

Role of Transportation in Supply Chain

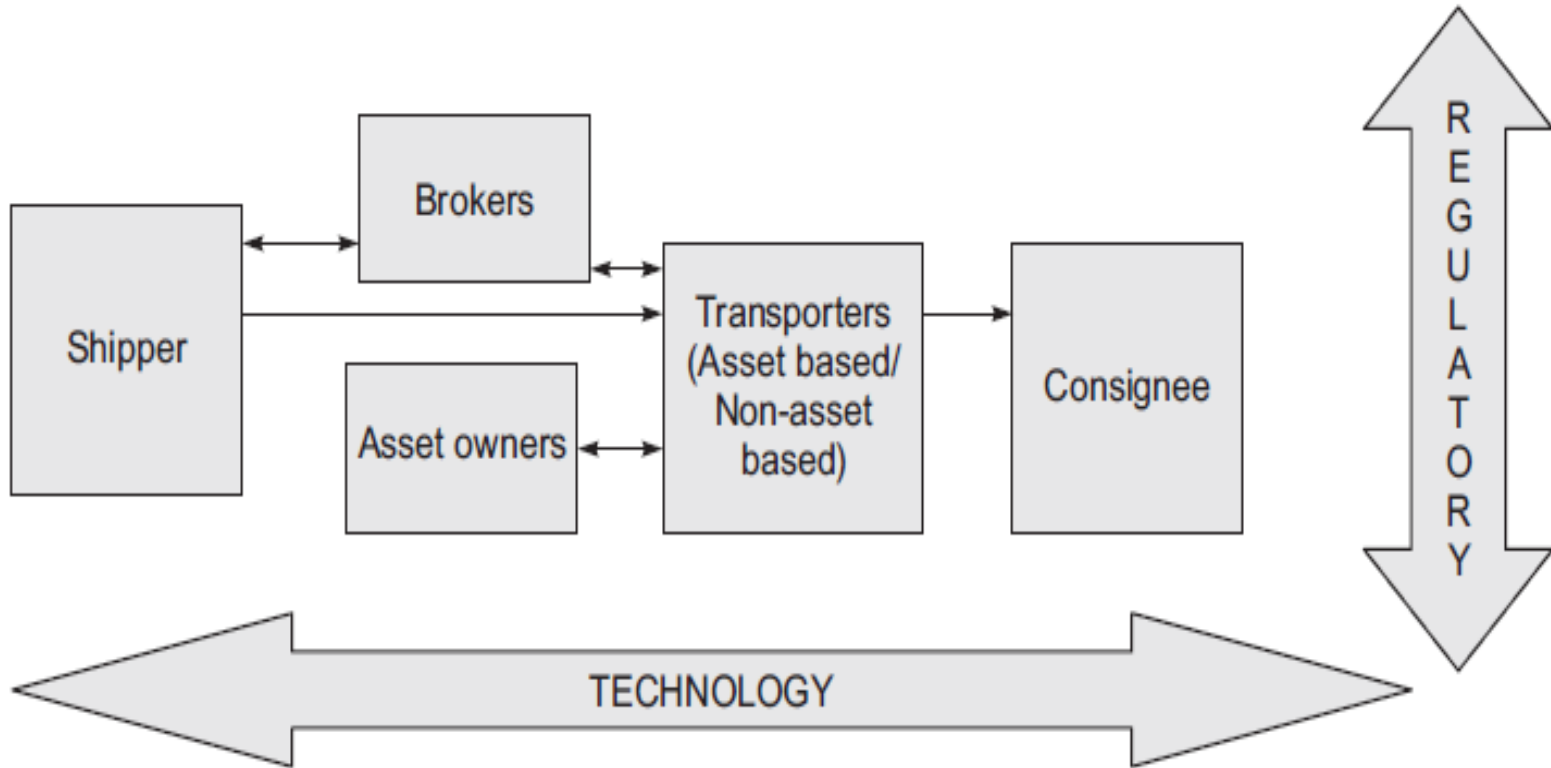
Learning objectives

- Role of transportation in the supply chain
- Key role players and factors that influence transport decision
- Transportation Modes, performance characteristics and selection
- Transportation performance, costs and value measures
- Transportation mode selection and speed of delivery and choice of mode
- Inventory aggregation and transportation cost management
- Vehicle scheduling and routing

Introduction

- Transportation interacts closely with facilities and inventory
- Key to the success for businesses especially where responsiveness and product availability are prime competitive factors
- Transportation decisions would have strategic impact through network decisions

Key Role Players



Transport Decisions

For Shipper

- *Transportation Cost:* This is calculated as the total cost paid to the transporters for inbound and outbound transportation
- *Inventory cost:* These costs are towards holding inventory in various stages of the supply
- *Facility cost:* considered as fixed for making transportation decisions.
- *Processing cost:* costs associated with loading, unloading and handling of goods.

Transport Decisions

For Transporter

- *Vehicle related costs*: costs towards the purchase or lease of a vehicle. Considered fixed for the short term and for the medium or long term these costs are considered as variable.
- *Fixed operating expenses*: Costs associated with maintaining transportation assets like insurance, taxes, labour etc.
- *Operations related expenses*: Include labour, fuel and depend on the duration of the trip
- *Quantity related costs*: costs in loading, unloading and handling.
- *Overhead costs*: Costs are incurred for planning, coordination, scheduling and any investment in IT tools and applications.

Characteristics of Transportation Modes and Selection

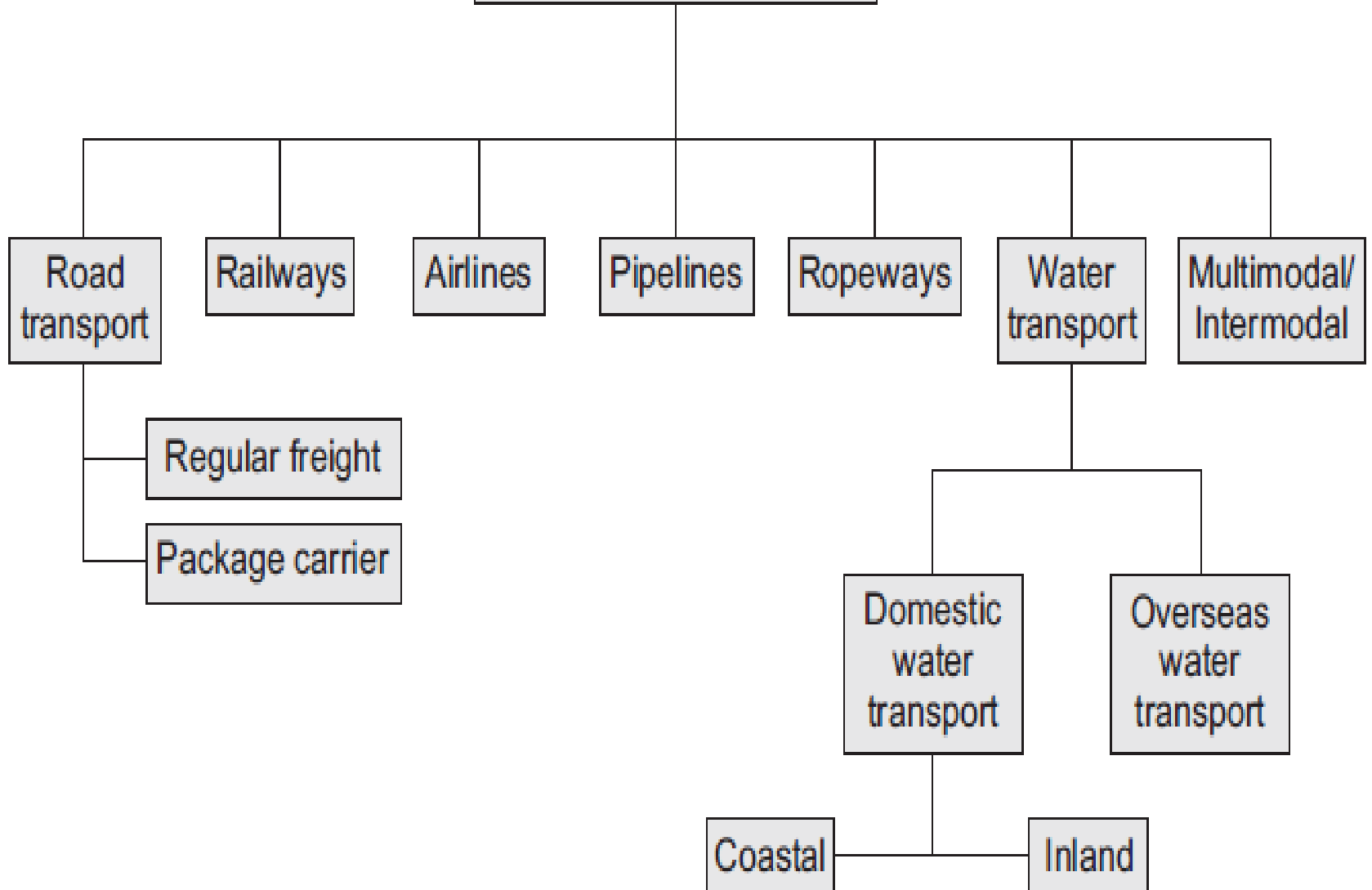
- (i) **Nature of Goods** : Low valued bulk materials obviously cannot be transported by air, rather than by road or rail transportation carriers. Likewise costly materials such as computer memory chips and diamonds are not transported by ship rather than by aircraft.
- (ii) **Access to Carriers** : Choice of transportation mode also depends on the accessibility the shipper has to the transport carriers or transportation modes.
- (iii) **Price** : Air transportation costs are far more higher than rail or road transportation costs. Road transportation costs more than rail, which in turn costs more than water–transport.
- (iv) **Transit Time** : It is the time from the shipment of the order at the place of origin to the point of receipt of goods at the destination. Transit time is a significant part of the order cycle.

- (V) **Security of Goods** : Terminals and other storage points in the integrated logistics systems may affect the safety of goods.
- (vi) **Government Regulations** : Regulations once governed every economic aspect of transportation but now regulations focus on safety even though economies may be effected because of regulations.
- (vii) **Safety** : Selection of transportation mode is often guided by safety concerns of general public as well as carrier employees who load and unload the goods. Some goods are packed from safety point of view.

Transportation Principle

- The principle of Economy of Scale - as the size of the shipment increases, the cost of weight transported per unit decreases
- The principle of Economy of Distance - the transportation cost per unit weight decreases as the transportation distance increases
- Goal - maximize the shipment size and the ship for longer distance by offering the desired service level to the customer.

Modes of Transportation



Intermodal Transportation

An appropriate mix of various modes to lower cost

- *Piggybacking or TOFC* (trailer on flatcar) - a combination of convenience and flexibility of trucking with long haul economy of rail.
- *Fishyback* - a system of transportation requiring the transfer of containers from truck to ship.
- *Birdyback* - a system of transportation requiring the transfer of containers from truck to airplane.

Comparison of various modes

Rail	High fixed cost (equipment, terminals, tracks, wagons, and so on) and low variable cost
Road	Low fixed cost and medium variable cost (fuel, maintenance, and so on)
Water	Medium fixed cost (ships and equipment) and low variable cost
Pipeline	Highest fixed cost (construction, pumping equipment) and lowest variable cost
Air	Low fixed cost (aircraft, cargo handling) and high variable cost (fuel labour, maintenance)

Transport Documentation

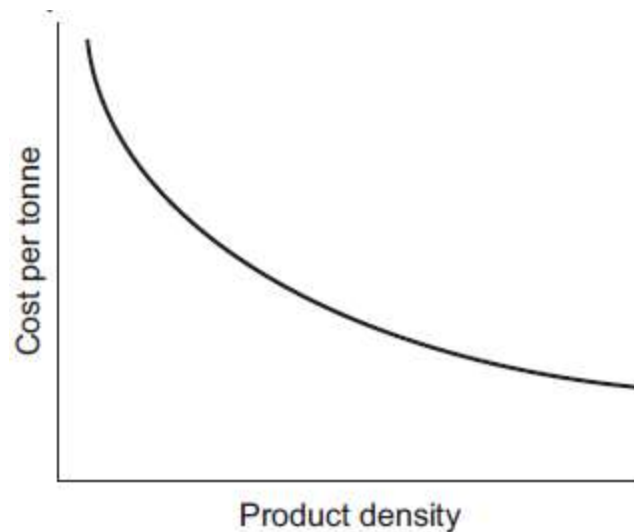
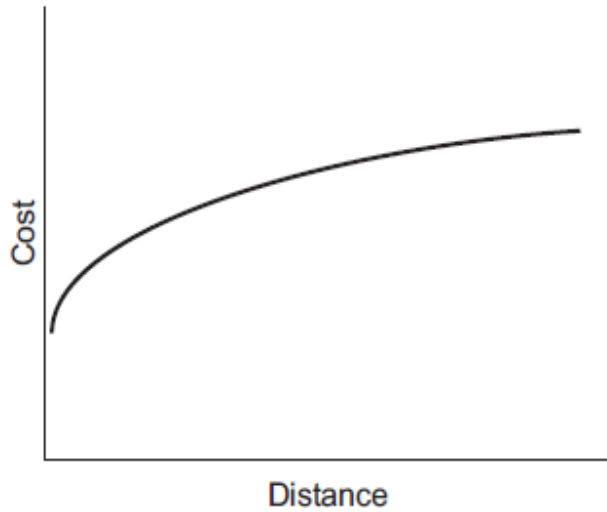
- The *bill of lading* is the basic document utilised in purchasing transport services. It serves as a receipt and documents commodities and quantities shipped. It specifies terms and conditions of carrier liability and documents responsibility for all causes of loss or damage except those defined as acts of God.
- The *freight bill* represents a carrier's method of charging for transportation services rendered. It may be either *prepaid* or *collect*.

Factors driving costs

six critical factors that drive transportation costs
are :

- distance
- Volume
- density
- Stowability
- handling
- liability

Cost relationships



Carrier pricing strategies

- *Cost-of-service* - a cost plus approach where the transporter adds a margin on base costs.
- *Value-of-service* - based on the value as perceived by the shipper.
- *Combination Pricing* - an intermediate level between the cost-of-service and the value-of-service
- *Rate contracts* - the shipper assures of specific volumes in a period of time in return for committed rates for that period with a clause for escalation in this period in case of increase in inputs like fuel.

Value added service

- COD – Collect payment on delivery
- Inside delivery
- Marking or tagging
- Notify before delivery
- Reconsignment of delivery
- Redelivery
- Residential delivery
- Sorting and segregation
- Storage

Transportation Mode Selection

The general principles for mode of transportation are:

- Match the shipment characteristic with the appropriate mode of transportation.
- Evaluate on the basis of cost
- Developing selection criteria is the final step and the modes should be evaluated on the basis of these.

Ranking of different modes

Operating characteristics	Rail	Truck	Water	Pipeline	Air
Availability	2	1	4	5	3
Capability	2	3	1	5	4
Dependability	3	2	4	1	5
Frequency	4	2	5	1	3
Speed	3	2	4	5	1

- Each has been ranked on a scale of 1 to 5 with 1 being the best option and 5 being the least desirable option

Speed of delivery and choice of mode

- A selected mode for continued support for business under strategic decision framework.
- The decision would be based on:
 - Total inventory holding cost which is a function of cycle inventory, safety inventory, in-transit inventory and annual cost of holding inventory that result from using each of alternative modes of transportation
 - Cost of transportation using each of mode

Inventory aggregation

- Aggregation would result in reduction in facility costs and inventory management cost.
- Increases transportation cost mainly because out bound transportation to each customer would be small and expensive mode like express cargo carrier.
- Works when inventory and facility form a large part of supply chain costs.
- Useful for products with high value to weight ratio and for products of with high demand uncertainty

Responsiveness

- Temporal aggregation refers to aggregating of stock dispatches over time buckets
- Depends on arriving at a balance between transportation cost and responsiveness.
- Helps to reduce transportation costs for a given nature of fixed and variable costs of transportation and distribution of demand pattern

Vehicle Scheduling and routing

Decisions situations involve:

- Number of nodes to be serviced
- Vehicle capacity
- Time window of service

Savings Matrix

The methodology of arriving at allocation of customers in a route and vehicles for all nodes to be serviced.

Approach - heuristic rather than optimality.

Steps are:

- Identify the distance matrix
- Identify the savings matrix
- Assign customers to vehicles or routes
- Sequence customers within routes

Milkrun

- Milk run is a transportation model for the collection and transportation of goods from suppliers with a defined delivery route, in which various stops are planned and executed in terms of quantities and timing. The same concept is applied in forward linkages for distribution of goods.

Milkrun

- Multiple pick-up / delivery points in a time window for a production schedule.
- Route optimization by LSP especially when load is less than the capacity of vehicle and there is scope for multiple pick – up or drop
- Effective deployment of JIT, VMI or any integrated service.

Milkrun – Variable that influence

- Distance to be covered
- Cost of running a route and adding any particular point in a route
- Priority of delivery / pick-up - regular schedules and non-regular
- Frequency depends on fixed versus variable demand / supply from each node.
- Cycle-time or longevity of a product.

Cross Docking

- A practice in transportation of unloading materials from an in-bound vehicle and loading these materials directly into outbound trucks, trailers, or rail cars.
- Little or no storage in between.
- Purpose - to combine small loads from different points and redistribute saving on dwell time, storage and costs.

Advantages

- Effective utilisation of vehicle space
- Provides responsiveness
- Reduces costs of storage and inventory and optimises transportation cost for a given service level
- In retail situation, helps for better handling of backroom storage space which stocks safety inventory

Transportation Management System (TMS)

- (i) **Mode Selection** : Transport service choices range from small air freight and ground package carriers to ocean container and rail car load movements. Multiple freight services are considered because many firms transport in multiple shipment sizes. The TMS can match shipment size with transportation service cost and performance requirements where there are competing choices involved.
- (ii) **Freight consolidation** : TMS gives suggestions regarding the patterns for consolidating small shipments into large ones:
- (iii) **Routing and scheduling shipments** : Firms owning or leasing a fleet of transport vehicles need to manage carefully efficient operation of the fleet using the order-processing information from the Order Management System (OMS) and order-processing information from the Warehouse Management System (WMS).

- (iv) **Claims Processing** : However good the transportation system be some damage to goods on some shipments can not be avoided. The process of insurance claims against transit damages, information such as shipment content, product value, carrier used, origin and destination and liability limits etc should be maintained in the TMS.
- (v) **Tracking Shipments** : Once the shipments have been transferred, to transport carriers, the process of shipments from source to destination should be tracked. Information Technology has a major role to play in tracking shipments Bar coding, Radio transmissions in route, Global Positioning System (GPS) and on-board computers are key elements of information system that allow the location of shipments to be known in real time
- (vi) **Freight bill payment and auditing** : Since carriers charge only the lowest applicable freight rate, when a rating error occurs, the shipper can make a claim for the difference between the actual charges and the lowest charges.

TMS also facilitates freight bill payment. It records that shipment has been made and requests the company's financial information system to execute payment to the carrier, often electronically.

International transportation documents

1. **Bill of Lading** : It is a key document on which freight moves. It is a *legal contract* between the shipper and the carrier for the movement of designated weight with reasonable dispatch to a specified destination, arriving damage free.

Types of Bill of Lading

- (i) Export Bill of Lading
 - (ii) Ocean Bill of Lading
 - (iii) Order Bill of Lading
 - (iv) Straight Bill of Lading
 - (v) Clean Bill of Lading
2. **Export Declaration** : This document is filed with port customs by the exporter (seller) after the buyer and seller reach an agreement to sales and credit terms.

3. **Export Licence :** Export licence is mandatory for exporting some category of goods in most of the countries in the world. Two categories of export licence are :
 - (i) *The General Licence*
 - (ii) *The validated export licence*
4. **Invoices :** The *commercial invoice* is a document which the seller uses to determine the commodity's value less freight and other charges. The *letter of credit* and the exporter's agents often require this invoice to determine the correct value for insurance purposes and for assessing import duties. A *consular invoice* is a special form of invoice required for any incoming shipments in some countries.
5. **Carnet :** A carnet is often issued when a seller makes a shipment in a sealed container. It indicates that the shipment has been sealed at its origin and will not be opened until it reaches its final destination.

6. **Certificate of origin** : A destination country that has made a treaty agreement to give favourable import duty treatment to certain goods of the exporter's country requires a *certificate of origin* which certifies that the goods originated from the exporter's country.
7. **Certificate of Insurance** : The terms of sale may require a *certificate of insurance* which will state that the buyer or seller has obtained adequate insurance to cover any losses resulting during transit.
8. **Freight Bill** : This is the document in which freight charges are mentioned where the bill of lading does not contain information about the freight charges.
9. **Airway Bill**: The *universal airway bill* is a standardized document that air carriers use on all international air shipments.
10. **Dock Receipt** : In ocean transportation, the shipping agent of the shipping company issues a dock receipt indicating the domestic carrier has delivered the shipment to the steamship company.

Risk Management in Transportation

- Three main risks to be considered in transportation are:
 - Risk that the shipment is delayed
 - Risk of disruptions
 - Risk of hazardous material
- Risk mitigation strategies:
 - Decrease the probability of disruptions
 - Alternative routings
 - In case of hazardous materials the use of modified containers, low-risk transportation models, modification of physical and chemical properties can prove to be effective