UNIT 3
Freight Management and Material Handling

3.0 Unit Overview & Description:

This unit gives information about the role of transportation and its related aspects such as cost, storage, handling of goods in logistic supply chain management.

Knowledge and Skills Outcome:

The unit is expected to impart the following knowledge and skill:

- Understand about network planning, route management in transportation
- Develops awareness relating the cost aspect off right transportation
- Provides exposure about the storage of materials and safety measures to be taken
- Enables handling of goods with loading and unloading aspects

Resource Material:

1. "Logistics Management"Satish C. Ailawadi, Rakesh Singh, Prentice' Hall of India, New Delhi.
2. "The Management of Business Logistics – A Supply Chain Perspective", Coyle, Bardi and Langley; Thomson South-Western

3. "Business Logistics/Supply Chain Management", Ronald H. Ballou, Pearson Education

4. "Logistics", David J. Bloomberg, Stephen Lemay and Joe B. Hanna; Prentice Hall of India Pvt. Ltd.

Duration:	**Total Hours 30 (Theory 10 hrs. Practical 10 hrs)**

Learning Comes:

Unit III	Logistic Transport Operation	Outcomes
3.2	Network Planning	• Explain the concept of network planning
3.3	Route Management	• Demonstrate the route management and vehicle scheduling
3.4	Hub and Spoke System	• Identify the hub and spoke model
3.5	Freight Management and Cost	• Distinguish between fixed cost and variable costs and costs involved in various means of transportation.
3.6	Material Storage and Safety Methods	• Explain the usages of storage facility and functions of storage. • Identify the safety methods to be followed while storing the goods
3.7	Staking of goods, Loading, Unloading and Handling of Goods	• Demonstrate staking of goods • Distinguish between unloading and handling of goods

Assessment Planning: (for teachers)

Unit III	Topic	Assessment Plan	Time plan	Remarks
3.2	Network Planning	Exercise: Activity Question & Answer		
3.3	Route Management	Exercise: Activity		
3.4	Hub and Spoke System	Exercise: Activity		
3.5	Freight Management and Cost	Exercise: Activity Question & Answer		
3.6	Material Storage and Safety Methods	Exercise: Question & Answer Match the following Activity		
3.7	Staking of goods, Loading, Unloading and Handling of Goods	Exercise: Activity Question & Answer		

3.1 Introduction:

Logistics is a link between the market place and the operating activity of the business with the ultimate purpose of satisfying customers. The transportation system is the physical link connecting a company's customers, raw material logistics supply chain. Hence, the transportation link permits goods to flow between various fixed points and bridges the buyer-seller gap.

Knowledge of the transportation system is fundamental to the efficient and economical operation of a company's logistics function. Transportation is the physical thread connecting the company's geographically dispersed operations. It specifies that transportation adds value to the company by creating time and place utility; the value added is the physical movement of goods to the place desired and at the time desired. Transportation is one of the most visible elements of logistics operations. It is mainly concerned with product movement and product storage.

Product movement represents that whether the product is in the form of materials, components, assemblies, work-in-process or finished goods, transportation is necessary to move it to the next stage of the manufacturing process or physically closer to the ultimate customer. Product storage is a less common function of transportation in which vehicles are used for temporary storage.

The objectives of transportation are summarized as:

1. To move product form an original location to prescribed destination, while minimizing temporal, financial and environmental resource costs.
2. To minimize expenses incurred due to loss and damage
3. To meet customer demand regarding delivery and shipment information availability.

To achieve the objectives of transportation operation in logistics we should be aware of important aspects like network planning, route management and hub-spoke system.

3.2 Network Planning:

Network planning in transportation is defined as an application of planning techniques in the operation, provision and management of facilities and services for any modes of transport to achieve safe, faster, convenience, economical and environmentally suitable movement of people and goods. It means application of planning techniques to predict future travel demand and ensuring adequate facilities and services to accomplish this demand. However, transportation management deals with transportation mode, fleet size, route selection, vehicle scheduling and freight consolidation. Transportation services include both local delivery and pick-up operations as well as over the road or trucking services. Transportation decisions include the mode of transportation, shipment size and allocation of product flow from source to sink to various transportation modes. Each transportation mode has restrictions in terms of capacity and availability. A typical network connecting people, Factories, houses, warehouses, shopping complexes is shown in Diagram 3.1

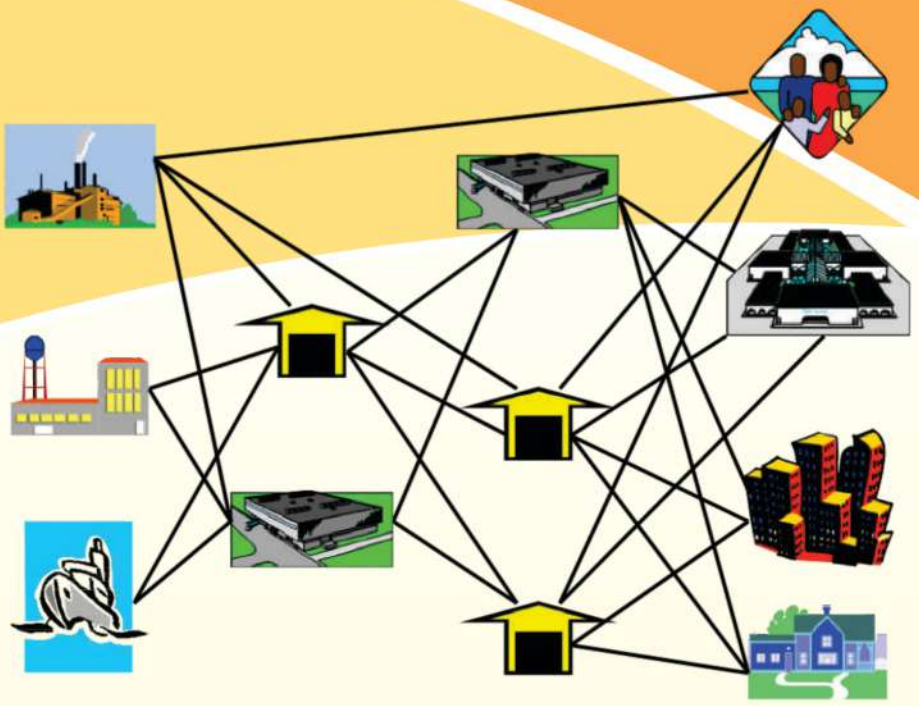

Diagram: 3.1 Typical Network Model

The transportation network planning includes three important factors such as (1) cost (2) speed of transportation i.e., transit cost and (3) consistency.

1. **Cost of Transportation:** It is the payment for movement between two geographical locations and expenses related to administration and maintaining in-transit inventory.

2. **Transit time:** It is the total time required for carrying of goods or people by vehicle from one place to another. This includes the time required for pickup and delivery for terminal handling and for movement between origin and destination terminals. Reliability refers to the consistency of the transit time a carrier provides. Shorter transit times result in lower inventories, while more dependability causes lower inventory levels or stock out costs. With a given level of lead time, a firm can minimize inventories and consequently inventory carrying costs. But if the transit time is not consistent, the firm must increase inventories above the level that a consistent transit time would require.

The market implications of reliable transit time are product differentiation and a competitive advantage in the market place. A firm can provide a customer with a shorter and more dependable transit time than its competitor, the customer can reduce inventory or stock out costs and the sales could be increased. Sales are quite sensitive to consistent service. Hence, concentration on carrier transit time and reliability to differentiate a firm's product in the market place.

- **Capability and accessibility** determine whether a particular carrier can physically perform the transport service desired. Capability refers to the carrier's ability to provide the equipment and facilities that the movement of a particular commodity requires. Equipment that can provide controlled

temperatures or humidity and special handling facilities are examples of capability factors. Thus, accessibility considers the carrier's ability to provide service over the route in question. Accessibility refers to a carrier's physical access to facilities. The geographic limits of a carrier's route network (rail lines or water ways) and the operating scope that regulatory agencies authorize constrain a carrier's accessibility.

- **Security** concerns the arrival of goods in the same condition they were in when tendered to the carrier. The unsafe carrier will adversely affect customer satisfaction and consequently sales.

3. Consistency of transportation: It refers to variations in time required to perform a specific movement over a number of shipments. Consistency is a measure of dependability of transportation. Inconsistency in transportation leads to inventory safety stocks required to protect against unpredictable service breakdowns. Speed and consistency combine to create quality aspect of transportation.

The important factors of Transport network planning can be shown (Diagram 3.2)

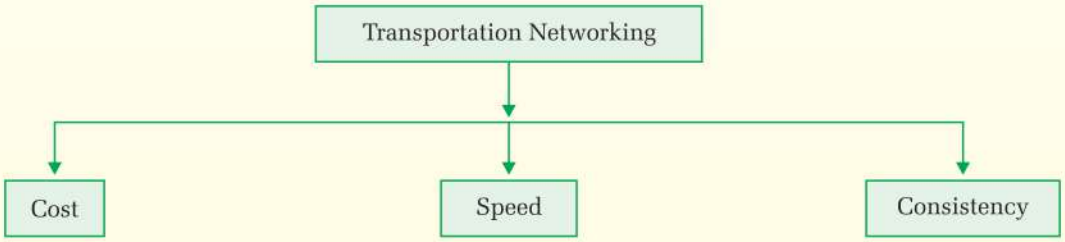

Diagram: 3.2 Factors of Transport Network Planning

Exercise

1. Analyze the role of transit time in network planning of transportation

Activity:

Prepare a questioner to check the importance of consistency in network planning of transportation

3.3 Route Management:

The transportation cost range between one-third and two-third of total logistics costs. Hence, improving efficiency through the maximum utilization of transportation equipment and personnel is a major concern. To reduce transportation costs and to improve customer service, finding the best paths that a vehicle should follow through a network of roads, rail lines, shipping lanes, or air navigational routes that will minimize time or distance is a frequent decision problem. In this context, Route Management concerns the selection of route between origins and destinations in transportation network. Routes indicate paths taken by trucks, rail, cars, buses, or individuals travelling from place to place. In route management the basic problem is due to variations in origin and destination points such as (1) separate and single origin and destination points (2) multiple origin and destination points.

1. Separate and Single Origin and Destination Points: The problem of routing has been solved by methods designed specifically for it like shortest route method. In this method a network is represented

by links and nodes. Nodes are connecting points between links. Links represent distance and time to travel between nodes, i.e. generally costs. The various shortest route methods lend themselves to computerized solution, where the network of links and nodes can be maintained in a database. By selecting particular origin and destination pairs, the shortest routes can be developed. Network route with single origin and destination is shown in Diagram 3.3

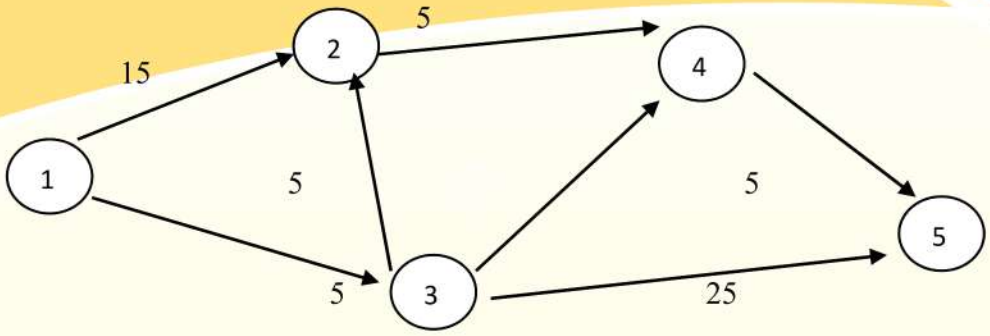

Diagram: 3.3 Network Route - Single Origin and Destination Points

In the diagram circles represent the nodes, while the arrows connecting nodes are known as links. The numbers above the arrows represent the time or cost or distance. The shortest route in the above network is 1 ⟶ 3 ⟶ 2 ⟶ 4 ⟶ 5 which costs 20 hours, if the numbers above arrow are treated as time in hours.

2. Multiple Origin and Destination Points: When there are multiple source points as well as multiple destination points there is a problem of assigning destinations to sources as well as finding the best routes between them. This problem arises when there is more than one vendor, plant, or warehouse to serve more than one customer for the same product. For this problem the transportation method is frequently applied which is a linear programming algorithm. Network route with Multiple Origin and Destination Points is shown in Diagram 3.4

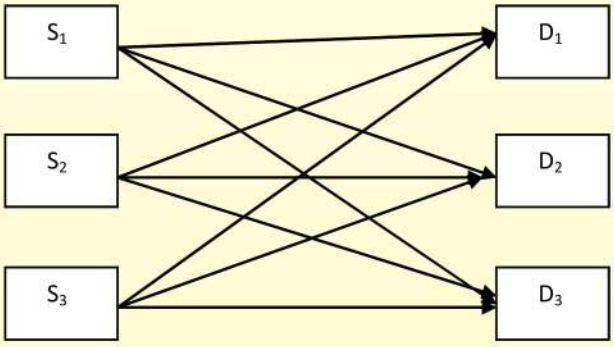

Diagram: 3.4 Network Route - Multiple Origin and Destination Points

3.3.1 Vehicle Routing and Scheduling:

Vehicle Routing and Scheduling (VRP) is basic vehicle routing problem. Some principles for good routing system are :-

1. Truck routes should be formed around clusters of stops that are nearest to each other in order to minimize the inter-stop travel between them.
2. When stops are to be served during different days of the week, the stops should be segmented into separate routing and scheduling problems for each day of the week.
3. Efficient routes can be developed through building stop clusters around the farthest stop from the depot and then working back toward the depot.
4. Stops should be sequenced, so that no route paths cross, and the route appears to have a teardrop shape.
5. Ideally, using a vehicle large enough to handle all stops in one route will minimize total distance or time traveled to serve the stops.
6. Pickups should be made as much as possible during the course of the deliveries to minimize the amount of path crossing that can occur when such stops are served after all deliveries are made.
7. Stops that are isolated from the stop clusters are served as more vehicle expense. Hence, using small trucks to handle such stops may prove be more economical.
8. Narrow stop time window restrictions should be avoided.

Activity:

- Visit the municipal corporation in your city/town/village and observe how many new routes were developed during the last five year period.
- Explain the principles of good routing system and discuss which route in your city/town/village is satisfying majority of these principles.

3.4 Hub and Spoke System:

The Hub and Spoke model is a system which makes transportation much more efficient by greatly simplifying a network of routes. It is extensively used in commercial aviation for both passengers and freight and the model has also been adopted in the technology sector.

The Hub-Spoke distribution paradigm is a system of connections arranged like a chariot wheel, in which all traffic moves along spokes connected to the hub at the center. This model is commonly used in industry particularly in transport, telecommunications and freight as well as in distributed computing. Thus, the principle of the modern intermodal transportation system is a network of intermodal terminals (including ports) that are mutually interlinked by high capacity double stack train routes and that serve as points of transfer between rail and truck modes. The principle of intermodal terminals is also called "the hub and spoke system"—terminal is the hub and highway routes to customer facilities are spokes. The Hub-Spoke system is as shown in the following Diagram 3.5

Delta Airlines pioneered the method in 1955. But, it was made popular by Fed Ex Express Company in 1970 by using this method to run the airlines. The model is named after a bicycle wheel, which has a

strong central hub with a series of connecting spokes. Routing all the traffic through the Hub actually makes the overall system more efficient.

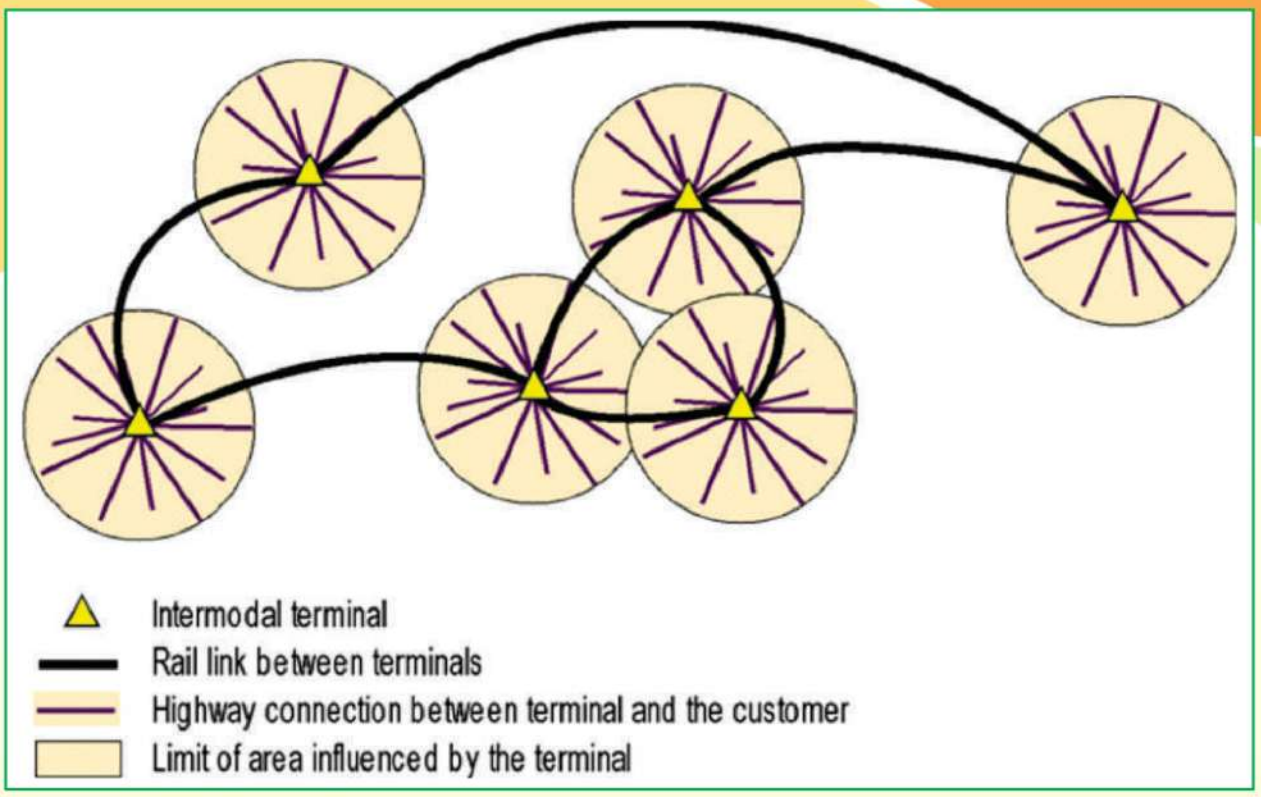

Diagram: 3.5 Hub-Spoke System

This model is also applicable to other forms of transportation as follows:

1. Sea transport, where feeder ships transport shipping containers from different ports to a central container terminal to be loaded onto larger vessel.
2. Cargo airlines; for example most UPS Airlines flights travel through its World port at Louisville International Airport, and a significant portion of Fed-Ex Express parcels are processed at its 'Super hub' at Memphis International Airport.
3. Freight rail transport, where cargo is hauled to a central exchange terminal. At the terminal, shipping containers are loaded from one freight car to another and classification yards are used to sort freight cars into trains and divide them according to varying destinations.
4. Public transit utilizes various transport hubs to allow passengers to transfer between different lines or transportation modes.
5. For passengers road transport, the spoke-hub model does not apply because drivers generally take the shortest or fastest route between two points.

Exercise

- Activity: Take any two modes of transportation and apply hub-spoke model

3.5 Freight Management and Cost:

Freight management represents the movement of product from one place to another. The dominating factor of freight management is its cost. Expenses incurred internally for private fleet of vehicles or externally for commercial or public transportation constitute financial resources. This includes expenses incurred on driver, vehicle operating cost, general and administrative costs and expenses resulting from product loss or damage. Hence, the detailed study of transportation cost is important to understand the freight management and cost. There are four basic costs in transportation.

3.5.1 Four Basic Costs in Transportation

1. **Fixed Cost:** Fixed cost is that cost which does not change with the services or volume. Fixed expenses include administrative cost of taking the transportation order, time to position the vehicle for loading or unloading, invoicing and equipment cost. These costs do not vary with the volume of shipment. In transport pricing, the costs that are constant over the normal operating volume of the carrier are fixed cost. However, in the long run all costs are variable costs.
2. **Variable Cost:** Variable cost is that cost which changes with the services or volume. If a truck is driven more miles certain costs increase proportionately. Fuel costs, wages, maintenance costs, and tire replacement depend on output. Variable costs include line-haul costs such as fuel and labour, equipment maintenance, handling and pick-up and delivery. Line-haul transportation rates are based on two important dimensions such as distance and shipper volume.
3. **Joint costs:** A joint cost occurs when the production of one product or service requires or offers the production of another product or service. For example a rail road moves goods from New York to Los Angeles (LA). It now has engines available in Los Angeles to provide back-haul service to New York or additional transportation form Los Angeles. The cost of placing the train in Los Angeles is a joint cost with the New York to LA run and whatever runs follows it. Fixed and variable costs can also be joint costs. All modes incur joint costs to some extent.
4. **Common Costs:** Common costs cannot be directly associated with a product or activity. Since this creates confusion, we normally assign activities percentages of these common costs. For example, a tractor/trailer traveling from Dallas to Chicago with three shipments breaks down and requires $5000 in repairs. How much of this repair cost should be allocated to the three different shipments? Is it based on space used, weight or both? That's the problem with common costs! In transportation, common costs are significant and are found in all modes.

3.5.2 Variable and Fixed Costs for Different Modes of Transportation:

Variable and fixed costs for different modes of transportation have been discussed below

Airlines: Airline costs are variable cost mode because they do not own their rights-of-way. Generally governmental entities own the large airports; the federal government operates the airways and airlines pay fees for the privilege of using them. Airlines pay take-off and landing fees only when they take off and land. Major fixed costs are the airplanes and salaries. Airlines also have many common costs.

Motor carriers: These carriers do not own the way, or path of travel. They are variable cost carriers. They pay user fees to offset the road maintenance costs along with other costs like fuel, driver wages and equipment maintenance. The major fixed costs are the terminals and equipment.

Pipe-lines: These are categorized as heavy fixed cost carriers. They own their right-of-way and their terminals. In fact, because of computerization, this mode is also classified as very capital intensive. Pipelines move a variety of liquid products, they have significant common costs.

Railroads: These are fixed cost carriers because they own their equipment and tracks. A significant portion of railroad cost is common because all traffic shares track replacement costs.

Water carriers: These are variable cost carriers because they do not own the waterways. The ways are not free. Water carriers pay user fees to offset the cost of channel maintenance. Its major variable costs are labour, fuel and maintenance. They also have common costs because multiple shipments often share a vessel.

The transportation cost is also influenced by the following factors:

Distance: Distance directly contributes to variable cost such as labour, fuel and maintenance. Fixed costs associated with the shipment pickup and delivery regardless of distance.

Volume: Transport cost per unit of weight decreases as load volume increases. Fixed costs of pick-up and delivery as well as administrative costs get spread over additional volumes.

Density: Density incorporates weight and space considerations. Transportation cost per unit of weight declines as product density increases. Higher density products allow relatively fixed transport costs to be spread across additional weight, as a result of which products are assessed at a lower transport cost per unit.

Stow away: It refers to product dimensions and impact of the same on vehicle space utilization. Odd sizes and shapes as well as excessive width or length do not stow well and the space is wasted. For example, items with standard rectangular shapes are much easier to stow than odd shaped items. While the steel blocks and rods have same density, rods are more difficult to stow because of their length and shape.

Handling: Special handling equipment may be required for loading or unloading trucks, trains or ships. The products are grouped such as taped, boxed or palletized which affect handling cost.

Liability: Liability refers to the product characteristics that affect the risk of damage and the resulting claims. These characteristics are susceptibility to damage, perishability, susceptibility to theft and susceptibility to combustion or explosion.

Market factors: Market factors influence transportation cost due to imbalances in manufacturing and consumption locations. Demand balance is also influenced by seasonality such as movement of fruits and vegetables to coincide with growing season. Transportation rates change with the demand directionality and seasonality.

Transport costs are also influenced by the product related factors such as density, stow away, ease or difficulty in handling and liability.

Market related factors also influence transport costs such as;

1. The degree of intra-mode and inter-mode competitions
2. The location of markets, i.e. distance to which the goods must be transported
3. The nature and extent of government regulation
4. The balance and imbalance of freight traffic in a market
5. Seasonality of product movement
6. Whether the product is being transported domestically or internationally etc.

Exercise:

1. Distinguish between fixed cost and variable cost

Activity:

Make a group of 7 students and collect examples of transportation cost related to volume, distance, stow away, density, handling, liability and market factors

3.6 Material Storage and Safety Measures

Material storage is an important part of the logistics system. Products stored in various methods include finished goods, ready for the market, semi-manufactured goods and raw materials.

3.6.1 Basic Reasons for Using Storage Space:

There are four basic reasons for using storage space such as:

1. To reduce transportation-production costs: Due to storage of materials the transportation and production costs could be reduced.
2. To coordinate supply and demand: Firms with highly seasonal production, along with reasonably constant demand have a problem of coordinating supply with demand. For example, food companies producing canned vegetables and fruits are forced to stockpile production output in order to supply the market place during the non-growing season.
3. To assist in the production process: The manufacturing of certain products such as cheeses, wines and liquors require time for aging. Hence, storage not only serves to hold the product during this manufacturing phase, but in the case, where products are taxed, to secure, or bond the product until the time of sale. The companies can delay paying taxes on the product until the product is sold.
4. To assist in the marketing process: Marketing is frequently concerned with how readily available the product is to the market place. Storage is used to put value into a product. This improved customer service through faster delivery can increase sales.

3.6.2 Functions of Storage System:

The storage system can be separated into two important functions; inventory holding (storage), and material handling.

Storage functions: Storage facilities are designed around four primary functions such as (1) Holding, (2) Consolidation, (3) Break-bulk and (4) Mixing.

1. **Holding:** The most use of storage facilities is to provide protection and the orderly holding of inventories. The facilities are different for different purposes such as long-term specialized storage (aging of liquor), general purpose merchandise storage (seasonal holding of goods), temporary holding of goods.
2. **Consolidation:** Transportation rate structure influence the use of storage facilities. If goods originate from a number of sources, it may be economical to establish a collection point to consolidate the small shipments into larger ones and to reduce overall transportation costs.
3. **Break-Bulk:** Using storage of break-bulk is the opposite of using them to consolidated shipments. For example, volume shipments having low transport rates are moved to the warehouse and then reshipped in smaller quantities. Break-bulk is common in distribution.
4. **Mixing:** Firms that purchase from a number of manufacturers to fill a portion of their product line at each of number plants may find that establishing a warehouse as a product mixing point offers transportation economies. Without a mixing point, customer orders might be filled directly from producing points at high transportation rates on small volume shipments. A mixing point permits volume shipments of portions of the product line to be collected at a single point and then assembled into orders and reshipped to customers.

However a company must pay storage system costs either through rates charged by an outside firm offering such services or through internal costs generated from the particular materials handling system in a company-controlled warehouse. There are four different systems such as public warehousing; leased warehousing, manual handling; private warehousing, pallet and forklift truck handling; and private warehousing, automated handling.

3.6.3 Safety Methods of Storage System:

There is an enormous variety of storage systems and stacking methods in use today. Materials handling equipment too is extremely diverse, ranging from hand trolleys through various types of forklift truck to sophisticated warehousing robots. Given the great diversity of goods and the wide range of storage methods and handling equipment in use, developing a safe system of work is necessary. It will integrate three main components namely people, materials and machinery within a safe and healthy working environment. Safety methods to be implemented such as

1. Adequate training and instruction for the entire workforce.
2. Comprehensive planning, incorporating the views and opinions of those who will operate the system whenever possible.
3. Adequate supervision and control.
4. Adequate information to enable the workforce to carry out their tasks in safe and healthy manner.

3.6.4 Safety Measures:

One way of covering the above said safety measures are to determine the important criteria for planning,

the provision of information, training and instruction and to set the framework for supervision and control. The important safety measures to be taken at material storage place are as explained below:

1. Floors and supporting surfaces: Floors or surfaces are required to support stocks, shelving, racks or other means of storage should be capable of sustaining the intended load together with shock loads.
2. Stock holding structures: Racks, shelving, bins, hoppers and other structures for the storage materials should be adequately designed to support and contain the materials for which they are used. Fire protective partitions should be used between stored items.
3. Positioning of stacks: Building of stacks within wall and gap between the stack and the wall should be maintained properly. Extra care should be taken, if the storage area is affected by vibration from rail or road traffic outside or inside the premises.
4. Storage racks and shelves should preferably be non-combustible and not prone to retain water.
5. Suitable means should be used to protect workers from injury due to sharp corners, projections or edges on structures and/or stored material.
6. Safe access, such as ladders, platform or walkways must be provided for workers required to climb or remove goods from stacks, shelves and fixtures.
7. Safety belts are useful aids when dealing with high stacks and awkward shapes.

Exercise

1. Describe the need of material storage
2. Match the following

1.	Mixing	a)	providing protection and holding of inventories
2.	Holding	b)	Volume shipments reshipped in smaller quantities
3.	Break-Bulk	c)	the small shipments into larger one
4.	Consolidation	d)	collected at a single point and then assembled into orders

Activity:

- Visit your nearby shop and observe the difference in storage of goods in different seasons.

3.7 Stacking of Goods, Loading, Unloading and Handling of Goods:

In any business, it is likely to involve the stacking and storage of goods and materials. Every year accidents occur while goods are being stacked or destacked and put into or taken out of storage. Many of these accidents are serious—some are fatal. Racks, shelving bins, hoppers and other structures for the storage of materials should be adequately designed to support and contain the materials for which they are used. Proper care should be made for the possibility of stored materials becoming water logged and for shock loads from placing materials or from accidental contact by handling equipment. When partitions are used to increase storage capacity, or to separate stored materials, they should be adequately designed and be of sufficient strength to contain the stored material safely. Fire-protective

partitions should be used between stored items of differing vulnerability to fire. The corners or ends of shelving and racks should be protected from damage by forklift trucks or mechanised equipment by steel posts, angle irons or other means. Diagram 3.6 shows Storage bin and Fire protective partitions.

Diagram: 3.6 Storage bin and Fire protective partitions.

The size and shape of a stack depends on the storage space available and on the size, shape, bulk, weight, rigidity or fragility of the articles to be stored. The following are the common forms of stack with respective pictures (3.7 and 3.8).

Column: Single articles placed one above the other.

Square: Any stack, other than a column, with all sides vertical.

Pyramid: A stack in which the plan area is reduced in every succeeding tier.

Diagram: 3.7 Column, Square and Pyramid Stacks

Stepped: Stacks with two or more adjacent tiers of the same area and each succeeding group of tiers of a smaller area than the group on which it is set.

Triangular: Stacks in pyramid or stepped form on two

Lean-to—Pyramid or stepped on one side and vertical on the other three sides.

Stepped Stack **Triangular Stack** **Lean-to—Pyramid Stack**

Diagram: 3.8

An important part of a warehouse, terminal, or plant is the movement of product in the facility. The formal definition of material handling is the art and science of moving, packaging and storing of substances in any form. Material handling can account for 30 to 70 percent of the cost of manufacturing. Hence, inefficient material handling leads to rise in costs. Thus, a properly installed material handling system can reduce costs and labour, increase safety, increase productivity, reduce waste, increase capacity and improve service. Some material handling tools are shown in the Diagram 3.9

Diagram: 3.9 Tools of material handling - Platform Truck and Hand Truck

Exercise:

What is meant by stacking? What are the various types of stacking?

Activity:

Go to Super market in your town and examine how different products are stacked

3.7.1 Objectives of Material Handling:

The following are objectives of material handling:

1. To increase the warehouse facility's usable capacity because utilizing as much of this space as possible minimizes the warehouse's operating cost. Many warehouses waste the vertical space by not storing goods as high as possible.
2. To reduce the number of times a company handles goods. Generally, a company moves products into a warehouse and places them in a storage area. Later moves them to an order selection area to be picked and made up into orders. And finally moves the product again to ready them for shipment to customers. During this process, many unavoidable movements may possible. Therefore, the design of any materials-handling system and its associated activities should minimize movement to, within, and from a warehouse.
3. The objective of effective working conditions has a number of significant dimensions in the logistics area, including safety. All materials-handling systems, whether in connection with logistics or manufacturing, should minimize danger to nearby workers while enhancing productivity.
4. To eliminate as much as possible short-distance warehouse movements, which are monotonous and involve heavy manual labor?
5. To improve efficiency by making the logistics system responds quickly and efficiently to plant and customer requirements.
6. To reduce cost with efficient material handling. By utilizing space more efficiently and misplacing items less frequently will lead to decreased cost.

3.7.2 Material Handling Checklist:

Material handling problems can be overcome by applying the "ten principles of material handling". Before applying these principles, it is necessary to review the material handling checklist by the material handling manager. The material handling check list is as follows:

1. Is the material handling equipment more than 10 years old?
2. Do you use a wide variety of makes and models that require high spare parts inventory?
3. Are equipment breakdowns the result of poor preventive maintenance?
4. Do the lift trucks go too far for servicing?
5. Are there excessive employee accidents due to manual handling of materials?
6. Are materials weighing more than 23 kilos (50 pounds) handled manually?
7. Are skilled employees wasting time in handling materials?
8. Does material become congested at any point?
9. Is production work delayed due to poorly scheduled delivery and removal of material?
10. Is high storage space being wasted?
11. Are high demurrage charges experienced?
12. Is material being damaged during handling?

13. Do shop trucks operate empty more than 20% of the time?
14. Does the plant have an excessive number of re-handling points?
15. Is power equipment used on jobs that could be handled by gravity?
16. Are too many pieces of equipment being used, because their scope of activity is confined?
17. Are many handling operations unnecessary?
18. Are single pieces being handled where unit loads could be used?
19. Are floors and ramps dirty and in need of repair?
20. Is handling equipment being overloaded?
21. Is there unnecessary transfer of material from one container to another?
22. Is inadequate storage areas hamper efficient scheduling of movement?
23. Is it difficult to analyze the system as there is no detailed flowchart?
24. Are indirect labour costs too high?

3.7.3 Principles of Material Handling:

With the help of above checklist the following ten principles of material handling should be analyzed.

1. **Planning Principle:** All material handling should be the result of deliberate plan where the needs, performance objectives and functional specification of the proposed methods are completely defined at the outset.
2. **Standardization Principle:** Material handling methods, equipment, controls and software should be standardized within the limits of achieving overall performance objectives and without sacrificing needed flexibility, modularity and throughput.
3. **Work Principle:** material handling work should be minimized without sacrificing productivity of the level of required of the operation
4. **Ergonomic Principle:** Human capabilities and limitations must be recognized and respected in the design of material handling tasks and equipment to ensure safe and effective operations.
5. **Unit Load Principle:** Unit loads shall be appropriately sized and configured in a way that achieves the material flow and inventory objectives at each stage in the supply chain.
6. **Space Utilization Principle:** Effective and efficient use must be made of all available space.
7. **System Principle:** Material movement and storage activities should be fully integrated to form a coordinated, operational system that spans receiving, inspection, storage, production, assembly, packing, unitizing, order selection, shipping, transportation and the handling of returns.
8. **Automation Principle:** Material handling operations should be mechanized and/or automated where feasible to improve operational efficiency, increase responsiveness,

improve consistency and predictability, decrease operating costs and eliminate repetitive or potentially unsafe manual labour.

9. **Environmental Principle:** Environmental impact and energy consumption should be considered as criteria when designing or selecting alternative equipment and material handling systems.

10. **Life Cycle Cost Principle:** A thorough economic analysis should account for the entire life cycle of all material handling equipment and resulting systems.

Material handling within storage and handling system is represented by three primary activities: loading and unloading, movement to and from storage and order filling.

3.7.4 Loading and Unloading:

Loading and unloading are two important main activities in materials-handling events. When the goods arrive at a warehouse, they must be unloaded from the transportation equipment. Unloading and movement of storage are sometimes considered as one operation. But, sometimes they are treated as separate as it requires special equipment. For example, ships are unloaded at dockside using cranes and rail hopper cars are turned upside down with mechanical unloading. However, unloading is treated as separate activity because goods may be offloaded and then sorted, inspected and classified before moving on to a storage location in the warehouse.

Loading is similar to unloading; however, several additional activities may take place at the loading point. A final check concerning order content and order sequence may be carried out before the shipment is loaded onto the transportation equipment. Loading also include an additional effort to prevent damage, such as bracing and packing the load.

Activity:

- Visit any production unit/plant nearby to you and according to the given checklist verify the material handling in that unit/plant.
- Prepare a chart of principle of material handling

Exercise

1. Explain the meaning of loading and unloading

3.8 Summary:

This unit analyses the logistic transport operation with the help of network planning, route management and hub-spoke system. The role of cost factor in transportation has been explained in detail. During the transportation process the role played by storage facilities, objectives of handling material and its related aspects, loading and unloading of goods were discussed in detail.

3.9 Test Your Understanding

1. Define the following
   a) Logistics
   b) Network planning
   c) Transit time
   d) Route management
   e) Hub-spoke system
   f) Joint costs
   g) Common costs
   h) Storage space
   i) Material handling
2. Distinguish between
   i) Single origin and destination point and multiple origin and destination point
   ii) Fixed cost and variable cost
   iii) Loading and Unloading
3. Discuss the role of transportation in logistics
4. Explain the objectives of transportation
5. Give an account of transit time in network planning of planning
6. Explain how transit time is determined by
   a) Product differentiation b) capability and accessibility c) Security
7. Describe how route management improves the quality of transportation
8. Narrate the relationship between route management and cost of transportation
9. Explain how the storage space concept is important in logistics
10. Discuss the functions of storage system
11. Brief the safety measures while storing
12. What are the objectives of material handling?
13. What are principles of material handling?
14. Match the following
    1. Fixed cost a) Cost cannot be directly associated with a product or activity

2. Variable cost b) Cost does not change with the products or services
3. Joint cost c) Cost changes with the products or services
4. Common cost d) production of one product requires the production of another product

15. State whether the following statement is true or false (with reason)
    1) Airlines are variable cost carriers
    2) Motor carriers are fixed cost carriers
    3) Pipe-lines are variable cost carriers
    4) Rail-roads are fixed cost carriers
    5) Water variables are fixed cost carriers

3.10 Practical:

1. Visit two transport offices nearest to your town and prepare a note relating to networking plan usually followed by those organizations and point out the best network among those two.
2. Based on the information obtained from the above transport offices draw the networks.
3. Collect information about four component costs in respect of two transport operators and point out the least cost operator, preparing comparative cost chart.
4. Visit super market in your town and prepare note
    (a) Relating to stacking of various products.
    (b) List the tools of handling material/products available.
    (c) On checklist of material handling.