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 m³ 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

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

**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)

**Water**

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

**Intermodal Container**

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

Source: May 21, 2012 issue of Fortune

Pipeline

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

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

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

Trade-offs in Transportation Design

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

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**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.

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**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.

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**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

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).