location and Capacity Allocation
 - 15.2.1 Network Optimization Models
 - 15.2.2 Gravity Location Models
 - 15.2.3 Network Optimization Models
- 15.3 Role of IT in Network Design
- 15.4 Network Design Decisions in Practice
- 15.5 Summary
- 15.6 Sample Questions
- 15.7 References

15.0 LEARNING OBJECTIVES

After reading this chapter, you will be able to:

1. Develop a framework for making network design decisions.
2. Use optimization for facility location and capacity allocation decisions

In this Chapter, we establish a framework and discuss various solution methodologies for network design decisions in a supply chain. We will see for different models for facility as well as capacity allocation and finally we will see what is the role of IT in the network design decisions.

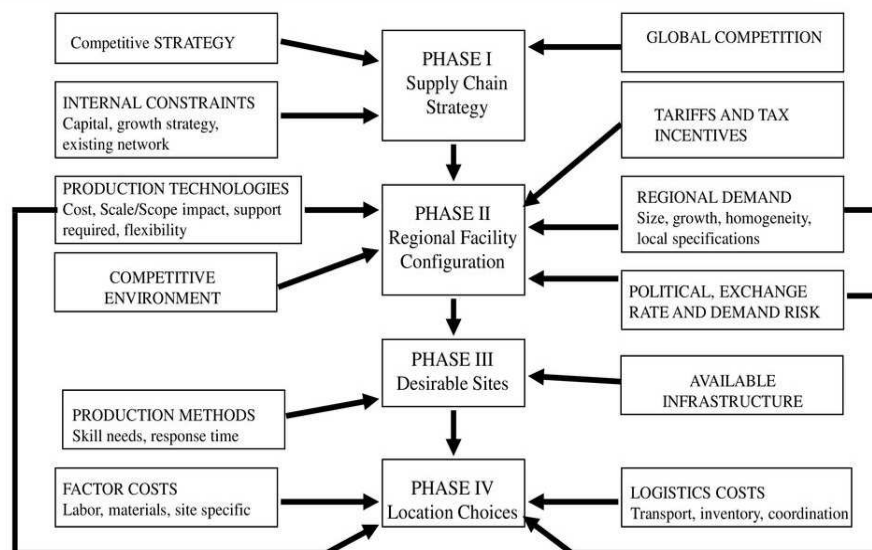
15.1 FRAMEWORK FOR NETWORK DESIGN DECISIONS

The goal of designing the supply chain network is to maximize the company's profits while satisfying the needs of customers in terms of demand and response. In order to design an effective network, the administrator must consider all the factors described in the previous chapter, as well as those discussed in the previous modules.

A supply chain network can be strategically designed to reduce supply chain costs; Experts have suggested that 80% of supply chain costs are determined by the location of facilities and the flow of product between facilities. The supply chain network design is sometimes referred to as a "network model". Companies have had to change their underlying supply chains, investing in tools and resources to develop an improved SCN design that takes into account tax regulations, new entrants to their industry and the availability of resources, led to more complex network designs. The SCN involves the creation of a combined network of all production facilities, products and transport assets belonging to the organization or those that do not belong to the organization but support the immediate operations of the chain. supply and flow of products. The design should also include details of the number and location of facilities: factories, warehouses and supply facilities. Thus, it can be said that an SCN design is a combination of capacity and nodes of capability, connected by pathways that help products move between facilities.

Global network design decisions are made in four stages, as shown in the figure below. We describe now each stage in more detail.

A Framework for Network Design Decisions



15.1.1 PHASE 1: DEFINE A SUPPLY CHAIN STRATEGY/DESIGN

The goal of the first phase of network design is to define the overall design of a company's supply chain. This includes defining the stages of the supply chain and whether each function in the supply chain will be performed in-house or outsourced.

The stage I have started with a clear definition of the competitive strategy of the company, as the requirements of customers aimed for the supply chain to the satisfaction. The Supply Chain Strategy will then specify which functions in which the supply chain network must support the competitive strategy. Next, the managers have to predict the development of global competitiveness, and whether opponents will be local or global players in every market. Managers also need to recognize capital restrictions, and whether growth is made by the purchase of existing facilities, the construction of new or cooperative institutions. Based on the competitive strategy of the company, the result is a supply chain strategy, a competitive analysis, any economies of scale or scope, and any constraints, managers must determine the supply chain design for the firm.

At this stage, the decision is mainly made by the management. The decision to be made treats these parts as long-term forecasts and implies that if something goes wrong, the price of the goods will be very expensive. It is very important to study market conditions at this stage.

These decisions take into account current and future market conditions. They understand the structural design of the supply chain. Once the design is ready, the tasks and responsibilities of each person are listed.

All strategic decisions are made by superiors or senior management. These decisions include deciding on the manufacturing materials, the factory location, what should make it easier for the carrier to load the materials and deliver them to the location they mentioned, the warehouse location to store finished goods or merchandise, etc.

15.1.2 PHASE 2: DEFINE THE REGIONAL FACILITY CONFIGURATION

The goal of the second phase of network design is to determine the areas where facilities are located, their potential roles, and their approximate capacity. The analysis of the second stage starts with the forecast of demand by country/region. The forecast should include a measurement of the scale of demand, as well as determining whether customer demand is homogeneous or variable in different countries.

Homogeneous requirements are conducive to large and comprehensive facilities, while requirements from different countries are conducive to smaller and more localized facilities.

The next step is for managers to determine whether economies of scale or scope can play an important role in reducing costs with available production technologies. If economies of scale or scope are important, it may be better to have a few facilities that serve many markets. For example, considering economies of scale in production, semiconductor manufacturers like Advanced Micro Devices have few factories in their global markets. If the economies of scale or scope are not significant, it may be better for each market to have its own facilities.

Next, managers must identify demand risks, foreign exchange risks, and political risks associated with different regional markets. They must also determine the regional tariffs, local production requirements, tax incentives, and import and export restrictions for each market. Tax information is used to determine the best place to extract most of the profits. Generally speaking, it is best to get the most profit where the tax rate is the lowest.

Managers must identify competitors in each region and discuss whether the facilities should be close to or far from the competitor's facilities. It is also necessary to determine the response time required for each market and the overall logistics cost of each region.

Based on all this information, managers use the network design model discussed in the next section to determine the configuration of the regional facilities of the supply chain network. The locale defines the approximate number of installations on the network, the area where the installations will be installed, and whether the installation produces all products for a given market or some products for all markets on the network.

15.1.3 PHASE 3: SELECT A SET OF DESIRABLE POTENTIAL SITES

In Phase III, we identify some potentially desirable sites within each region defined in Phase II.

For each area defined in the second stage, we define a list of potential sites based on the "availability of infrastructure" and other "soft" factors:

- "Available infrastructure": access to suppliers, transportation services, communications, public services, and warehouses facilities.

- "Soft" factors: availability of skilled labour, acceptance by the community.

The goal of the third stage is to select a set of ideal potential locations in each area to establish facilities. The site should be selected based on an analysis of the availability of infrastructure to support the required production method. Physical infrastructure requirements include

the availability of providers, transportation services, communications, utilities, and storage infrastructure. Soft infrastructure requirements include the availability of skilled labor, labor mobility, and community acceptance of businesses and industries.

15.1.4 PHASE 4: LOCATION CHOICES

The goal of the fourth phase is to select the precise location and capacity allocation for each facility. Attention is limited to the potential ideal locations selected in the third stage. The network aims to maximize total profit by considering the expected profit and demand of each market, various logistics and facility costs, and taxes and fees for each location.

15.2 MODELS FOR FACILITY LOCATION AND CAPACITY ALLOCATION

Decisions about the distribution system are a strategic issue for almost all companies. The problem of locating facilities and distributing to customers covers the core components of the power distribution system design. Industrial companies must find manufacturing and assembly plants and warehouses. The store must be located near the retail store. The ability to manufacture and sell your products depends in part on the location of the facility. Similarly, government agencies must determine the location of offices, schools, hospitals, fire stations, etc. In any case, the quality of service depends on the location of the facility relative to other facilities.

When locating facilities and allocating capacity, the manager's goal should be to maximize the overall profitability of the resulting supply chain network while providing customers with sufficient responsiveness. Revenue comes from the sale of products, while costs come from facilities, labor, transportation, materials, and inventory. Company profits are also affected by taxes and fees. Ideally, when designing the supply chain network, the after-tax profit should be maximized.

Managers must consider many trade-offs during network design. For example, building many facilities for the local market may reduce transportation costs and provide quick response times, but will increase the company's facility and inventory costs. Managers use the network design model in two different situations.

- First, these models are used to determine the location of the facilities and the capacity assigned to each facility. Managers must consider the period of time during which location and capacity will not change (usually in years) to make this decision.
- Second, these models are used to map current demand to available facilities and determine the transportation channels through which products will pass. As demand, prices, exchange rates, and expenses change, managers should consider this decision at least once a year.

In both cases, the goal is to maximize profits while meeting customer needs.

The following information ideally is available in making the design decision:

- Location of supply sources and markets
- Location of potential facility sites
- Demand forecast by market
- Facility, labor, and material costs by site
- Transportation costs between each pair of sites
- Inventory costs by site and as a function of quantity
- Sale price of product in different regions
- Taxes and tariffs
- Desired response time and other service factors

Given this information, a gravity model or a network optimization model can be used to design the network. We organize the models according to the stages of the network design framework where each model may be useful.

15.2.1 Network Optimization Models

In Phase II of the network design framework, the administrator considers regional needs, tariffs, economies of scale, and composite factor costs in deciding where to place facilities. For example, consider a company that manufactures products with worldwide sales. The VP of Supply Chain may consider a number of different options to meet demand. One possibility is to create a structure in each region. The advantage of such an approach is that it reduces shipping costs and also avoids taxes that may be imposed if the product is imported from other regions. The downside to this approach is that factories are sized to meet local needs and may not be able to fully exploit economies of scale. Another approach is to group factories in just a few regions. This improves economies of scale but increases transport costs and taxes. In Phase II, management must consider these quantifiable trade-offs as well as non-quantifiable factors such as the competitive environment and political risk.

The network optimization model is useful for managers considering area setup in the second stage. The first step is to collect data in a form that can be used in quantitative models.

Fixed and variable costs associated with facilities, transportation, and inventory at each facility. Fixed costs are those that are incurred regardless of the quantity produced or shipped from a facility. Variable costs are costs that are incurred relative to the quantity produced or shipped from a given facility. Installation, transportation, and inventory costs generally exhibit economies of scale, and marginal costs decrease as the amount of production in a facility increases. However, in the models

we review, all variable costs increase linearly with the quantity produced or shipped.

Then we will discuss the capacitated plant location model to see what the cheapest network will look like:

The Capacitated Plant Location Model

Plant/ facility location is a key decision in supply chain network planning, where its variations are brought by considering the capacity of the plant to be located as un-capacitated/ capacitated in nature thus to fulfil the demands originated at market points. The installed capacity of a production unit is often constrained by various factors like land and construction cost, labor cost, raw material availability and other regulations applicable at that location. The monthly fixed costs (location costs) of the different locations and also the transportation costs have to be well estimated by the cross functional team comprising of Finance, Production and Supply Chain personnel.

A capacitated plant location network optimization model requires the following inputs:

n = number of potential factory locations / capacity (each capacity level will be counted as a separate location)

m = number of markets or demand sites

D_j – annual demand from market j

K_i - the potential production capacity of the factory i

f_i - the annual fixed cost of keeping the factory i in operation

C_{ij} = the cost of production and the cost of transportation from factory i to market j (cost includes production, inventory, transportation and customs)
The goal of the supply chain team is to determine a network design that maximizes after-tax profits. However, for the sake of simplicity, we assume that all needs must be met and income tax is ignored. Therefore, the model focuses on minimizing the cost of meeting global demand.

The capacitated plant location model is a generalization of the transportation model we introduced in the section Developing a Set-Based Transportation Model. The capacitated plant location problem allows greater latitude of decision making in that the points of origin (plant locations) are variable.

15.2.2 Gravity Location Models

The manager determines the company's decision to establish potential locations for factories in each region. It is useful for identifying suitable geographic locations within a range. The gravity model is used to

find the location where the cost of transporting raw materials from suppliers and finished products to the service market is minimized. The model also assumes that transportation costs increase linearly with the number of transportations.

A company may consider investing in new facilities for a variety of reasons, such as increasing the production capacity of existing products, or expanding its product range by introducing new products, or using existing and / or new products to enter new ones. markets. product. Here, facility refers to the smallest production entity that manufactures a single product (or at most a single series of products). However, a factory refers to a group of facilities in the same location, so it generally produces several goods. Therefore, if a new facility is built at this location, it may mean expansion of the existing factory; otherwise, it will be necessary to open new factories. In many investment projects, decisions about the location and scale of new facilities to be built are interrelated because the cost of acquiring capacity is location dependent. A typical example is investing in new facilities on an international scale, and governments of various countries provide subsidized financing and low tax rates to attract multinational companies to set up production plants in their countries. In this case, it is obvious that not only the fixed costs incurred by opening a new facility at a specific site, but also the capacity acquisition costs that vary with the size of the new facility are site-specific.

In the third stage, the manager determines the potential locations where the company decides to build factories in each region. As a preliminary step, the administrator should determine that the geographic location of potential sites can be considered. The gravity position model can be used to identify the appropriate geographic location in the area. The gravity model is used to find the location where the cost of transporting raw materials from suppliers and finished products to the service market is minimized.

The gravity model assumes that both markets and sources of supply can be positioned as grid points on the plane. All distances are calculated as the geometric distance between two points on the plane. These models also assume that transportation costs increase linearly with the number of transports.

15.2.3 Network Optimization Models

Supply chain network optimization seeks to find the best combination of factories and distribution centres in the supply chain. The solution must match supply and demand and find the lowest cost network configuration. Based on the optimization results, managers can compare potential network designs and assess the maximum profitability of each design.

In phase IV, the manager decides on the location and capacity allocation for each installation. In addition to determining the location of

the facilities, the manager also decides how to award the contract to the facilities. This attribution must take into account the limitations of customer service on response times. Demand allocation decisions can be changed frequently as costs change and the market evolves. When designing a network, placement and allocation decisions are made together.

- **Allocating Demand to Production facilities**

Companies must decide how to allocate the demand to their production facilities as demand and costs change. The demand allocation problem can be solved using a demand allocation model. The goal is to allocate the demand from different markets to the various plants to minimize the total cost of facilities, transportation, and inventory.

- **Locating Plants: The Capacitated Plant Location Model**

The problem of choosing the optimal location and allocating power is very similar to the problem of region configuration that we studied in phase II. The only difference is that instead of using costs and fees that apply to an area, we now use location-specific costs and fees. Therefore, the supply chain team decided to use the capacity factory location model discussed earlier to solve the phase IV problem.

Ideally, the problem should be formulated to maximize total profits taking into account costs, taxes, and duties by location. Given that taxes and duties do not vary between locations, the supply chain team decides to locate factories and then allocate demand to the open factories to minimize the total cost of facilities, transportation, and inventory.

- **Locating Plants: The Capacitated Plant Location Model with Single Sourcing**

In some cases, the company wants to design a supply chain network where the market is supplied by a single factory, called a single source. Enterprises can impose this restriction because it reduces the complexity of network coordination and requires less flexibility from each installation.

- **Locating Plants and Warehouses Simultaneously**

A much more general form of the plant location model needs to be considered if the entire supply chain network from the supplier to the customer is to be designed. Multiple warehouses may be used to satisfy demand at a market and multiple factories may be used to replenish warehouses. The goal is to identify plant and warehouse locations as well as quantities shipped between various points that minimize the total fixed and variable costs.

15.3 ROLE OF IT IN NETWORK DESIGN

Although it may seem at first glance that the strategic nature of a network design problem makes a computer system less valuable, a good computer system can greatly improve a network designer's abilities. Although the basic models are the same, the problems in practice tend to be much larger. For much larger problems, there are four ways that computer systems can help design networks instead of using a general-purpose tool like Excel:

1. A good IT network design system makes it easier to model network design problems than in general tools such as Excel. These applications have many built-in tools to facilitate accurate descriptions of large supply chain networks, combined with real-world functions that are time-consuming and difficult to build in Excel.
2. The IT system contains high-performance optimization technology that can provide high-quality solutions to large-scale problems in a reasonable time. Although the Excel's solver can be upgraded, in many cases the scale and complexity of the optimization requires more complex systems than network design applications can provide.
3. A good network design application also allows analysis of different "what if" scenarios. Given the uncertainty associated with forecasting, the ability to evaluate network designs under a variety of scenarios is a very powerful tool for a designer. A network designer may find it much more appropriate to choose a design that works very well in many possible scenarios than a design that is optimal in one scenario but poorly in another. The ease of modeling and speed of the solution allow a good network design application to facilitate simulation analysis to a much greater extent than a general-purpose tool like Excel.
4. Finally, network design applications are structured to easily interface with business planning and operations software, which contains most of the actual data required for network design. Ease of communication with the data source speeds up the creation and resolution of network design models.

Network design applications are usually quite cheap compared to the other computing applications we are discussing. Network design applications, sometimes called supply chain strategy modules, are often added for free to much more expensive planning and execution modules. In fact, many companies have rights to these products without even realizing it, as a result of past software purchases.

However, there are some caveats regarding the use of computer systems in network design. Network design decisions are strategic and involve many factors that are difficult to quantify. When using a network

design tool, it is easy to fall into the trap of allowing the application to make decisions based only on quantifiable aspects. Important factors such as culture, quality of life issues, and difficult-to-manage coordination costs for IT can be very important in making network design decisions. Therefore, relevant unidentifiable factors should be included in the output of the computer system when making decisions on network design.

Software companies that produce network design software fall into three groups.

- The first are the large enterprise resource planning (ERP) companies that currently dominate the software space of the supply chain. The two giants here are SAP and Oracle.
- Some of the best supply chain providers have also outlived the profitability of ERP providers in recent years.
- Finally, there is a group of small businesses that focus exclusively on network design or supply chain strategy. These companies are more of a consulting company than a pure software company.

In general, although network design is not as closely related to IT as many other supply chain areas we discussed, you can still benefit from the power of IT at a relatively low cost.

15.4 NETWORK DESIGN DECISIONS IN PRACTICE

Managers should keep the following issues in mind when making network design decisions for a supply chain:

- Do not underestimate the longevity of installations.

It is important to think about the long-term consequences of facility decisions, as facilities last a long time and have a lasting impact on a company's operations. Managers must consider not only future needs and costs, but also scenarios where technology may change. Otherwise, the installation could become unnecessary within a few years. For example, an insurance company moved its office workers from a downtown location to a suburban location to cut costs. With increasing automation, the need for office manpower decreased drastically and within a few years installation was no longer necessary. The company struggled to sell the facility because it was far from residential areas and the airport. In most supply chains, the production facility is more difficult to change than the storage facility. Supply chain network designers must consider that any factories they place will be there for a decade or more. Warehouses or storage facilities, especially those that do not belong to the company, can be changed within one year of the decision.

- Don't ignore the cultural impact.

Network design decisions about facility location and role have a significant impact on the culture of individual facilities and businesses. The culture of one facility will be influenced by other facilities nearby.

Network designers can use this fact to influence the role of the new facility and the direction of the people who work there. The location of a facility has a significant impact on the level and form of communication that develops within the supply chain network. Setting up a facility far from headquarters will likely give it a more autonomous culture. This can be beneficial if the business is starting a new division that needs to operate in a different way from the rest of the business. On the other hand, merging two facilities is likely to promote communication between them. In-depth communication can be very helpful if decisions made at one facility or another have a significant impact on the performance of another.

- Don't ignore the quality of life issues.

Quality of life at certain facilities has a significant impact on performance as it affects workforce availability and morale. In many cases, a business can choose a more expensive location if it offers a much better quality of life. Failure to do so could have serious consequences. For example, an airline supplier decided to move an entire department to an area with a lower standard of living to reduce costs. However, most marketing teams refuse to relocate. As a result, relationships with customers deteriorated and the company went through a very difficult transition. The cost reduction effort harmed the company and effectively limited its position as a major player in its market.

- Pay attention to cost and tax incentives when choosing a site.

Managers deciding on the location of facilities should carefully consider fees and tax incentives. When considering international locations, it is surprising that the frequency with which tax incentives drive location selection usually exceeds the sum of all other cost factors. For example, Ireland has developed a large high-tech industry that attracts low-tax companies. Even within the country, when a company decides to set up facilities within its jurisdiction, local governments can offer preferential low or no tax and free land packages. Toyota, BMW and Mercedes have chosen the location of their factories in the United States, in large part because of the tax incentives provided by different states.

15.5 SUMMARY

- The goal of network design is to maximize the long-term profitability of the supply chain. The process begins with defining the supply chain strategy, which must be consistent with the company's competitive strategy. Supply chain strategy, regional demand, cost, infrastructure, and competitive environment are used to define the configuration of regional facilities. For the area where the facility is located, select a potentially attractive location based on the infrastructure available. The best configuration is determined from the potential sites according to the needs of different markets, logistics costs, factor costs, and

profit margins. Use optimized facility location and capacity allocation decisions.

- The gravity location model identifies a location that minimizes inbound and outbound transportation costs. They are simple to implement but do not take into account other important costs. Network optimization models can include contribution margin, taxes, tariffs, incidentals, shipping and inventory and are used to maximize profits. These models are useful when locating facilities, allocating capacity to facilities, and awarding contracts to facilities.
- Network design applications are usually quite cheap compared to the other computing applications we are discussing. Network design applications, sometimes called supply chain strategy modules, are often added for free to much more expensive planning and execution modules. In fact, many companies have rights to these products without even realizing it, as a result of past software purchases.
- Important factors such as culture, quality of life issues, and difficult-to-manage coordination costs for IT can be very important in making network design decisions. Therefore, relevant unidentifiable factors should be included in the output of the computer system when making decisions on network design.

15.6 SAMPLE QUESTIONS

- Consider a firm, with very few production facilities worldwide. List the pros and cons of this approach and why it may or may not be suitable for the computer industry?
- Consider a firm, with more than 150 facilities worldwide. List the pros and cons of having many facilities?
- Explain the framework for network design?
- What is the role of IT in network design in supply chain management?
- Explain the network design in practice?

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