

## Transportation in a Supply Chain



## Factors Affecting Transportation Decisions

- ◆ **Carrier** (party that moves or transports the product)
  - Vehicle-related cost
  - Fixed operating cost
  - Trip-related cost
- ◆ **Shipper** (party that requires the movement of the product between two points in the supply chain)
  - Transportation cost
  - Inventory cost
  - Facility cost

## Transportation Modes

- ◆ Trucks
  - TL
  - LTL
- ◆ Rail
- ◆ Air
- ◆ Package Carriers
- ◆ Water
- ◆ Pipeline

## Road freight transport Europe

- ◆ Semitrailer combinations, with 26 to / 85 m<sup>3</sup> capacity on a 13,6 metre long semi-trailer, are dominant
- ◆ 73% of inland freight transport is on roads
- ◆ Average loading is 57%, overall efficiency 43%
- ◆ On national transport 61% of journeys are shorter than 50 km, on international transport 46% are longer than 500 km.
- ◆ The average share of empty journeys is between 30% - 35%

Source : European Commission, Road Freight Transport Vademecum, March 2009



## Truckload (TL)

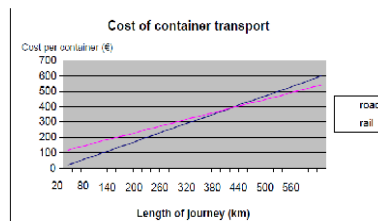
- ◆ Average revenue per ton mile (1996) = 9.13 cents
- ◆ Average haul = 274 miles
- ◆ Average Capacity = 42,000 - 50,000 lb.
- ◆ Low fixed and variable costs
- ◆ Major Issues
  - Utilization
  - Consistent service
  - Backhauls

## Less Than Truckload (LTL)

- ◆ Average revenue per ton-mile (1996) = 25.08 cents
- ◆ Average haul = 646 miles
- ◆ Higher fixed costs (terminals) and low variable costs
- ◆ Major issues:
  - Location of consolidation facilities
  - Utilization
  - Vehicle routing
  - Customer service

## Rail freight transport EU

- ◆ Best for large volumes transported over long distances
- ◆ Less costly in environmental terms than road transport
- ◆ Key issues:
  - has to share the infrastructure with passenger traffic
  - lack of interoperability
  - a culture which is still insufficiently customer-orientated



Source : European Commission

## Rail

- ◆ Average revenue / ton-mile (1996) = 2.5 cents
- ◆ Average haul = 720 miles
- ◆ Average load = 80 tons
- ◆ Key issues:
  - Scheduling to minimize delays / improve service
  - Off-track delays (at pickup and delivery end)
  - Yard operations
  - Variability of delivery times

## Air

### ◆ Key issues:

- Location/number of hubs
- Location of fleet bases/crew bases
- Schedule optimization
- Fleet assignment
- Crew scheduling
- Yield management



Copyright © 2010 Pearson Education, Inc.

13-14

## Package Carriers

- ◆ Companies like FedEx, UPS, USPS, that carry small packages ranging from letters to shipments of about 70 kg
- ◆ Expensive
- ◆ Rapid and reliable delivery
- ◆ Small and time-sensitive shipments
- ◆ Preferred mode for e-businesses (e.g., Amazon, Dell)
- ◆ Consolidation of shipments (especially important for package carriers that use air as a primary method of transport)

Copyright © 2010 Pearson Education, Inc.

13-16

## Water

- ◆ Limited to certain geographic areas
- ◆ Ocean, inland waterway system, coastal waters
- ◆ Very large loads at very low cost
- ◆ Slowest
- ◆ 90% of global trade



Source : May 21, 2012 issue of Fortune

Copyright © 2010 Pearson Education, Inc.

13-17

## Intermodal Container

- ◆ Capacity is expressed in 20 ft equivalent units (TEU)
- ◆ About 17 millions containers in use worldwide



CSQU3054383

Owner code here: CSQU  
Serial number here: 3054383  
Category identifier here: U - U.S. origin container  
Check digit here: 3

Source : Wikipedia

		20' container		40' container		45' high-cube container	
		imperial	metric	imperial	metric	imperial	metric
external dimensions	length	20' 0"	6.096 m	40' 0"	12.192 m	45' 0"	13.716 m
	width	8' 0"	2.438 m	8' 0"	2.438 m	8' 0"	2.438 m
	height	8' 6"	2.591 m	8' 6"	2.591 m	9' 6"	2.896 m
interior dimensions	length	18' 10 5/16"	5.758 m	39' 5 45/64"	12.032 m	44' 4"	13.556 m
	width	7' 8 19/32"	2.352 m	7' 8 19/32"	2.352 m	7' 8 19/32"	2.352 m
	height	7' 9 57/64"	2.385 m	7' 9 57/64"	2.385 m	8' 9 15/16"	2.698 m
door aperture	width	7' 8 1/4"	2.343 m	7' 8 1/4"	2.343 m	7' 8 1/4"	2.343 m
	height	7' 5 1/4"	2.280 m	7' 5 1/4"	2.280 m	8' 5 49/64"	2.585 m
volume		1,169 ft³	33.1 m³	2,385 ft³	67.5 m³	3,040 ft³	86.1 m³
maximum gross mass		66,139 lb	30,400 kg	66,139 lb	30,400 kg	66,139 lb	30,400 kg
empty weight		4,850 lb	2,200 kg	8,380 lb	3,800 kg	10,580 lb	4,800 kg
net load		61,289 lb	28,200 kg	57,759 lb	26,600 kg	55,559 lb	25,600 kg

## Pipeline

- ◆ High fixed cost
- ◆ Primarily for crude petroleum, refined petroleum products, natural gas
- ◆ Best for large and predictable demand



Copyright © 2010 Pearson Education, Inc.

## Intermodal

- ◆ Use of more than one mode of transportation to move a shipment to its destination
- ◆ Most common example: rail/truck
- ◆ Also water/rail/truck or water/truck
- ◆ Grown considerably with increased use of containers
- ◆ Increased global trade has also increased use of intermodal transportation
- ◆ More convenient for shippers (one entity provides the complete service)
- ◆ **Key issue involves the exchange of information to facilitate transfer between different transport modes**

Copyright © 2010 Pearson Education, Inc.

13-23

## Design Options for a Transportation Network

- ◆ What are the transportation options? Which one to select? On what basis?
- ◆ Direct shipping network
- ◆ Direct shipping with milk runs
- ◆ All shipments via central DC
- ◆ Shipping via DC using milk runs
- ◆ Tailored network

Copyright © 2010 Pearson Education, Inc.

13-24

## Trade-offs in Transportation Design

- ◆ Transportation and inventory cost trade-off
  - Choice of transportation mode
  - Inventory aggregation
- ◆ Transportation cost and responsiveness trade-off

Copyright © 2010 Pearson Education, Inc.

13-25

## Choice of Transportation Mode

---

- ◆ A manager must account for inventory costs when selecting a mode of transportation
- ◆ A mode with higher transportation costs can be justified if it results in significantly lower inventories

## Inventory Aggregation: Inventory vs. Transportation Cost

---

- ◆ As a result of physical aggregation
  - Inventory costs decrease
  - Inbound transportation cost decreases
  - Outbound transportation cost increases
- ◆ Inventory aggregation decreases supply chain costs if the product has a high value to weight ratio, high demand uncertainty, or customer orders are large
- ◆ Inventory aggregation may increase supply chain costs if the product has a low value to weight ratio, low demand uncertainty, or customer orders are small

## Trade-offs Between Transportation Cost and Customer Responsiveness

---

- ◆ Temporal aggregation is the process of combining orders across time
- ◆ Temporal aggregation reduces transportation cost because it results in larger shipments and reduces variation in shipment sizes
- ◆ However, temporal aggregation reduces customer responsiveness

## Tailored Transportation

---

- ◆ The use of different transportation networks and modes based on customer and product characteristics
- ◆ Factors affecting tailoring:
  - Customer distance and density
  - Customer size
  - Product demand and value

## Role of IT in Transportation

---

- ◆ The complexity of transportation decisions demands use of IT systems
- ◆ IT software can assist in:
  - Identification of optimal routes by minimizing costs subject to delivery constraints
  - Optimal fleet utilization
  - GPS applications

UPS routing

## 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

## Making Transportation Decisions in Practice

---

- ◆ Align transportation strategy with competitive strategy
- ◆ Consider both in-house and outsourced transportation
- ◆ Design a transportation network that can handle e-commerce
- ◆ Use technology to improve transportation performance
- ◆ Design flexibility into the transportation network

## Impact of terrorism on logistics systems

---

- ◆ In 2011 there were 439 pirate attacks on commercial ships and 43 merchant vessels were hijacked.
- ◆ After 9/11 new security measures have profoundly impacted logistics practices on a worldwide basis.
- ◆ The Trade Act of 2002 requires submission of advanced electronic data on all shipments entering and leaving the United States.
- ◆ Through the Container Security Initiative (CSI) currently 58 ports worldwide allow U.S. Agents to screen high-risk containers.
- ◆ The U.S. is considering a 100% scanning law for all cargo entering the U.S. (currently pending).