Logistics Engineering & Management

Transportation and Distribution Logistics

Planning, Modelling, and Management

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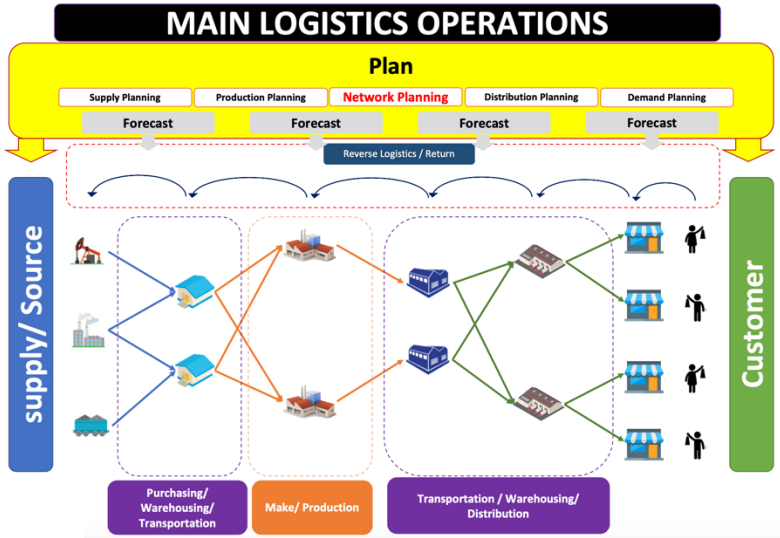
Definition

- Transport systems convey goods from the sources to the exits and sinks of a logistics, or production-network
- Transportation systems move goods between origins and destinations using vehicles and equipment such as trucks, tractors, trailers, cranes, pallets, containers, cars, and trains
- The functions performed by inbound ar



The Role of Transportation in Logistics

between 1/3 and 2/3 of total logistics costs

between 9% and 10% of the gross national product for the Europe economy

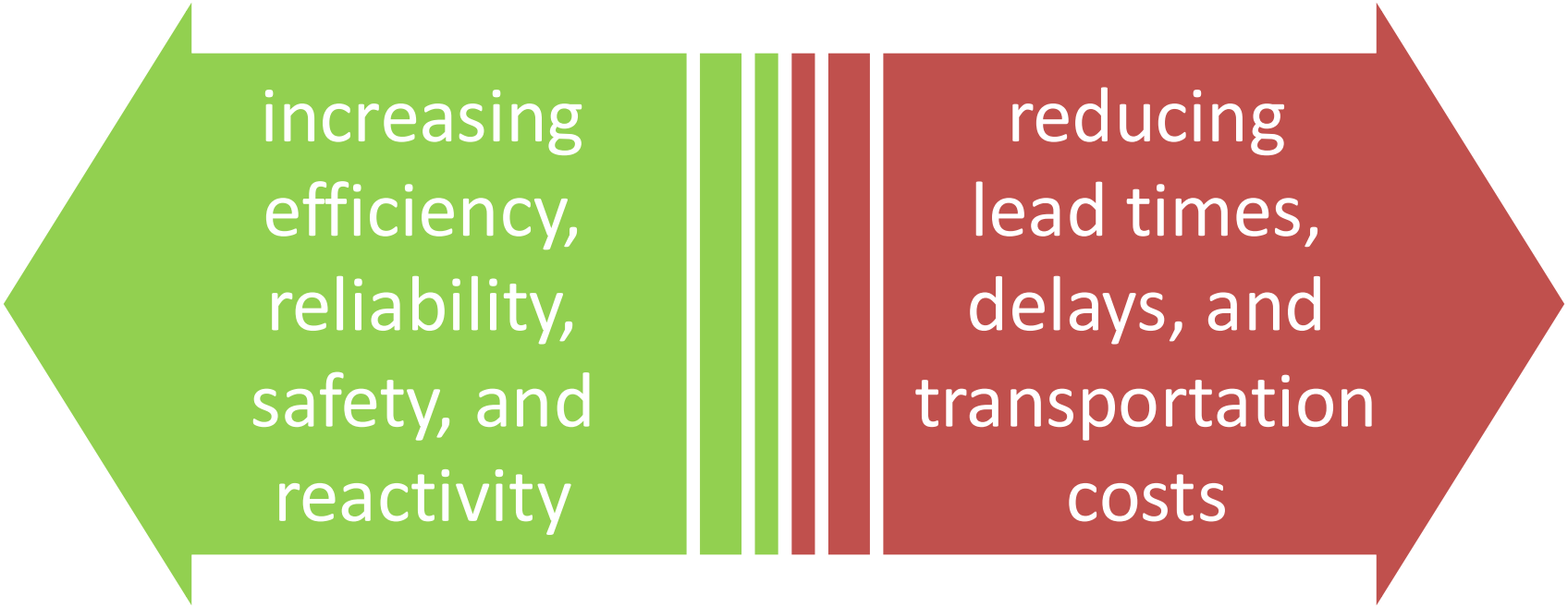
between 10% and 20% of a product's price

the most important logistics costs

The Role of Transportation in Logistics

- Firms and their products' markets are often separated geographically.
- increases the **place** utility of products
- Increasing the customers' level of satisfaction
- moving any shipment in a logistic system:
  - **Raw materials**
  - **Semi-finished products**
  - **Final goods**

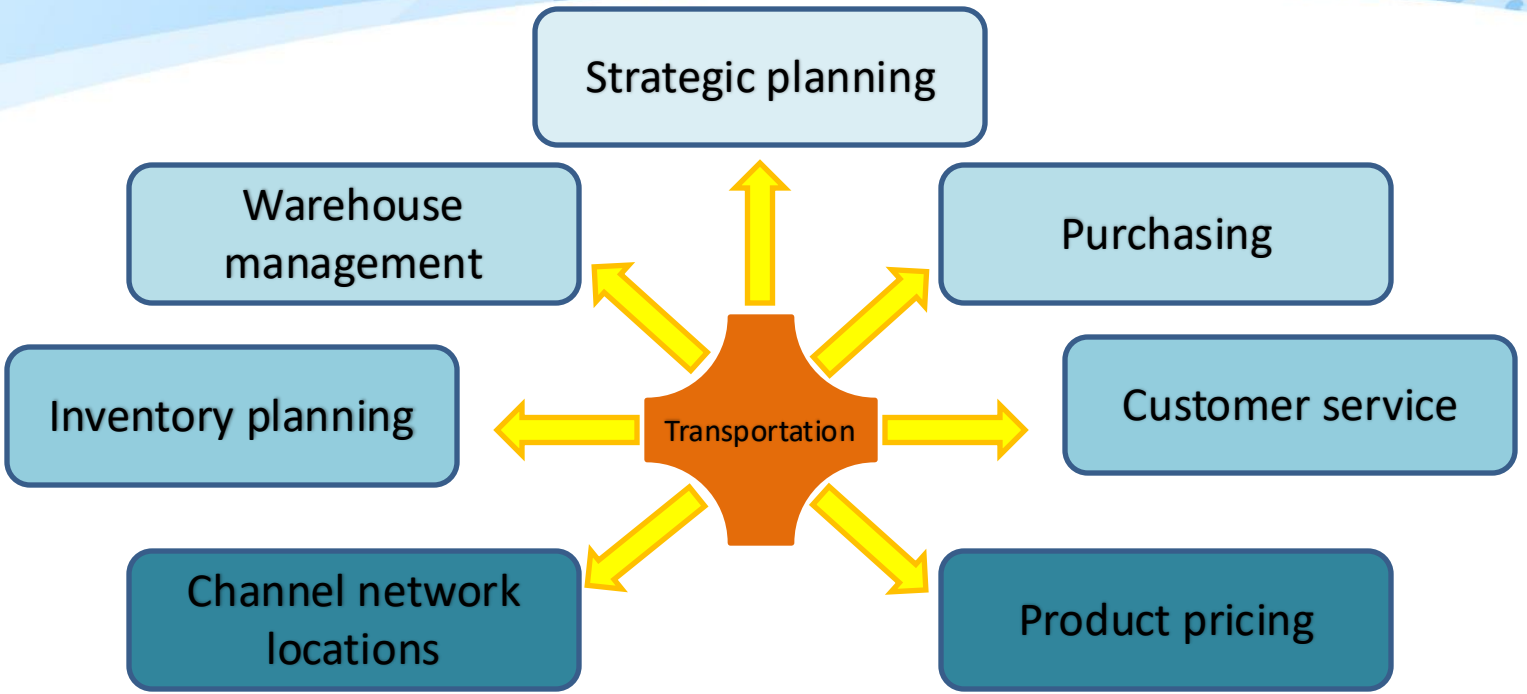
The Role of Transportation in Logistics



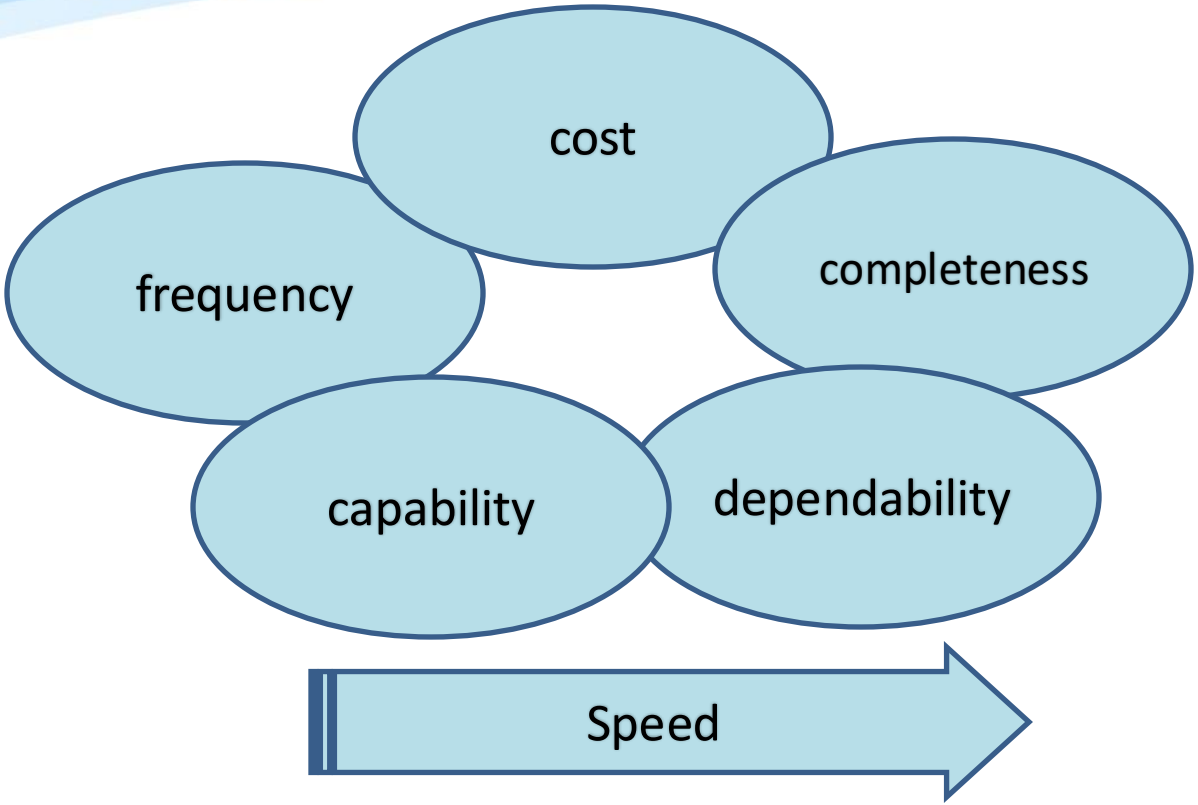
The Magnitude of Transportation

1. bridge the geographical gap
2. the growth of competition
3. economies of scale
4. lower the selling price

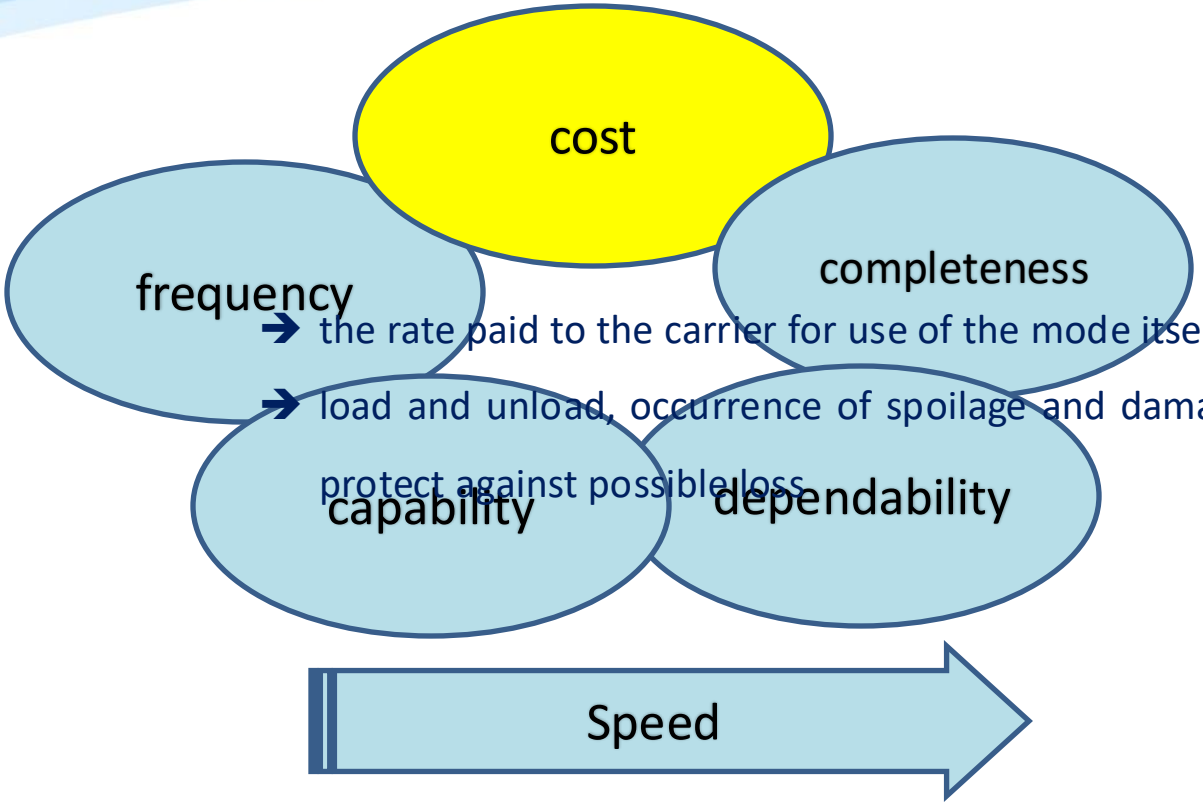
Relationship of Transportation to other Business Functions



Transportation Performance Characteristics

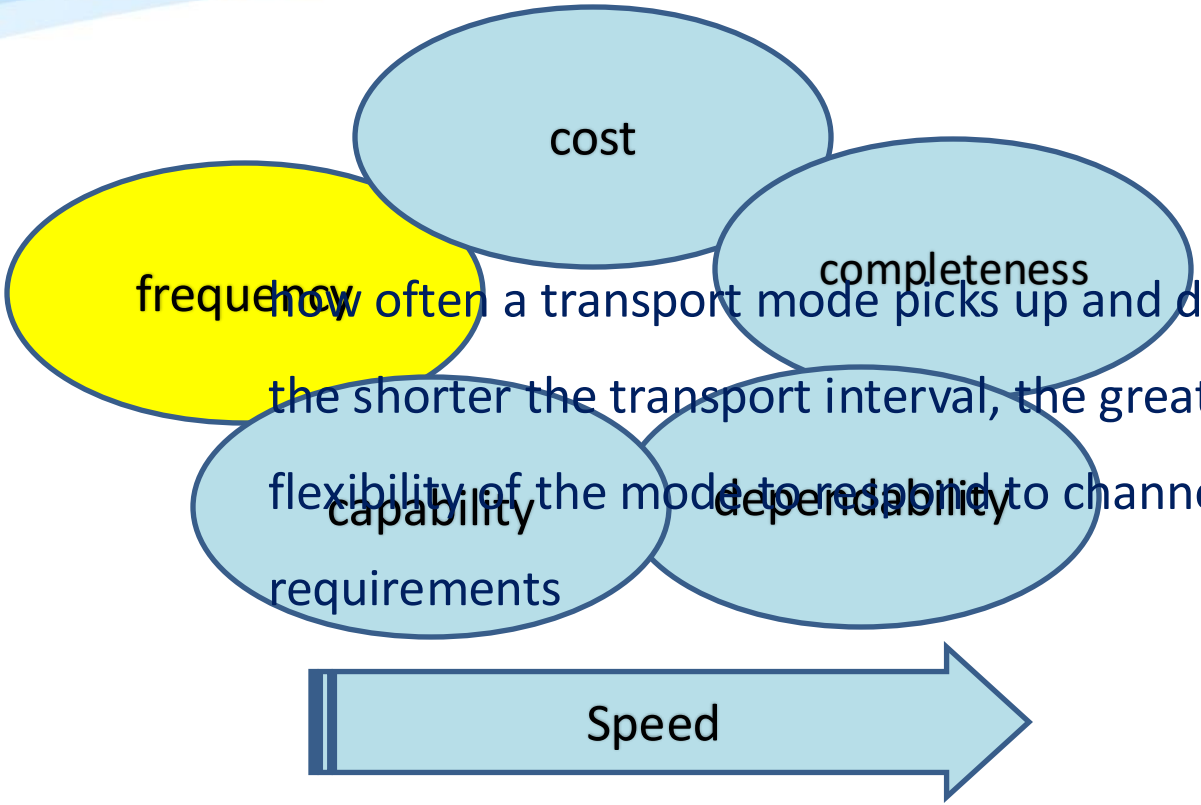


Transportation Performance Characteristics



- ➔ the rate paid to the carrier for use of the mode itself
- ➔ load and unload, occurrence of spoilage and damage, insurance to protect against possible loss

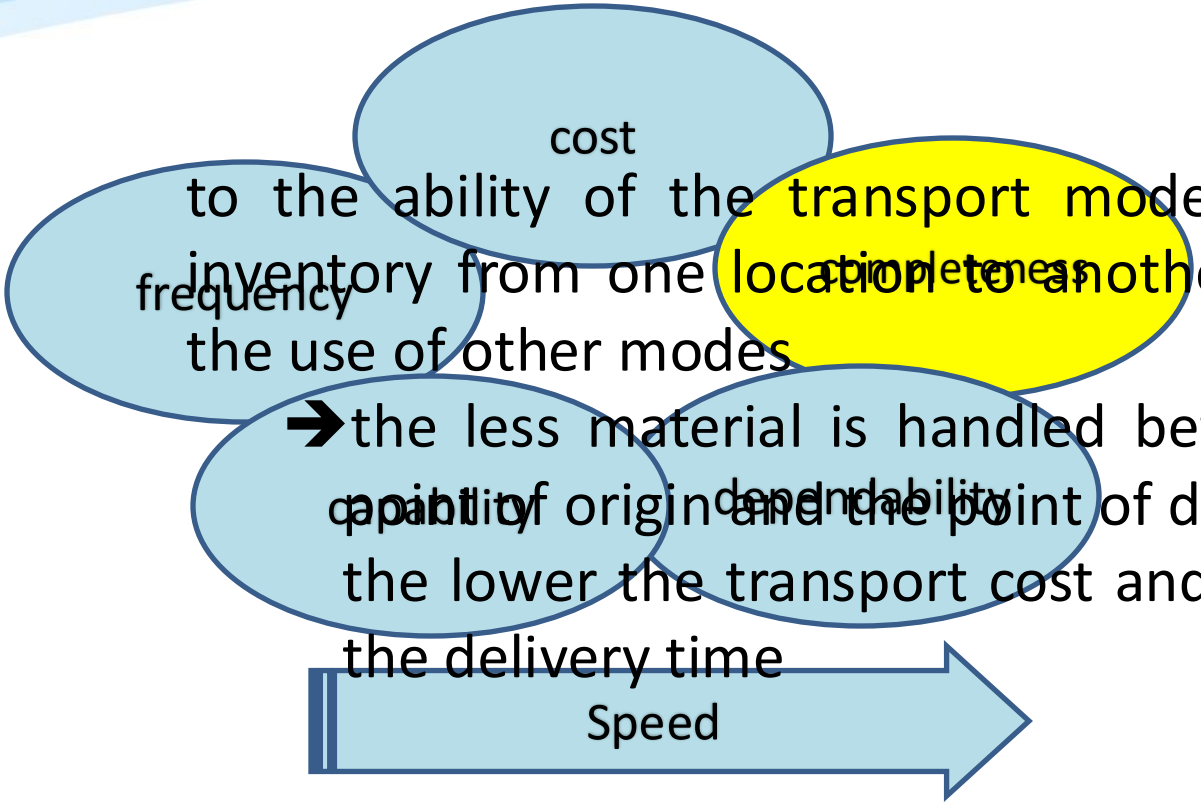
Transportation Performance Characteristics



how often a transport mode picks up and delivers goods.

the shorter the transport interval, the greater the flexibility of the mode to respond to channel requirements

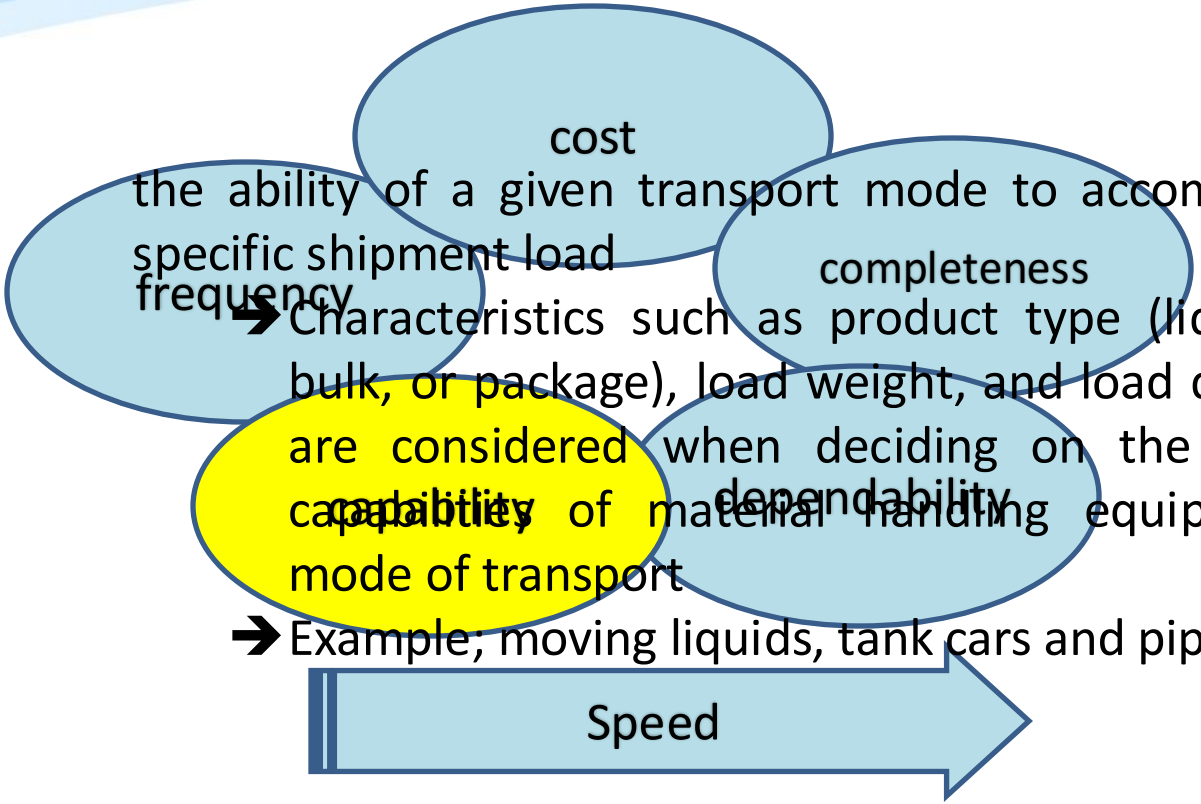
Transportation Performance Characteristics



to the ability of the transport mode to move inventory from one location to another without the use of other modes

➔the less material is handled between the point of origin and the point of destination, the lower the transport cost and the short the delivery time

Transportation Performance Characteristics

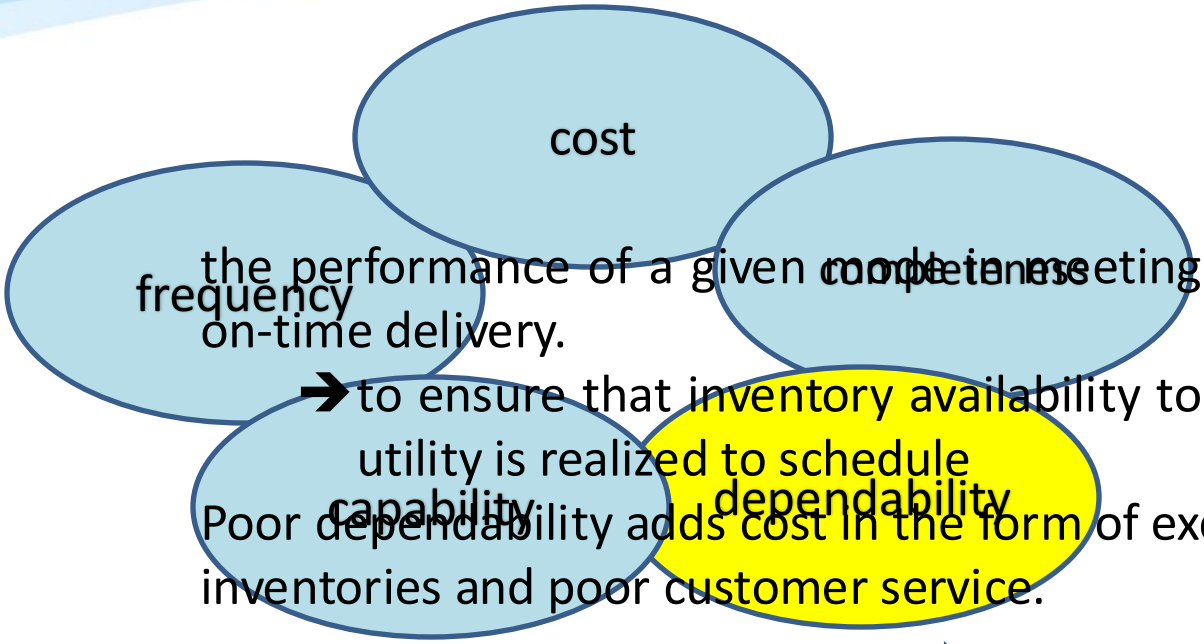


the ability of a given transport mode to accommodate a specific shipment load

➔ Characteristics such as product type (liquid, solid, bulk, or package), load weight, and load dimensions are considered when deciding on the necessary capability of material handling equipment and mode of transport

➔ Example; moving liquids, tank cars and pipelines

Transportation Performance Characteristics

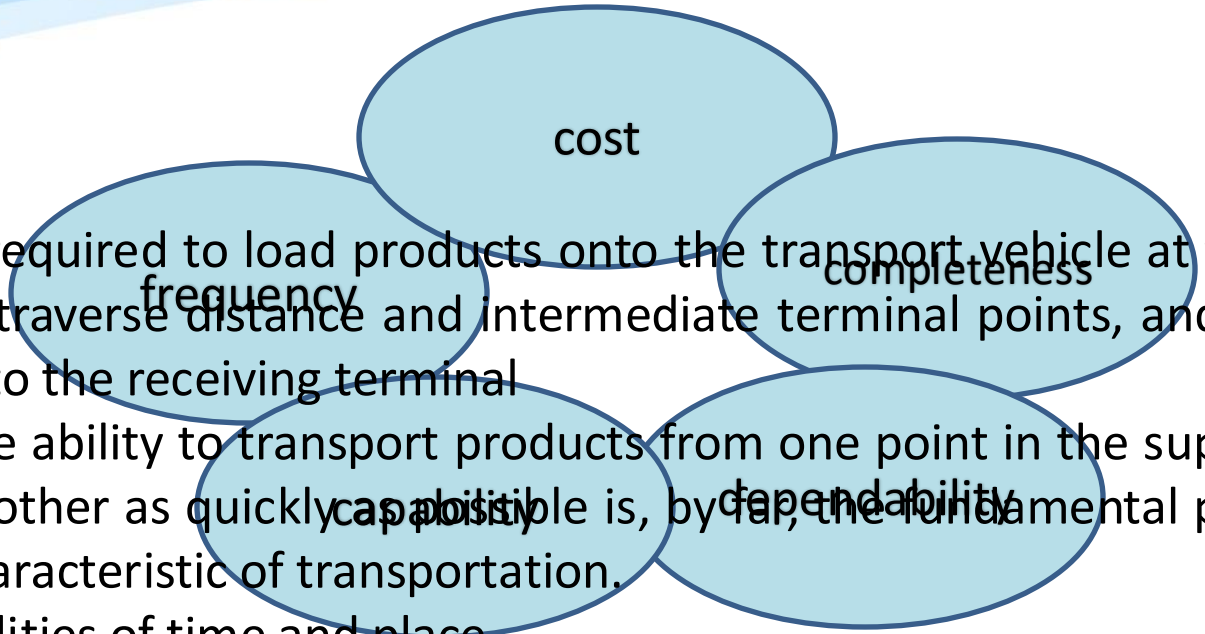


the performance of a given mode in meeting anticipated on-time delivery.

➔to ensure that inventory availability to meet place utility is realized to schedule

Poor dependability adds cost in the form of excess inventories and poor customer service.

Transportation Performance Characteristics



the time required to load products onto the transport vehicle at the shipping terminal, traverse distance and intermediate terminal points, and deliver the products to the receiving terminal

- ➔ The ability to transport products from one point in the supply chain to another as quickly as possible is, by far, the fundamental performance characteristic of transportation.
- ➔ utilities of time and place

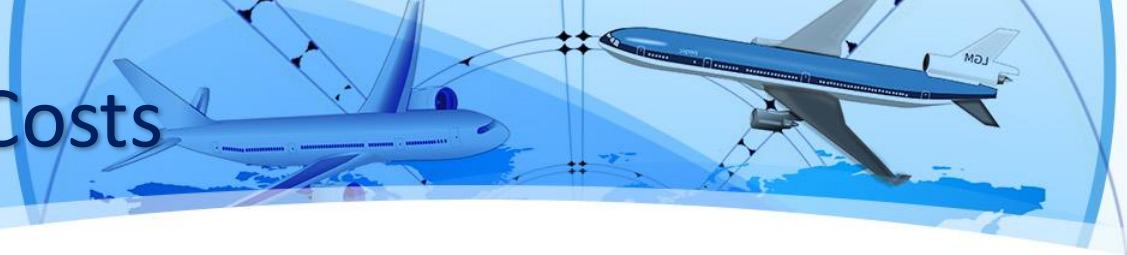
Speed

Influencing factors on the selection of Transportation type

- required delivery lead time;
- financial capacities;
- product characteristics;
- order quantity size;
- supply chain strategic goals;
- geographic size of the channel network;
- carrier-type availability;
- strength of the competition

Etc.;

Transportation Costs



motor vehicles and trailers, terminals, ports, pipelines, docking systems, rights-of-way, information systems, taxes, rents and loan interests, and materials handling equipment

fixed costs

Variable cost

arises when transportation equipment and/or services are used to make a shipment. affected by shipment volume. Examples: fuel, labor, and vehicle maintenance. These expenses are generally determined as a cost per mile or per unit of weight

Cost

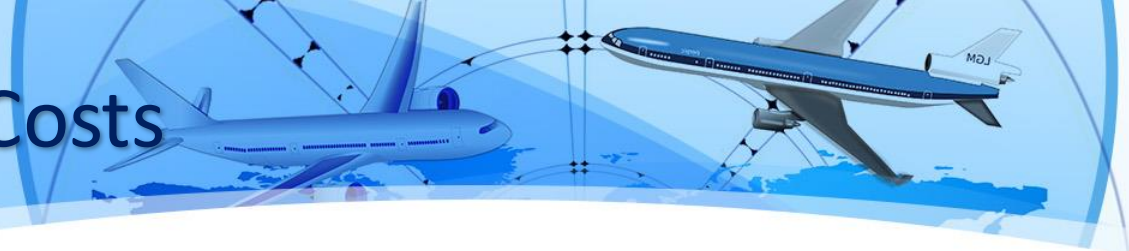
shared by the shipper and carrier to perform a certain transport service
Example: backhaul

joint cost

common costs

These are costs for equipment such as terminals, rights-of-way, and management expenses that are spread proportionally over all shippers using the service

Transportation Costs



the **volume** of the shipment

the **distance** the shipment travels from point of origin to the destination

Modes of Transportation and Their Performance Characteristics

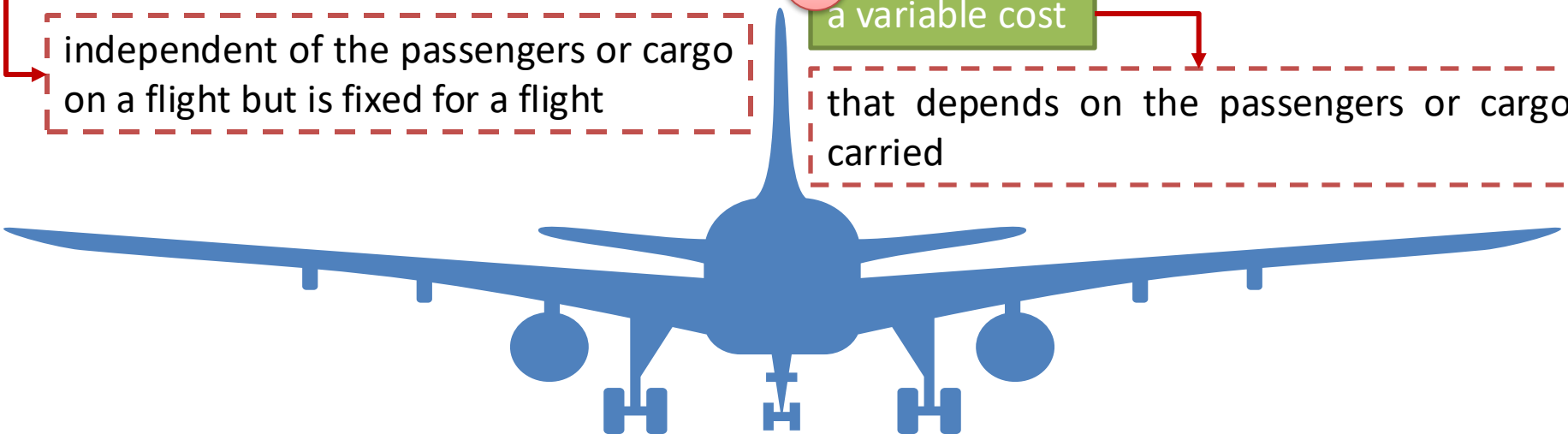
- Air
- Package carriers
- Truck
- Rail
- Water
- Pipeline
- Intermodal

Modes of Transportation and Their Performance Characteristics

Air

Airlines have three cost components:

1. cost of labor and fuel
   - independent of the passengers or cargo on a flight but is fixed for a flight
2. a fixed cost
   - infrastructure and equipment
3. a variable cost
   - that depends on the passengers or cargo carried



Modes of Transportation and Their Performance Characteristics

Air

Key issues that air carriers face include:

- identifying the location and nu
- assigning planes to routes
- setting up maintenance sched
- scheduling crews
- managing prices and availabili

Modes of Transportation and Their Performance Characteristics

Package Carriers

- Package carriers carry small packages ranging from letters to shipments weighing about 150 pounds.
- Package carriers use air, truck, and rail to transport time-critical smaller packages
- Package carriers are expensive and cannot compete with LTL carriers on price for large shipments

Modes of Transportation and Their Performance Characteristics

Package Carriers

The major service:

- rapid and reliable delivery

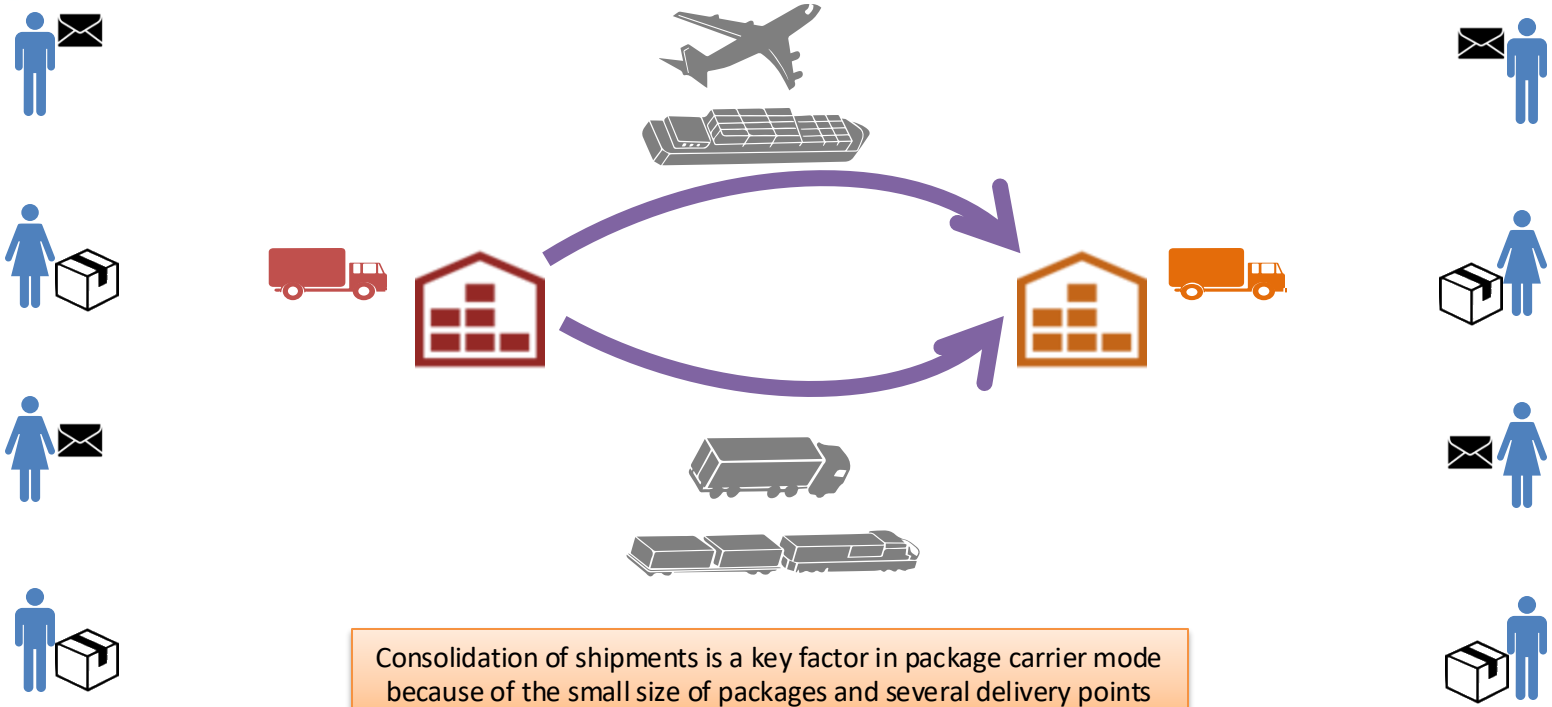
Other Services:

- package tracking and, in some cases, processing and assembly of products.
- for small and time-sensitive shipments

Preferred mode for Amazon, Gilt Groupe, W.W. Grainger and McMaster-Carr

Modes of Transportation and Their Performance Characteristics

Package Carriers



Consolidation of shipments is a key factor in package carrier mode because of the small size of packages and several delivery points

Modes of Transportation and Their Performance Characteristics

Package Carriers

Key issues in this mode:

- the location and capacity of transfer points
- information capability to facilitate and track package flow
- the scheduling and routing of the delivery trucks.

Advantages:

- increasing utilization and decreasing costs

Modes of Transportation and Their Performance Characteristics

Package Carriers

FedEx Express

UPS

UNITED STATES POSTAL SERVICE

https://www.youtube.com/watch?v=v-Q7Tmw85Xs

https://www.youtube.com/watch?v=pcsk9nEKPGM

Modes of Transportation and Their Performance Characteristics

Truck

In 2002, trucks moved 69.5 % of U.S commercial freight by value and 60.1 % by weigh.

The trucking industry consists of two major segments:

- truckload (TL)
- less than truckload (LTL)

- Trucking is more expensive than rail
- offers the advantage of door-to-door shipment
- shorter delivery time

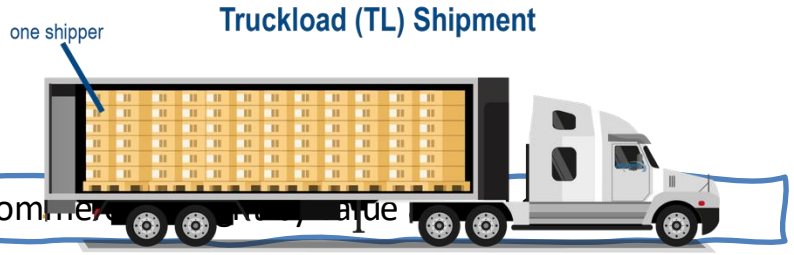
Modes of Transportation and Their Performance Characteristics

Truck

T truckload (TL) tation mode!

Proof

In 2002, trucks moved 69.5 % of U.S comme[illegible]alue



less than tru

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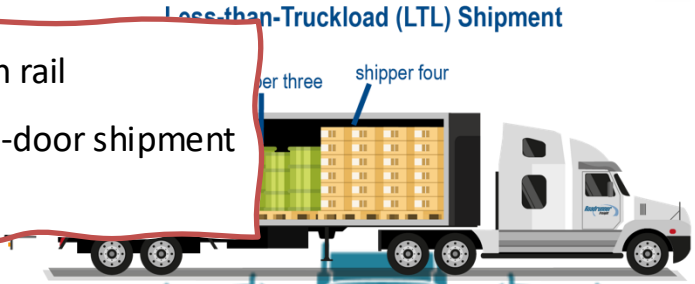


Modes of Transportation and Their Performance Characteristics

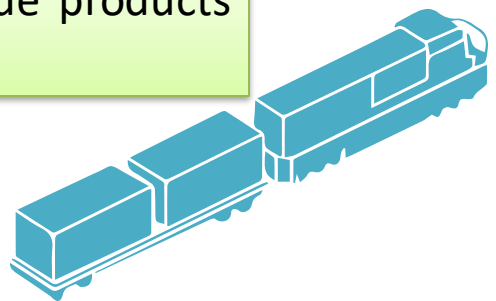
Rail

In 2002, rail carried about 3 percent of U.S. shipments by value, 10 percent by weight, and more than 30 percent of total ton-miles

move commodities over large distances
high fixed cost
Labor and fuel together account for more than 60 percent of railroad expense

an ideal mode for carrying large, heavy, or high-density, low-value products that are not time sensitive, over long distances

Transportation time is long



Modes of Transportation and Their Performance Characteristics

Rail

A major goal for railroad firms:

- keep locomotives and crews well utilized
- Labor and fuel costs

Major operational issues at railroads

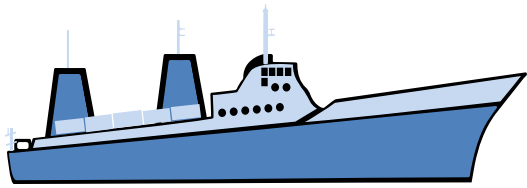
- vehicle and staff scheduling
- track and terminal delays
- poor on-time performance

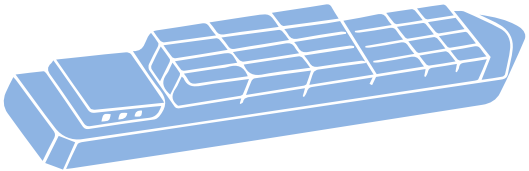
Modes of Transportation and Their Performance Characteristics

Water

Water transport is ideally suited for carrying large loads at low costs

- movement of **large bulk commodity**
- the **cheapest** mode for carrying such loads
- the **slowest** of all the modes
- significant **delays** occur at ports and terminals
- **difficult to operate** for short-haul trips





Modes of Transportation and Their Performance Characteristics

Water

For the quantities shipped and the distances involved in international trade, water transport is by far the cheapest mode of transport

major issues:

Delays at ports, customs, and security and the management of containers used, Port congestion

Modes of Transportation and Their Performance Characteristics

Pipeline

In the United States, pipeline accounted for about 16 percent of total ton-miles in 2002

Pipeline is used primarily for the transport of crude petroleum, refined petroleum products, and natural gas.

significant initial fixed cost
best suited when relatively stable and large flows are required

Modes of Transportation and Their Performance Characteristics

Pipeline

Pipeline pricing usually consists of two components:

- a fixed component related to the shipper's peak usage
- a second charge relating to the actual quantity transported >> for the predictable component of demand

Modes of Transportation and Their Performance Characteristics

Intermodals

Intermodal transportation is the use of more than one mode of transport to move a shipment to its destination

increased use of containers for shipping and the rise of global trade >>

Increasing in use of intermodal transportation

Containers >> easy to transfer from one mode to another >> facilitate intermodal transportation

Modes of Transportation and Their Performance Characteristics

Intermodals

Key issues in the intermodal industry involve the exchange of information to facilitate shipment transfers between different modes because these transfers often involve considerable delays, hurting delivery time performance

Modes of Transportation and Their Performance Characteristics

Intermodals

For global trade, intermodal is often the only option because factories and markets may not be situated next to ports

- ➔ bringing together different modes of transport to create a price/service offering that cannot be matched by any single mode
- ➔ how to facilitate the transfer of unitized loads from one form of transport to another

Modes of Transportation and Their Performance Characteristics

Intermodals

The more popular combinations are:

1. Trailer on flatcar (TOFC)
2. Container on flatcar (COFC)
3. Trailer and Tractor on flatcar
4. Roadrailers

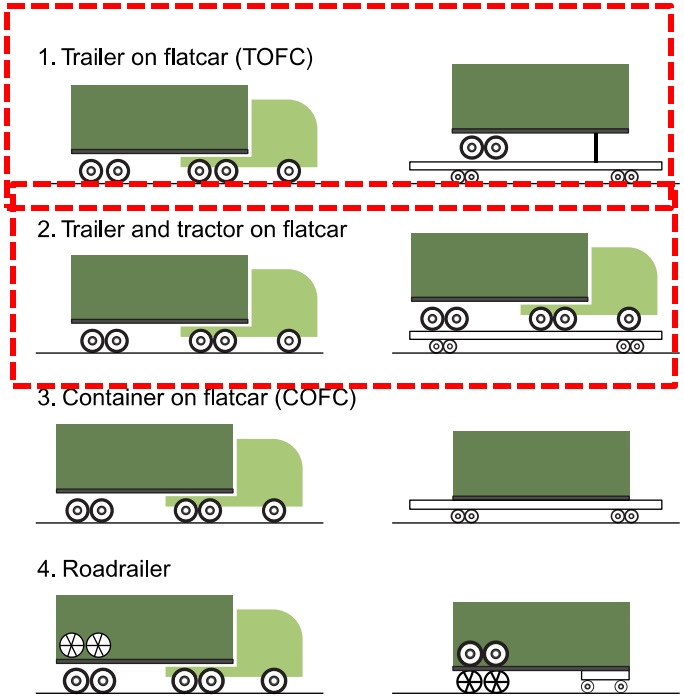
Modes of Transportation and Their Performance Characteristics

TOFC

TOFC, often called the piggyback system, is a method by which a truck trailer load is transferred in transit from the truck carrier to another transit mode without unloading and reloading product

There are several forms of TOFC systems.

- between motor carrier and rail (Piggyback)
- between motor carrier and transoceanic vessels or barge (fishyback)
- motor carrier and container
- motor carrier, container, and air (birdyback).

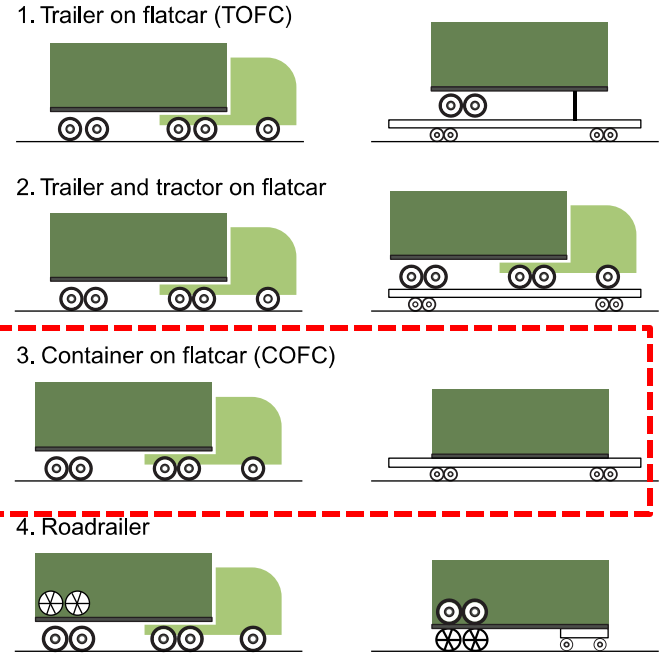


Modes of Transportation and Their Performance Characteristics

COFC

Operationally, COFC methods function similarly to TOFC methods.

Procedurally, the container(s) are first loaded onto motor flatbed trailers at the shipping point. After what is usually a short haul, the containers are then unloaded onto flatbed railcars, waterway carriers, or special air cargo planes for delivery. Upon arrival, the containers are loaded back onto motor carriers for customer delivery

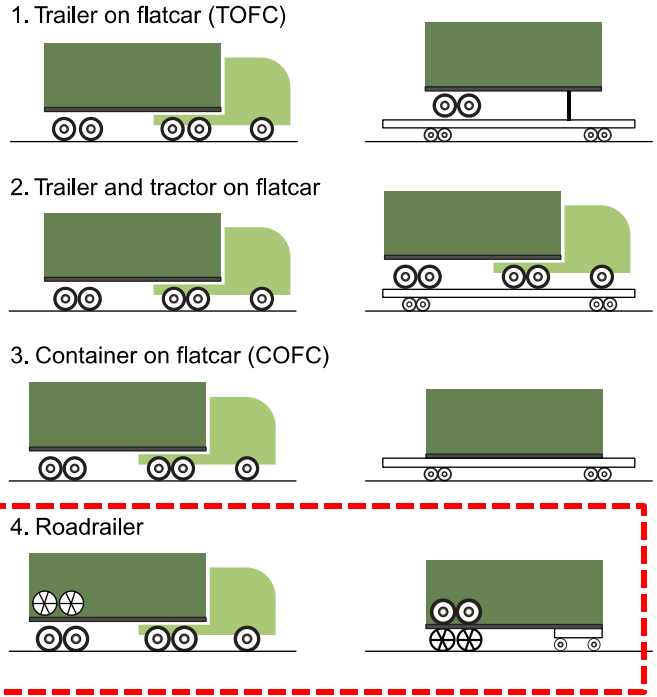


Modes of Transportation and Their Performance Characteristics

Roadrailers (trailertrain)

Although roadrailers appear similar to conventional truck trailers, they have both rubber truck tires and steel rail wheels, thus providing a combination of rail and motor transport in a single piece of equipment

The trailers are shipped in the normal way via tractor over highways. By changing wheels for rail movement, the trailer rides directly on the railroad instead of being placed on a flatcar



Modes of Transportation and Their Performance Characteristics

Comparison

Attribute	Truck	Rail	Air	Water	Pipeline
Speed/Transit time	Fast	Slow	Very Fast	Slow	Slow
Cost	High	Low	Very High	Low	Low
Accessibility	Very High	High	Limited	Poor	Very Poor
Reliability of Service	Very High	High	Variable	Moderate	Very High
Safety	Poor	Moderate	Very High	High	Very High
Security	Poor	High	Very High	Moderate	Very High
Bulk transport	Moderate	Very High	Very Poor	Very High	Poor
Small package delivery	High	Poor	Very High	Poor	Poor
Intermodal capability	Very High	Very High	High	Very High	Poor

Modes of Transportation and Their Performance Characteristics

Comparison

Attribute	Truck	Rail	Air	Water	Pipeline
Strengths	Accessible Fast and Versatile Customer Service	High Capacity Low Cost	Speed Load Protection Flexibility	High Capacity Low Cost International Capabilities	In transit storage Efficiency Low cost
Limitations	Limited Capacity High Cost	Accessibility Inconsistent Service Damage Rates	Accessibility High Cost Limited Capacity	Slow Accessibility	Slow Accessibility
Primary Role	Move smaller shipments in local, regional, and national market	Move large shipments of domestic freight long distances	Move urgent shipments of freight and smaller shipments of international freight	Move large domestic shipments via rivers, canals, and large shipments of international freight	Move large volumes of domestic freight long distances
Product Attributes	High value, finished goods, low volume	Low value, raw materials, high volume	High value, finished goods, low volume, time sensitive	Low values, raw materials, bulk commodities, containerized goods	Low values, liquid commodities, not time sensitive
Example Products	Food, clothing, electronics, furniture	Coal/coke, lumber/paper, grain, chemicals	Computer, periodicals, pharma products, B2C deliveries	Crude oil, ores/minerals, farm products, clothing, electronics, toys	Crude oil, petroleum, gasoline, natural gas

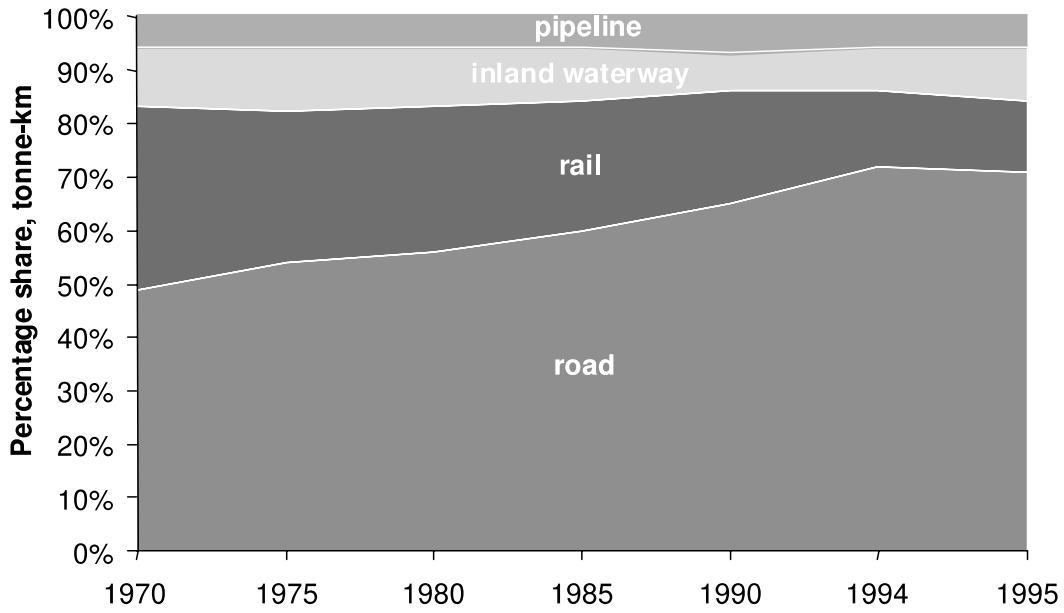
Modes of Transportation and Their Performance Characteristics

Comparison

Attribute	Truck	Rail	Air	Water	Pipeline
Product options	Very broad	Broad	Narrow	Broad	Very broad
Predominant traffic	All types	Low-moderate value, moderate-high density	High value, low-moderate density	Low value, high density	Low value, high density
Market coverage	Point to point	Terminal to terminal	Terminal to terminal	Terminal to terminal	Terminal to terminal
Average length of haul	Short to long	Medium to long	Medium to long	Medium to long	Medium to long
capacity	Low	Moderate	Low	Very high	Very high
cost	Moderate	Low	High	Low	Low
Speed (Time in transit)	Moderate	Slow	Fast	Very slow	Very slow
Availability	High	Moderate	Moderate	Low	Low
Delivery time consistency	High	Moderate	High	Low-moderate	High
Loss and damage	Low	Moderate-high	Low	Low-moderate	Low
Flexibility	High	Moderate	Low-moderate	Low	Low
Intermodal capability	Very high	Very high	Moderate	Very high	Low

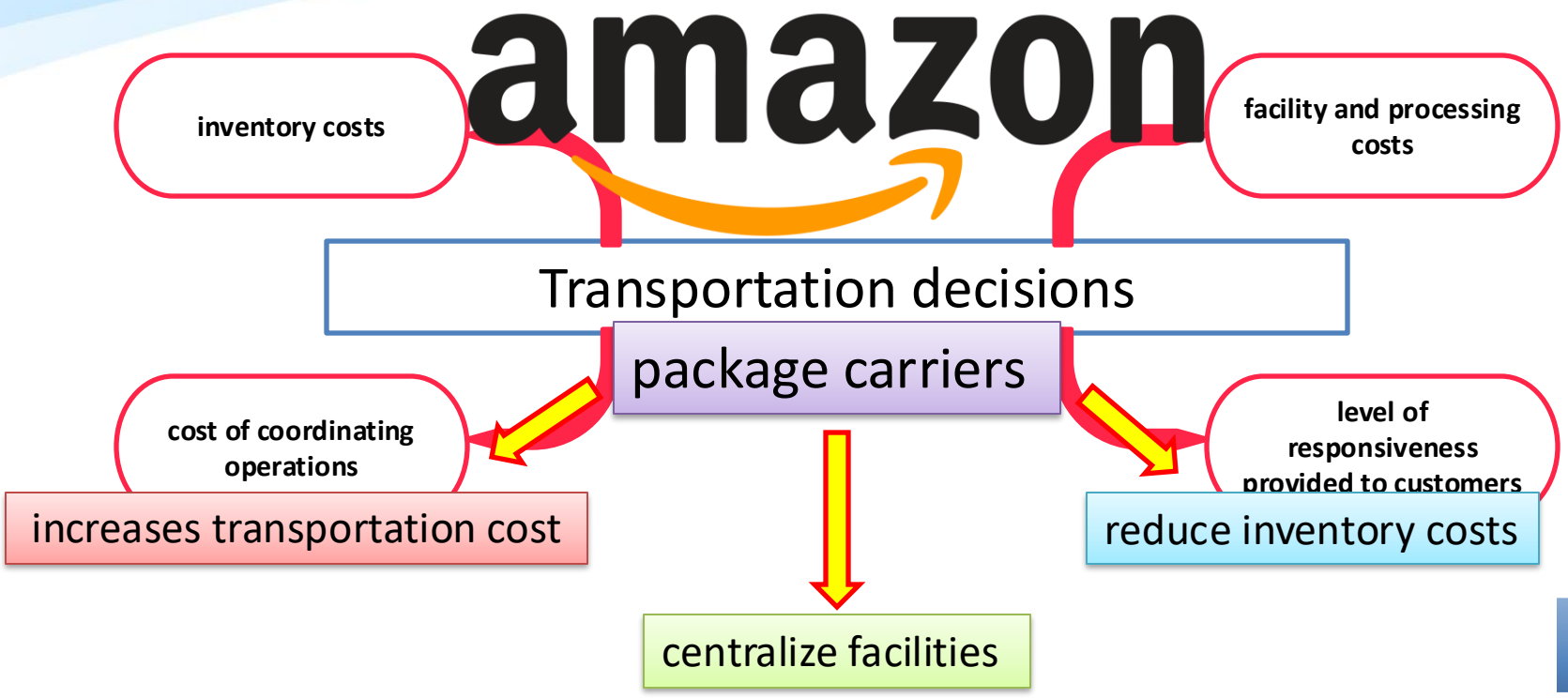
Modes of Transportation and Their Performance Characteristics

Comparison



Source: Department of Transport, Transport Statistics Great Britain 1999

Trade-Offs in Transportation Design



Trade-Offs in Transportation Design

The main trade-offs must be considered when making transportation decisions:

Trade-Offs in Transportation Design

Transportation and Inventory Cost Trade-Off

The trade-off between transportation and inventory costs is significant when designing a supply chain network

Two fundamental supply chain decisions involving this trade-off are:

- Choice of transportation mode
- Inventory aggregation

Trade-Offs in Transportation Design

Transportation and Inventory Cost Trade-Off

a planning and an operational decision in a supply chain

- ✓ The mode of transportation that results in the lowest transportation cost does not necessarily lower total costs for a supply chain

- ✓ Cheaper modes of transport typically have longer lead times and larger minimum shipment quantities, both of which result in higher levels of inventory in the supply chain

Inventory aggregation

- ✓ Modes that allow for shipping in small quantities lower inventory levels but tend to be more expensive

Trade-Offs in Transportation Design

Transportation and Inventory Cost Trade-Off

airfreights several of its products from Asia

use of a faster mode of transportation for shipping valuable components

low levels of inventory and still be responsive to its customers

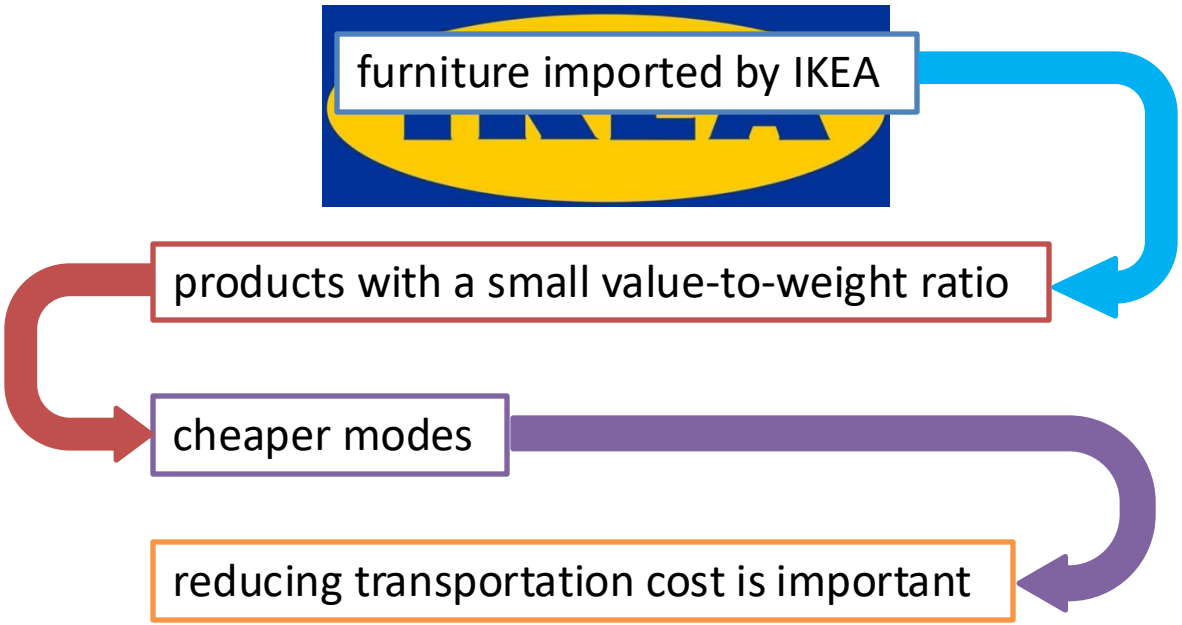
Faster modes of transportation

products with a high value-to-weight ratio → iPad

reducing inventories → Saving money

Trade-Offs in Transportation Design

Transportation and Inventory Cost Trade-Off



Trade-Offs in Transportation Design

Transportation and Inventory Cost Trade-Off

choice of transportation mode >> potential lost sales, cycle, safety, and in-transit inventory costs in addition to the cost of transportation

speed, flexibility, and reliability of the mode >> lost sales and inventory costs

The purchase price >> it changes with the choice of transportation mode (perhaps because of a change in lot sizes).

Modes with high transportation costs can be justified if they result in significantly lower inventory costs.

Trade-Offs in Transportation Design

Transportation and Inventory Cost Trade-Off

Mode	Cycle Inventory	Safety Inventory	In-Transit Cost	Transportation Cost	Transportation Time
Rail	5	5	5	2	5
TL	4	4	4	3	3
LTL	3	3	3	4	4
Package	1	1	1	6	1
Air	2	2	2	5	2
Water	6	6	6	1	6

The impact of using different modes of transportation on inventories, response time, and costs in the supply chain; 1 refers to the best and 6 refers to the worst.

Trade-Offs in Transportation Design

Transportation and Inventory Cost Trade-Off

Inventory aggregation is a good idea when inventory and facility costs form a large fraction of a supply chain's total costs.

Inventory aggregation is useful for products with a large value-to-weight ratio and for products with high demand uncertainty.

Choice of transportation mode

diamond industry >> large value-to-weight ratio and uncertain demand

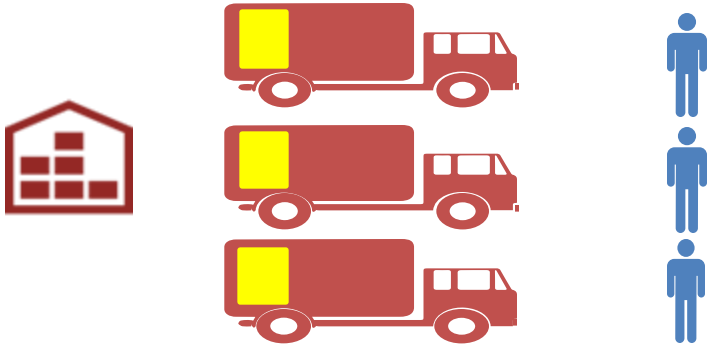
Inventory aggregation

customer orders are large enough to ensure sufficient economies of scale on outbound transportation.

Trade-Offs in Transportation Design

Trade-Off Between Transportation Cost and Customer Responsiveness

if we have 1 order per day and send the orders everyday



High responsiveness
High transportation cost

If we have 1 order per day and send the orders 2 times per week

Low responsiveness
Low transportation cost

! Assumption: The vehicle's capacity is 3 unit of our product

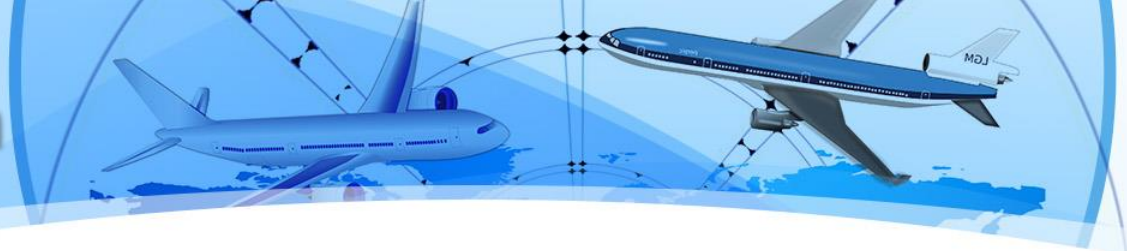
Tailored Transportation

Tailored Transportation by Customer Density and Distance

Tailored Transportation by Size of Customer

Tailored Transportation by Product Demand and Value

Channel Selection



- Market characteristics
- Channel Characteristics
- Competitive characteristics
- Company resources
- Product Characteristics
  - ✓ Volume-to-weight ratio
  - ✓ Value-to-weight ratio
  - ✓ Substitutability
  - ✓ Special characteristics

Design Options for a Transportation Network

Well-designed transportation network → the desired degree of responsiveness at a low cost.

- ✓ Should transportation be direct or through an intermediate site?
- ✓ Should the intermediate site stock product or only serve as a cross-docking location?
- ✓ Should each delivery route supply a single destination or multiple destinations (milk-run)?

Design Options for a Transportation Network

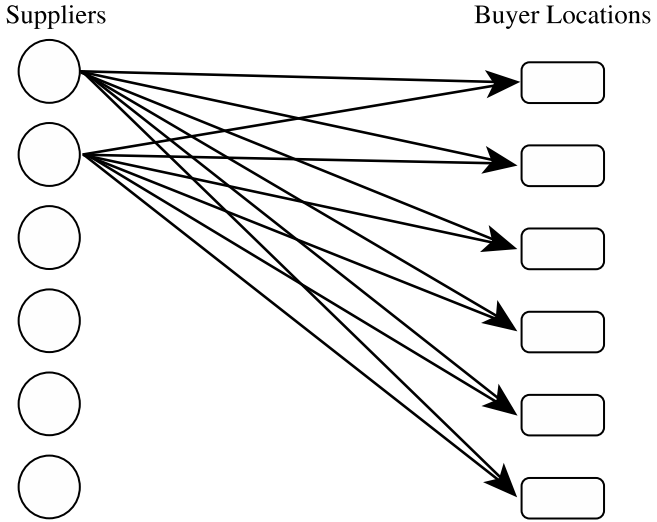
Direct Shipment Network to Single Destination

The major advantage >> elimination of intermediate warehouses >> simplicity of operation and coordination

- All shipments come directly from each supplier to each buyer location
- The routing of each shipment is specified.
- The supply chain manager needs to decide only the quantity to ship and the mode of transportation to use.
- This decision involves a trade-off between transportation and inventory costs

- the decision made for one shipment does not influence others
- optimal replenishment lot sizes are close to a truckload

Example: Home Depot

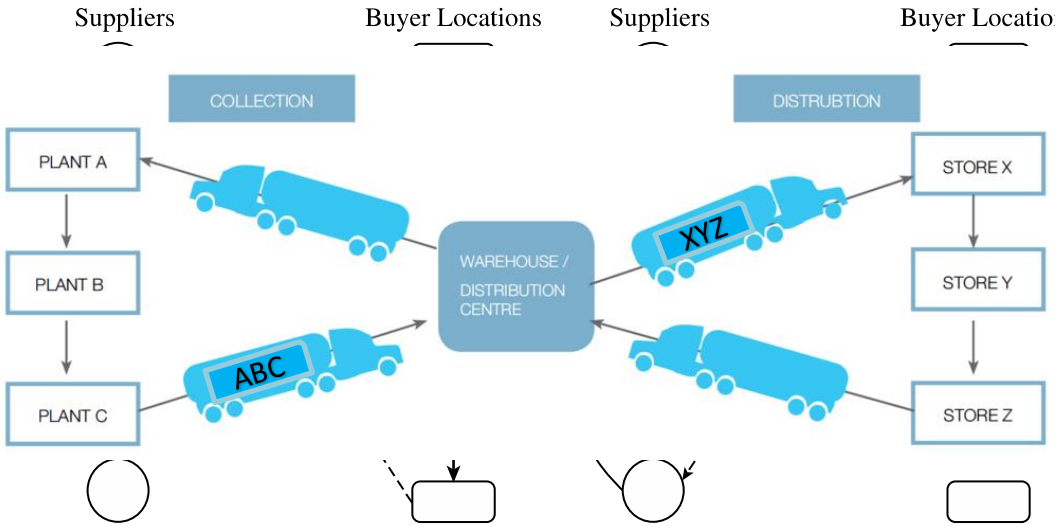


Design Options for a Transportation Network

Direct Shipping with Milk Runs

A *milk run* is a route on which a truck either delivers product from a single supplier to multiple retailers or goes from multiple suppliers to a single buyer location

When using this option, a supply chain manager has to decide on the **routing** of each milk run



Design Options for a Transportation Network

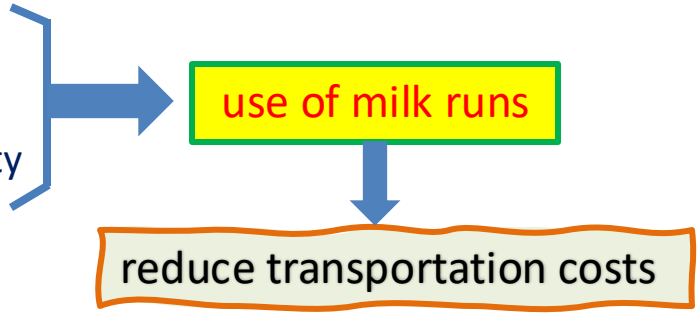
Direct Shipping with Milk Runs

- Direct shipping provides the benefit of eliminating intermediate warehouses
- Milk runs lower transportation cost by consolidating shipments to multiple locations on a single truck
- Milk runs make sense when the quantity ordered for each location is too small to fill a truck, but multiple locations are close enough to each other such that their combined quantity fills the truck

Design Options for a Transportation Network

Direct Shipping with Milk Runs

- frequent small deliveries
- regular basis
- set of suppliers/set of retailers is in geographic proximity



Frito Lay™
Good fun!

- ✓ **make direct store deliveries**
- ✓ **use milk runs to lower their transportation cost.**

Design Options for a Transportation Network

Direct Shipping with Milk Runs

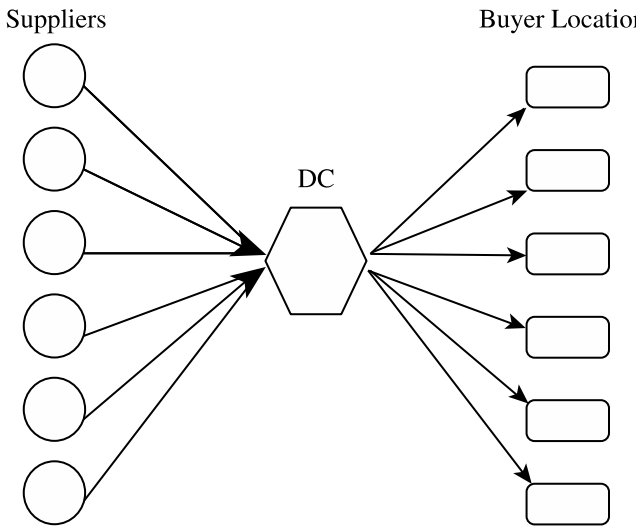
- uses milk runs from suppliers to support its just-in-time (JIT) manufacturing system in both Japan and the United States.
- In Japan, Toyota has many assembly plants located close together and thus uses milk runs from a single supplier to many plants.
- In the United States, however, Toyota uses milk runs from many suppliers to each assembly plant, given the large distance between assembly plants.

Design Options for a Transportation Network

All Shipments via Intermediate Distribution Center with Storage

- Product is shipped from suppliers to a central distribution center, where it is stored until needed by buyers when it is shipped to each buyer location
- Product comes in large quantities into a DC, where it is held in inventory and sent to buyer locations in smaller replenishment lots when needed.

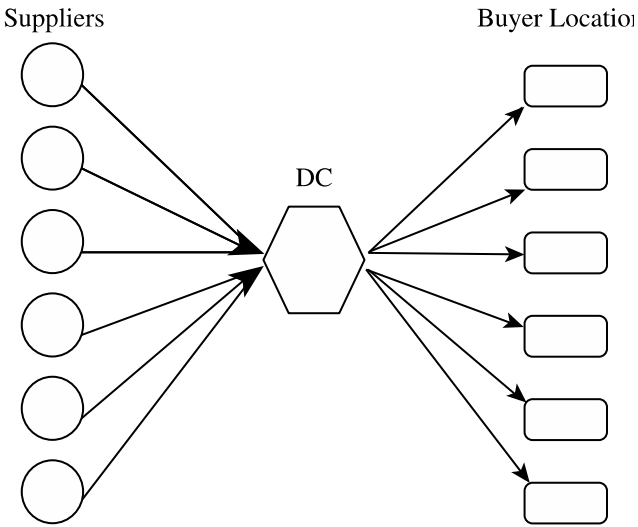
DC allows a supply chain to achieve economies of scale for inbound transportation to a point close to the final destination, because each supplier sends a large shipment to the DC that contains product for all locations the DC serves.



Design Options for a Transportation Network

All Shipments via Intermediate Distribution Center with Storage

GRAINGER®



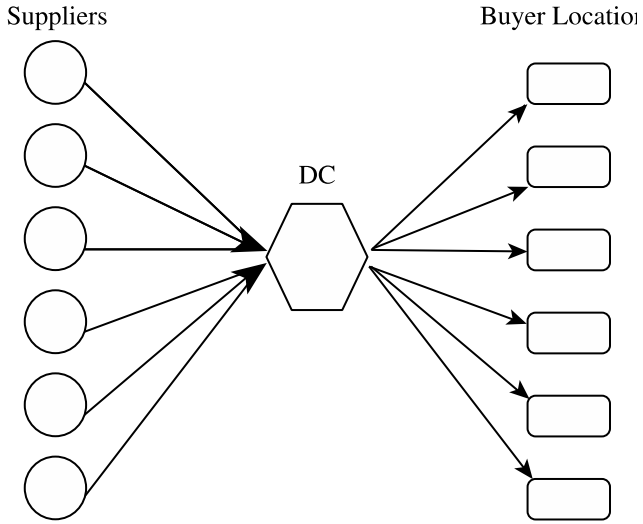
W.W. Grainger has its suppliers ship products to one of nine DCs (typically in large quantities), with each DC, in turn, replenishing stores in its vicinity with the smaller quantities they need. It would be expensive for suppliers to try to serve each store directly

Design Options for a Transportation Network

All Shipments via Intermediate Transit Point with Cross-Docking

suppliers send their shipments to an intermediate transit point (which could be a DC), where they are cross-docked and sent to buyer locations without storing them

no storage at the intermediate facility!



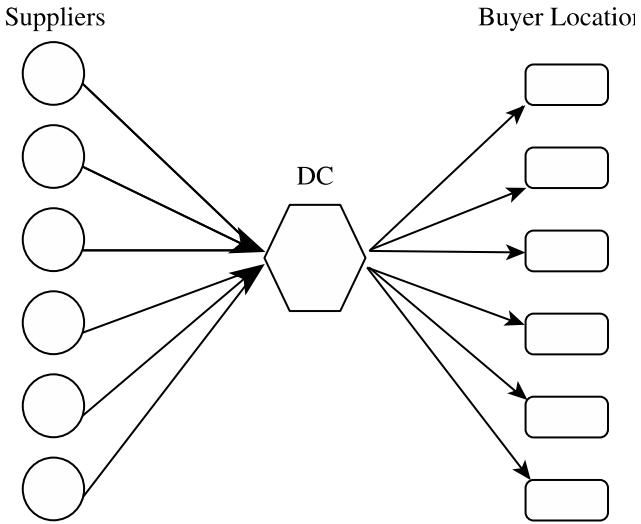
Design Options for a Transportation Network

All Shipments via Intermediate Transit Point with Cross-Docking

Major benefits of cross-docking are that little inventory needs to be held and product flows faster in the supply chain

saves on handling cost because product does not have to be moved into and out of storage.

Cross-docking is appropriate when economies of scale in transportation can be achieved on both the inbound and outbound sides and both inbound and outbound shipments can be coordinated

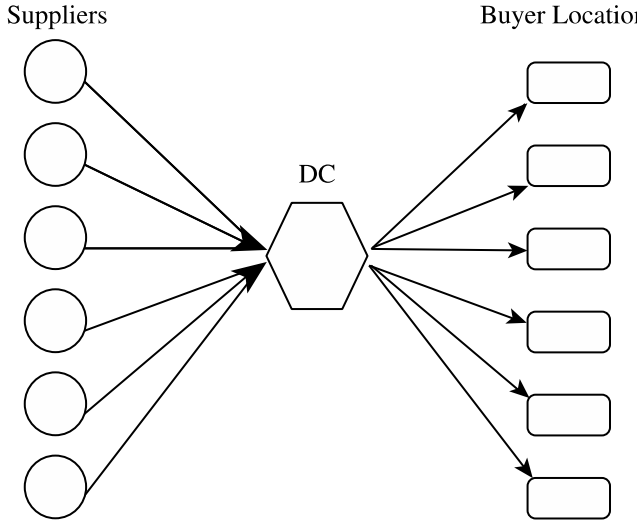


Design Options for a Transportation Network

All Shipments via Intermediate Transit Point with Cross-Docking

Walmart

Decrease inventories in the supply chain without incurring excessive transportation costs

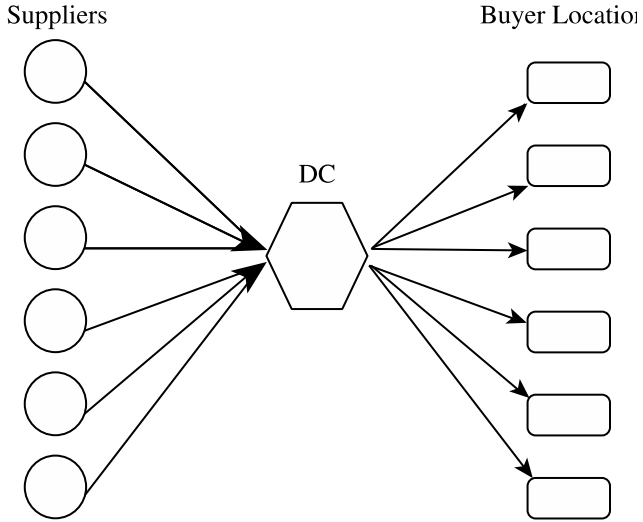


Design Options for a Transportation Network

All Shipments via Intermediate Transit Point with Cross-Docking

Peapod®

Peapod in the Chicago area >> a DC in Lake Zurich >> milk runs

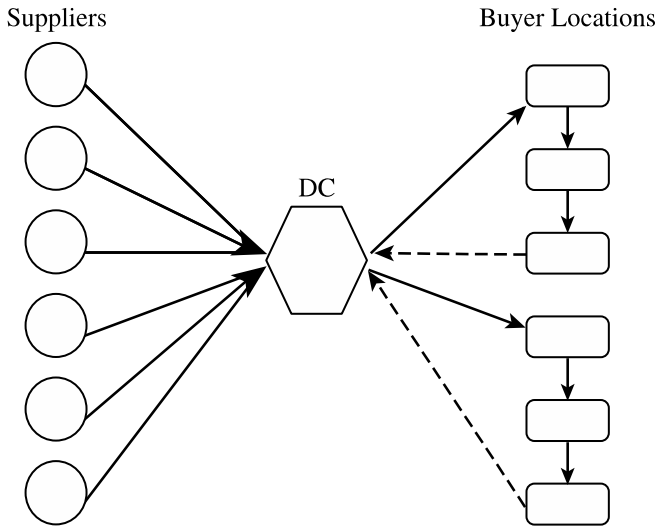


Design Options for a Transportation Network

Shipping via DC Using Milk Runs

Milk runs can be used from a DC if lot sizes to be delivered to each buyer location are small

Milk runs reduce outbound transportation costs by consolidating small shipments



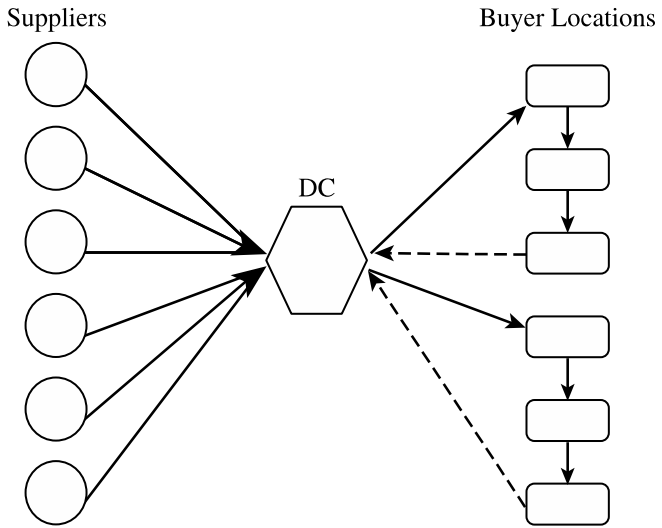
Design Options for a Transportation Network

Shipping via DC Using Milk Runs

Seven-Eleven Japan cross-docks deliveries from its fresh-food suppliers at its DCs and sends out milk runs to the retail outlets because the total shipment to a store requires a significant degree of coordination and suitable routing and scheduling.

The use of cross-docking with milk runs requires a significant degree of coordination and suitable routing and scheduling.

The use of cross-docking and milk runs allows Seven- Eleven Japan to lower its transportation cost while sending small replenishment lots to each store.

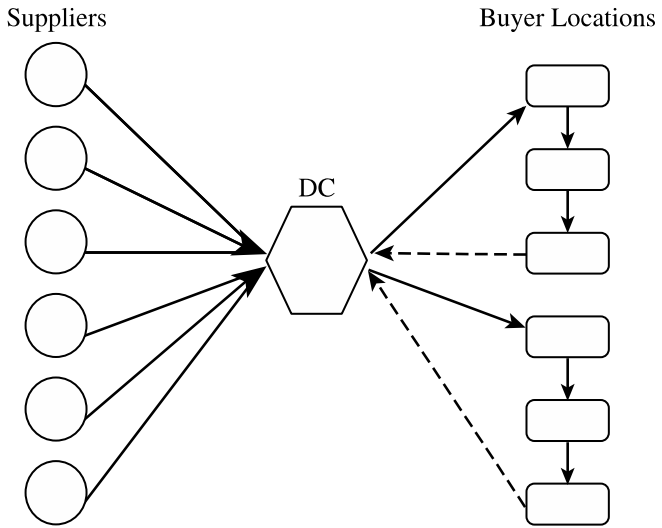


Design Options for a Transportation Network

Shipping via DC Using Milk Runs

Peapod®

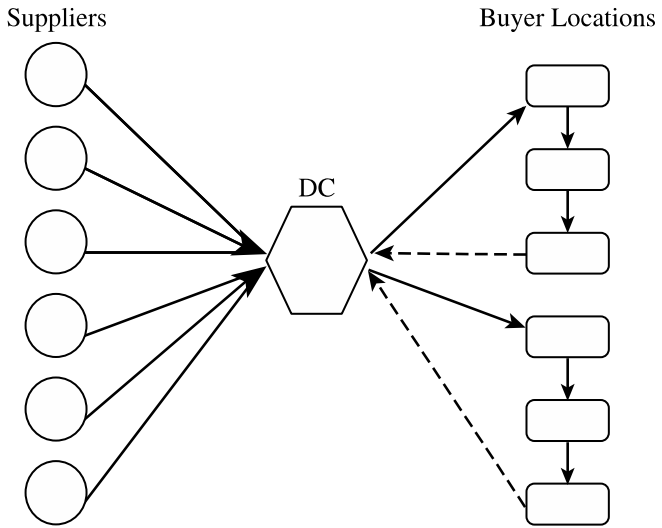
The online grocer Peapod uses milk runs from DCs when making customer deliveries to help reduce transportation costs for small shipments to be delivered to homes



Design Options for a Transportation Network

Shipping via DC Using Milk Runs

OshKosh B'Gosh, a manufacturer of children's wear, has used this idea to virtually eliminate LTL shipments from its DC in Tennessee to retail stores



Design Options for a Transportation Network

Tailored Network

The tailored network option is a suitable **combination** of previous options that reduces the cost and improves the responsiveness of the supply chain

In this model, transportation uses a combination of cross-docking, milk runs, and TL and LTL carriers, along with package carriers in some cases.

The goal is to use the appropriate option in each situation!

Design Options for a Transportation Network

Tailored Network

High-demand products may be shipped directly to high-demand retail outlets, whereas low-demand products or shipments to low- demand retail outlets are consolidated to and from the DC

The complexity of managing this transportation network is high because different shipping procedures are used for each product and retail outlet.

Operating a tailored network requires significant investment in information infrastructure to facilitate the coordination. Such a network, however, allows for the selective use of a shipment method to minimize the **transportation** as well as **inventory costs.**

Design Options for a Transportation Network

Pros and Cons of Different Transportation Networks

Network Structure	Pros	Cons
Direct shipping	No intermediate warehouse Simple to coordinate	High inventories (due to large lot size)
Direct shipping with milk runs	Lower transportation costs for small lots Lower inventories	Increased coordination complexity
All shipments via central DC with inventory storage	Lower inbound transportation cost through consolidation	Increased inventory cost Increased handling at DC
All shipments via central DC with cross-dock	Low inventory requirement Lower transportation cost through consolidation	Increased coordination complexity
Shipping via DC using milk runs	Lower outbound transportation cost for small lots	Further increase in coordination complexity
Tailored network	Transportation choice best matches needs of individual product and store	Highest coordination complexity

Digital Technology In The “Delivery” Processes (Distribution)

Drones or Unmanned Aerial Vehicles

Digital Technology In The “Delivery” Processes (Distribution)

Drones or Unmanned Aerial Vehicles

Digital Technology In The “Delivery” Processes (Distribution)

Drones or Unmanned Aerial Vehicles

HOW IT WORKS:

Drone docks on the roof of the package car, where a cage suspended beneath the drone extends through a hatch into the truck.

Driver loads a package into the cage and presses a button on a touch screen to send the drone autonomously on a preset route to an address.

After making the delivery, drone returns to package car and recharges while docked.

1. UPS driver loads the package and launches the drone.

2. Drone launches from roof of package car, gains altitude and proceeds to delivery location.

3. At delivery location, drone descends and package is released.

4. Drone returns to package car at a planned stop and autonomously redocks.

5. Driver continues along regular delivery route.

Digital Technology In The “Delivery” Processes (Distribution)

Drones or Unmanned Aerial Vehicles

Digital Technology In The “Delivery” Processes (Distribution)

Smart Driverless Transportation Systems

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Smart Driverless Transportation Systems

https://www.youtube.com/watch?v=mzhvR4wm__M

https://www.youtube.com/watch?v=tXjTQuxC5_g

https://www.youtube.com/watch?v=51-BbgUQoAs

Making Transportation Decisions In Practice

Align transportation strategy with competitive strategy.

Consider both in-house and outsourced transportation.

Use technology to improve transportation performance.

Design flexibility into the transportation network.