

# **Supply Chain Management (6<sup>th</sup> Edition)**

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## **Chapter 14 Transportation in the 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

# Truckload (TL)

- ◆ Low fixed and variable costs
- ◆ Major Issues
  - Utilization
  - Consistent service
- ◆ Backhauls (when a trucking company needs a load back to their terminal to get a driver home.  
Example: Let's say a person is bringing a truck of potatoes to a storage facility. Instead of coming back to the original place with an empty truck, they will use their trip back to transport something else

# Less Than Truckload (LTL)

- ◆ Higher fixed costs (terminals) and low variable costs
- ◆ Major issues:
  - Location of consolidation facilities
  - Utilization
  - Vehicle routing
  - Customer service

# Rail

## ◆ 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 150 pounds
- ◆ Expensive
- ◆ Rapid and reliable delivery
- ◆ Small and time-sensitive shipments
- ◆ Preferred mode for e-businesses (e.g., Amazon, Dell, McMaster-Carr)
- ◆ 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
- ◆ Dominant in global trade (autos, grain, apparel, etc.)

# Pipeline

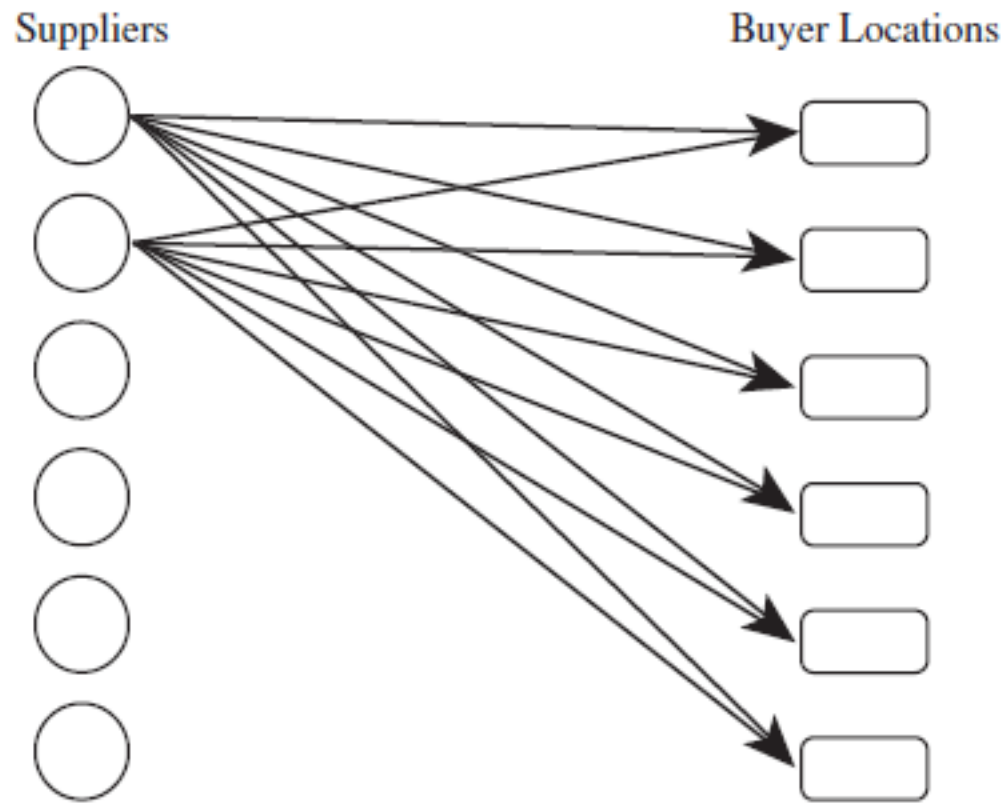
- ◆ High fixed cost
- ◆ Primarily for crude petroleum, refined petroleum products, natural gas
- ◆ Best for large and predictable demand
- ◆ Would be used for getting crude oil to a port or refinery, but not for getting refined gasoline to a gasoline station (why?)

# 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

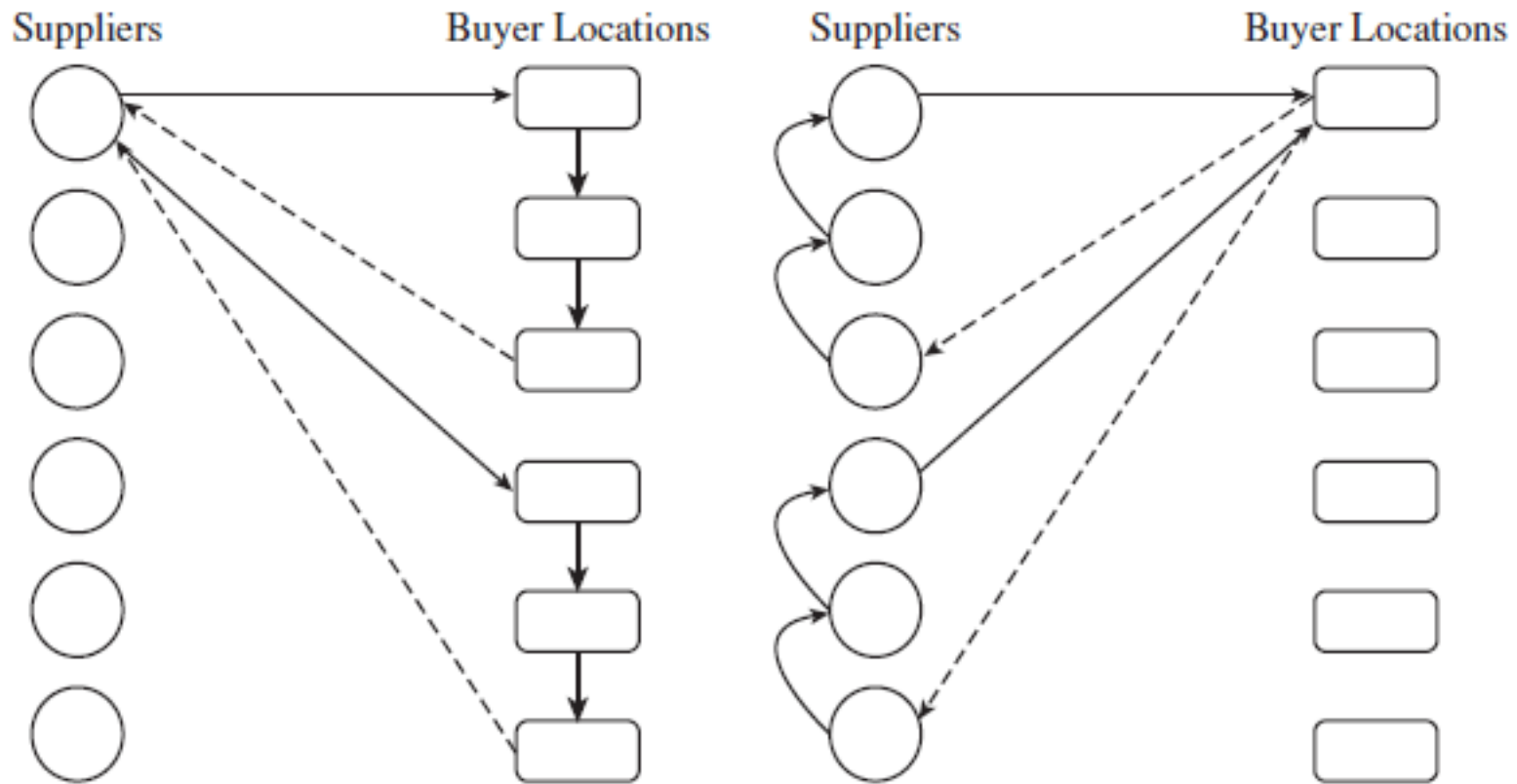
# Design Options for a Transportation Network

- ◆ 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

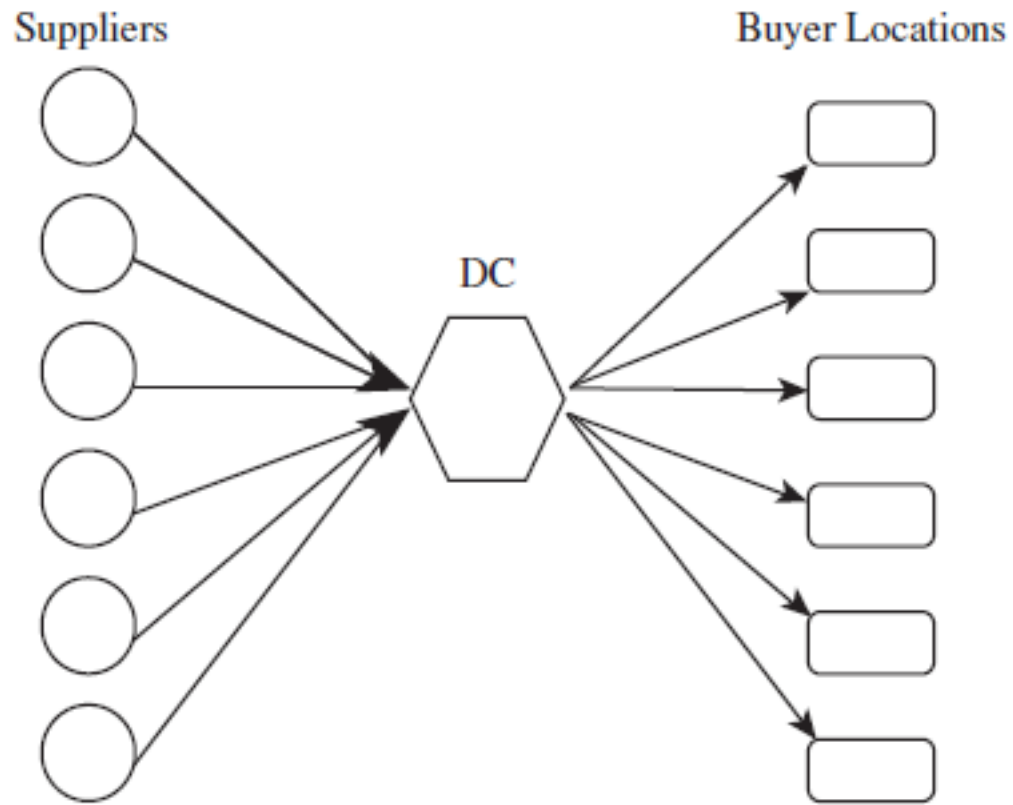


**FIGURE 14-2** Direct Shipment Network

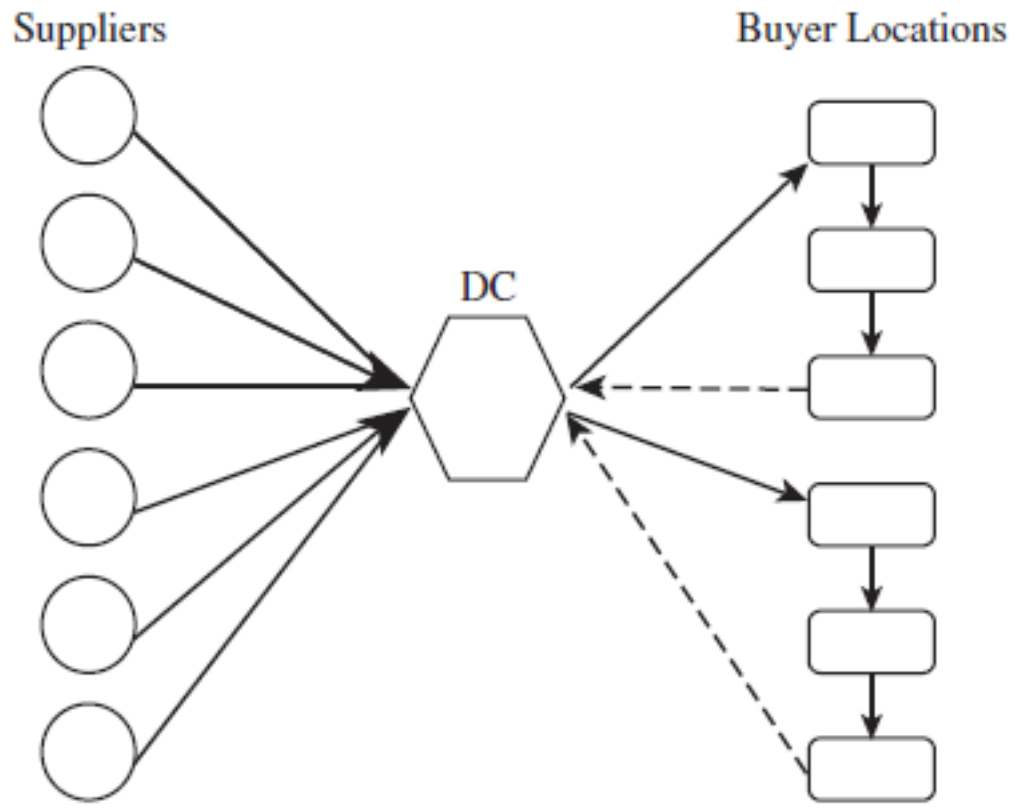
A *milk run* is a route on which a truck either delivers product from a single supplier to multiple retailers or goes from multiple suppliers to a single buyer location



**FIGURE 14-3** Milk Runs from Multiple Suppliers or to Multiple Buyer Locations



**FIGURE 14-4** All Shipments via DC



**FIGURE 14-5** Milk Runs from DC



**TABLE 14-2** 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

**Important: Read Examples 14-1, 14-2 and 14-3 from the text**

# 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

# 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

# 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

# Role of IT in Transportation

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