Supply Chain Management

Part 9

Transportation in a Supply Chain

The role of transportation in supply chain

Transportation refers to the movement of product from one location to another as it makes its way from the beginning of a supply chain to the customer.

Any supply chain's success is closely linked to the appropriate use of transportation.

Faster transportation is more expensive but allows a supply chain to be more responsive. As a result, the supply chain may carry lower inventories and have fewer facilities.

The role of transportation in supply chain

Four parties influence the effectiveness of transportation:

1. Shipper: is the party that requires the movement of the product between two points in the supply chain.
2. Carrier : is the party that moves or transports the product.
3. the owners and operators of transportation infrastructure such as roads, ports, canals, and airports, and
4. the bodies that set transportation policy worldwide.

Transportation modes

Supply chains use a combination of the following modes of transportation:

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

Air

Major airlines carry both passengers and cargo.

Air carriers offer a fast and fairly expensive mode of transportation for cargo.

Small, high-value items or time-sensitive emergency shipments that must travel a long distance are best suited for air transport.

Key issues that air carriers face include identifying the location and number of hubs, assigning planes to routes, setting up maintenance schedules for planes, scheduling crews, and managing prices and availability at different prices.

Package Carriers

Companies like FedEx, UPS, USPS, that carry small packages ranging from letters to shipments of about 150 pounds.

Package carriers use air, truck, and rail to transport time-critical smaller packages.

Package carriers are expensive but offer shippers a rapid and reliable delivery.

Package Carriers

Shippers use package carriers for small and time-sensitive shipments.

Preferred mode of transport for online businesses such as Amazon and Dell.

Consolidation of shipments is a key factor in increasing utilization and decreasing costs for package carriers.

Truck

In most of the world, trucks carry a significant fraction of the goods moved.

The trucking industry consists of two major segments: truckload (TL) or less than truckload (LTL).

LTL shipments take longer than TL shipments because of other loads that need to be picked up and dropped off.

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

Rail

Rail is an ideal mode for carrying large, heavy, or high-density products over long distances.

Transportation time by rail can be long.

Small, time-sensitive, short-distance, or short-lead-time shipments rarely go by rail.

Major operational issues at railroads include vehicle and staff scheduling, track and terminal delays, and poor on-time performance.

Water

Water transport is ideally suited for carrying large loads at low cost but is limited to certain areas.

It is the slowest of all the modes, and significant delays occur at ports and terminals.

In global trade, water transport is the dominant mode for shipping all kinds of products. Cars, grain, apparel, and other products are shipped by sea.

In international trade, water transport is by far the cheapest mode of transport.

Pipeline

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

A significant initial fixed cost is incurred in setting up the pipeline and related infrastructure that does not vary significantly with the diameter of the pipeline.

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

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

A variety of intermodal combinations are possible; Most common example: rail/truck, Also water/rail/truck or water/truck.

Intermodal traffic has grown considerably with the increased use of containers for shipping and the rise of global trade.

Key issues in the intermodal industry involve the exchange of information to facilitate shipment transfers between different modes.

Design options for a transportation network

1- Direct Shipment Network to Single Destination

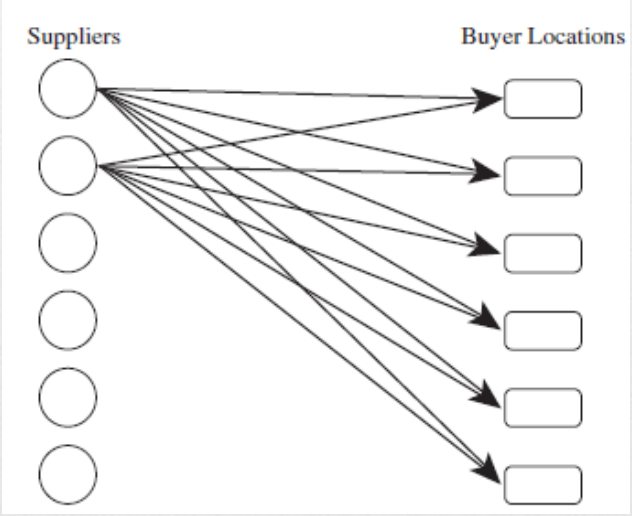
The buyer structures the transportation network so that all shipments come directly from each supplier to each buyer location.

Advantages:

No intermediate warehouses, simple to operate and coordinate, and short transportation time.

Disadvantages:

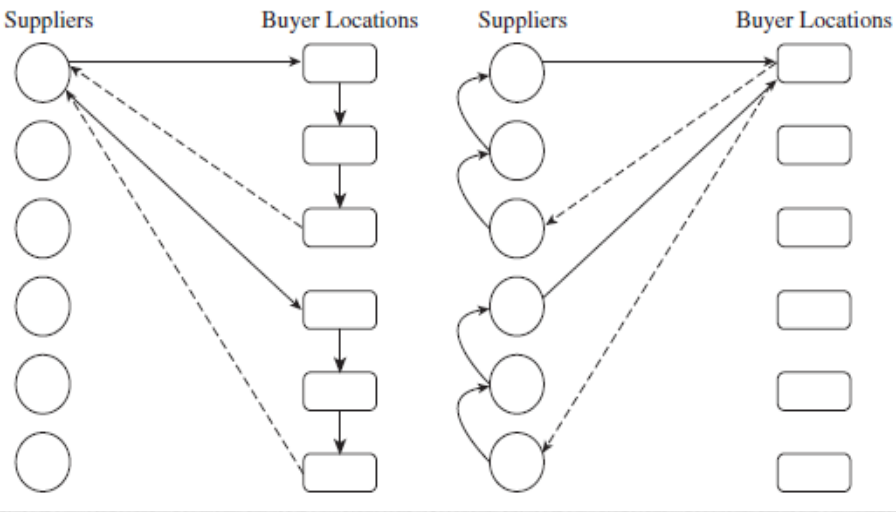
Large inventory.



Design options for a transportation network

2- 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.



Design options for a transportation network

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

Milk runs make sense when the quantity destined 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.

Advantages:

- Lower transportation costs for small lots
- Lower inventories

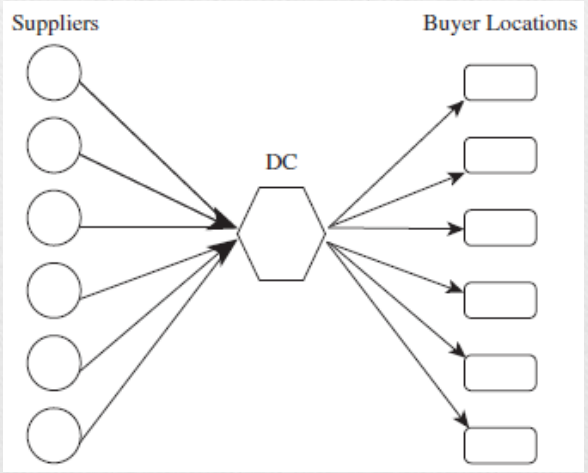
Disadvantages:

- Increased coordination complexity

Design options for a transportation network

3- 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.



Advantages:

Lower inbound transportation cost through consolidation

Disadvantages:

Increased inventory cost and Increased handling at DC

Design options for a transportation network

4- 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.

When a DC cross-docks product, each inbound truck contains product from suppliers for several buyer locations, whereas each outbound truck contains product for one buyer location from several suppliers.

Advantages: Low inventory requirement and Lower transportation cost through consolidation.

Disadvantages: Increased coordination complexity.

Design options for a transportation network

5- Shipping via DC Using Milk Runs

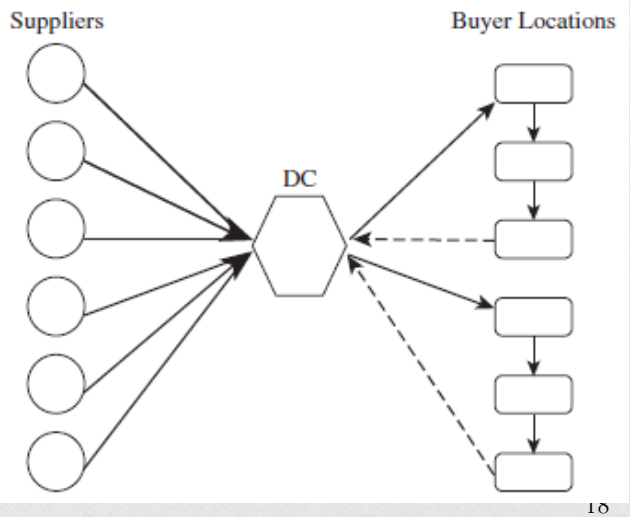
Milk runs can be used from a DC if lot sizes to be delivered to each buyer location are small. Milk runs reduce outbound transportation costs by consolidating small shipments.

Advantages:

Lower outbound transportation cost for small lots.

Disadvantages:

Further increase in coordination complexity.



Design options for a transportation network

6- 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.

Advantages:

Transportation choice best matches needs of individual product and store.

Disadvantages:

Highest coordination complexity.

Design options for a transportation network

Example. A retail chain has eight stores in a region supplied from four supply sources. Trucks have a capacity of 40,000 units and cost $1,000 per load plus $100 per delivery. Thus, a truck making two deliveries charges $1,200. The cost of holding one unit in inventory at retail for a year is $0.20.

The vice president of supply chain is considering whether to use direct shipping from suppliers to retail stores or setting up milk runs from suppliers to retail stores.

What network do you recommend if annual sales for each product at each retail store are 120,000 units?

Design options for a transportation network

First analyze the direct shipping network and assume that full truckloads will be shipped from suppliers to retail stores. In this case, we have the following:

Batch size shipped from each supplier to each store = 40,000 units

Number of shipments/year from each supplier to each store = 120,000/40,000 = 3

Annual trucking cost for direct network = 3 * 1,100 * 4 * 8 = $105,600

Average inventory at each store for each product = 40,000/2 = 20,000 units

Annual inventory cost for direct network = 20,000 * 0.2 * 4 * 8 = $128,000

Total annual cost of direct network = $105,600 + $128,000 = ***$233,600***

Design options for a transportation network

Now, we analyze the network in which suppliers run milk runs to retail stores. Milk runs increase the transportation cost but decrease the level of inventory each store has to hold.

For the instance of suppliers running milk runs to ***two stores*** on each truck:

Batch size shipped from each supplier to each store = 40,000/2 = 20,000 units

Number of shipments/year from each supplier to each store = 120,000/20,000 = 6

Transportation cost per shipment per store (two stores/truck) = 1,000/2 + 100 = $600

Annual trucking cost for milk run network = 6 * 600 * 4 * 8 = $115,200

Average inventory at each store for each product = 20,000/2 = 10,000 units

Annual inventory cost for milk run network = 10,000 * 0.2 * 4 * 8 = $64,000

Total annual cost of milk run network = $115,200 + $64,000 = ***$179,200***

Design options for a transportation network

For the instance of suppliers running milk runs to ***three stores*** on each truck:

Batch size shipped from each supplier to each store = 40,000/3 = 13,333 units

Number of shipments/year from each supplier to each store = 120,000/13,333 = 9

Transportation cost per shipment per store (three stores/truck) = 1,000/3 + 100 = $433.3

Annual trucking cost for milk run network = 9 * 433.3 * 4 * 8 = $127,790

Average inventory at each store for each product = 13,333/2 = 6,666 units

Annual inventory cost for milk run network = 6,666 * 0.2 * 4 * 8 = $42,666

Total annual cost of milk run network = $127,790 + $42,666 = ***$170,456***

Design options for a transportation network

For the instance of suppliers running milk runs to ***four stores*** on each truck:

Batch size shipped from each supplier to each store = 40,000/4 = 10,000 units

Number of shipments/year from each supplier to each store = 120,000/10,000 = 12

Transportation cost per shipment per store (three stores/truck) = 1,000/4 + 100 = $350

Annual trucking cost for milk run network = 12 * 350 * 4 * 8 = $134,400

Average inventory at each store for each product = 10,000/2 = 5,000 units

Annual inventory cost for milk run network = 5,000 * 0.2 * 4 * 8 = $32,000

Total annual cost of milk run network = $134,400 + $32,000 = ***$166,400***

Design options for a transportation network

This analysis shows that when demand per product per store is 120,000 units, the milk run network with four stores per route is cheaper than the direct network.