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## Chapter 6: Transportation

### Objectives

- Understand the role of transportation and its importance in logistics.
- Examine the principles of transportation.
- Able to identify the role of entities in a transportation network.
- Examine the transportation modes and their costs.
- Understand the concept of total transportation cost.

### 1. Introduction – Role of Transportation in Logistics

The role of transportation in logistics operations has changed dramatically over the last three decades.

Today a wide range of transportation alternatives is available. For example, supply chain managers may combine private with 3PL transportation to reduce total logistics costs.

Transportation adds place value to products and services.

Transportation is essential because no modern firm can operate without providing for the movement of its raw materials and /or finished products.

### 2. Transport Functionality

Transportation is a very visible element of logistics. Consumers are accustomed to seeing trucks and trains transporting product or parked at business facilities. Few consumers fully understand just how dependent our economic system is upon economical and dependable transportation.

Transportation enterprises provide two major services: Product Movement and Product Storage.

#### 2.1 Product Movement

Whether in the form of materials, components, work-in-process, or finished goods, the basic value provided by transportation is to move inventory to the next stage of the business process. The primary transportation value proposition is product movement up and down the logistics network. The performance of transportation is vital to procurement, manufacturing, and market distribution.

#### 2.2 Product Storage

A less visible aspect of transportation is product storage. While a product is in a transportation vehicle, it is being stored. Transport vehicles can also be used for

product storage at shipment origin or destination, but they are comparatively expensive storage facilities.

If the inventory involved is scheduled to move within a few days to a different location, the cost of unloading, warehousing, and reloading the product may exceed the temporary charge of using the transportation vehicle for storage.

### **3. Transport Principles**

There are two fundamental economic principles that impact transportation efficiency: economy of scale and economy of distance.

#### **3.1 Economies of Scale**

The cost per unit of weight generally decreases as the size of a shipment increases. For example, truckload shipments that use an entire vehicle's capacity have lower cost per kg than smaller shipments that use a limited portion of vehicle capacity.

It is also generally true that larger capacity transportation vehicles such as rail and water are less costly per unit of weight than smaller capacity vehicles such as trucks and air.

#### **3.2 Economy of Distance**

This refers to decreased transportation cost per unit of weight as distance increases. For example, a shipment of 1000 km will cost less to perform than two shipments of the same weight each moving 500 km.

Transportation economy of distance is often referred to as the *tapering principle*. The rationale for distance economies is similar to economies of scale. Specifically, longer distances allow fixed cost to be spread over more km, resulting in lower per km charges.

### **4. Transport Participants**

The transportation environment impacts the range of decisions that can be implemented in a logistical system. Unlike most commercial transactions, transportation decisions are influenced by six parties:

- Shipper.
- Destination party traditionally called the consignee.
- Carriers and agents.
- Government.
- Internet.

- The public.

Figure 6-1 illustrates the relationship among the involved parties. To understand the complexity of the transportation environment it is useful to review the role and perspective of each party.

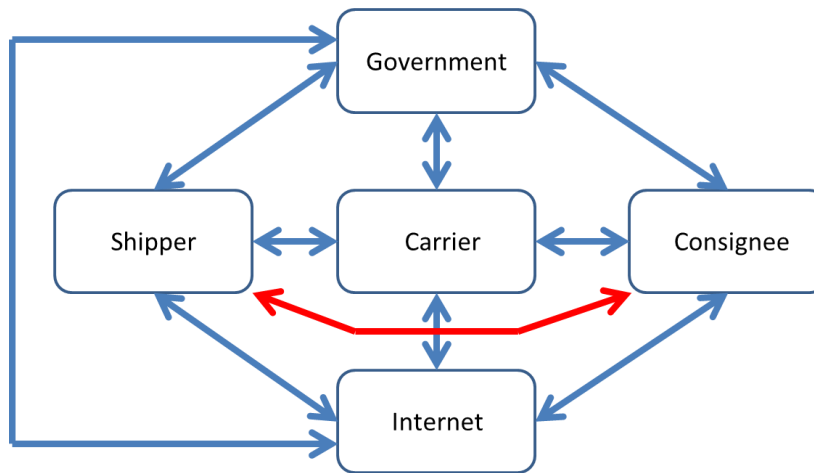


Figure 6-1: Relationship among Transportation Participants

#### 4.1 Shipper and Consignee

The shipper and consignee have a common interest in moving goods from origin to destination within a given time at the lowest cost. Services related to transportation include specified pickup and delivery times, predictable transit time, and zero loss and damage as well as accurate and timely exchange of information and invoicing.

#### 4.2 Carrier Agents

The carrier, a business that performs a transportation service, desires to maximize its revenue for movement while reducing associated costs.

As a service business, carriers want to charge their customers the highest rate possible while minimizing labor, fuel, and vehicle costs required to complete the movement.

To achieve this objective, the carrier seeks to coordinate pickup and delivery times in an effort to group or consolidate many different shippers' freight into movements that achieve economy of scale and distance.

Brokers and freight forwarders are transport agents that facilitate carrier and customer matching.

#### 4.3 Government

The government has a vested interest in transportation because of the critical importance of reliable service to economic and social well-being. Government desires a stable and efficient transportation environment to support economic growth.

A stable and efficient transportation environment requires that carriers provide essential services at reasonable cost. Because of the direct impact of transportation on economic success, governments have traditionally been more involved in the practices of carriers than in most other commercial enterprises.

#### **4.4 Internet**

A recent development in the transportation industry is a wide assortment of internet-based especially cloud computing services. The primary advantage of such communications is the ability of carriers to share real time information with customers and suppliers.

Information exchange operating over the internet provides carriers the opportunity to aggregate their purchasing and identify opportunities across a wide range of potential vendors.

The availability of real time information is improving shipment visibility to the point where tracing and tracking are no longer a challenge. In addition to real time visibility, the internet can be used to share information concerning scheduling and capacity planning.

### **5. Importance of an Effective Transportation System**

Without reliable transportation, most commercial activity could not function.

An efficient and inexpensive transportation system contributes to greater competition in the marketplace, greater economies of scale in production and reduced prices for goods.

#### **5.1 Greater Competition**

With a poorly developed transportation system, the extent of the market is limited to the areas immediately surrounding the point of production.

Unless production costs are extremely low compared with those at a second production point – that is, the production cost difference offsets the transportation costs of serving the second market – not much competition is likely to take place.

However, with improvements in the transportation system, the landed costs for products in distant markets can be competitive with other products selling in the same markets.

#### **5.2 Economies of Scale**

Wider markets can result in lower production costs. With the greater volume provided by these markets, more intense use can be made of production facilities and specialization of labor usually follows.

In addition, inexpensive transportation also permits decoupling of markets and production sites. This provides a degree of freedom in selecting production sites such that production can be located where there is a geographic advantage.

### **5.3 Reduced Prices**

Inexpensive transportation also contributes to reduced product prices. This occurs not only because of the increased competition in the marketplace but also because transportation is a component cost along with production, selling, and other distribution costs that make up the aggregate product cost.

As transportation becomes more efficient, as well as offering improved performance, society benefits through a higher stand of living.

## **6. Transport Cost Characteristics**

Transportation usually represents the most important single element in logistics costs for most firms. Freight movements have been observed to absorb between one-third and two-thirds of total logistics costs.

### **6.1 Variable and Fixed Costs**

A transportation service incurs a number of costs, such as labor, fuel, maintenance, terminal, roadway, administrative, and others. This cost mix can be arbitrarily divided into those costs that vary with services or volume (variable costs) and those that do not (fixed costs).

Fixed costs are those for roadway acquisition and maintenance, terminal facilities and transport equipment.

Variable costs usually include line-haul costs such as fuel and labor, equipment maintenance, handling, and pickup and delivery.

## **7. Cost Characteristics by Mode**

The type of services that a carrier is likely to emphasize is indicated by the nature of the general cost function and by the relationship of the mode to those of other carriers.

### **7.1 Rail**

As a transporter of freight and passengers, the railroad has the characteristics of high fixed cost and relatively low variable cost.

Loading, unloading, billing and collecting, and yard switching of multiple-product, multiple-shipment trains contribute to high terminal costs for rail.

Increased per-shipment volume and its effect on reducing terminal costs result in some substantial economies of scale, that is, lower per-unit costs for increased per-

shipment volume.

## **7.2 Water**

The major capital investment that a water carrier makes is in transport equipment and, to some extent, terminal facilities.

Waterways and harbors are publicly owned and operated. Little of this cost, especially for inland waterway operations, is charged back to water carriers. The predominant fixed costs in a water carrier's budget are associated with terminal operations.

Terminal costs include the harbor fees, as the carrier enters a seaport, and the costs for loading and unloading cargo.

Water is one of the least-expensive carriers of bulk commodities over long distances and in substantial volume.

## **7.3 Air**

Air transportation has many of the same cost characteristics as water carriers. Air terminals and the air space are generally not owned by the airline companies.

Airlines purchase airport services as needed in the form of fuel, storage, space rental, and landing fees.

If we include ground handling and pickup and delivery in the case of airfreight operations, these costs are the terminal costs for air transportation.

Combined fixed and variable expenses generally make air transportation a premium service, especially for short distances; however, distribution of terminal expenses and other fixed charges over increased volume offers some reduction in per-unit costs.

Substantial per-unit cost reductions come from operating aircraft over long distances.

## **8. Carrier Pricing Strategies**

When setting rates to charge shippers, carriers typically follow one or a combination of two strategies.

Although it is possible to employ a single strategy, the combination approach considers trade-offs between cost of service incurred by the carrier and value of service to the shipper.

### **8.1 Cost-of-Service**

The cost-of-service strategy is a build-up approach where the carrier establishes a rate based on the cost of providing the service plus a profit margin.

For example, if the cost of providing a transportation service is \$200 and the profit markup is 10 percent, the carrier would charge the shipper \$220.

## 8.2 Value-of-Service

It is an alternative strategy that charges a price based on value as perceived by the shipper rather than the carrier's cost of actually providing the service. For example, a shipper perceives transporting 1000 kg of electronics equipment as more critical or valuable than 1000 kg of coal since electronics are worth substantially more than the coal.

As such, a shipper is probably willing to pay more for transportation. Carriers tend to use value-of-service pricing for high-value goods or when limited competition exists.

Value-of-service pricing is illustrated in the premium overnight freight market.

When FedEx first introduced overnight delivery, there were few competitors that could provide comparable service, so it was perceived by shippers as a high-value alternative. They were willing to pay \$22.50 for overnight delivery of a single package. Once competitors such as UPS and the United States Postal Service entered the market, rates dropped to current discounted levels of \$5 to \$10 per package. This rate decrease more accurately reflects the value and cost of this service.

## 9. Total Cost Concept & Trade-offs

Central to the scope and design of the supply chain and logistics system is trade-off analysis, which, in turn, leads to the total cost concept.

Choosing a transportation service on the basis of either lowest rates or fastest service may not be the appropriate method. Therefore, the basic problem in supply chain is one of cost-conflict management.

Wherever there are substantial cost conflicts among activities, they should be managed in a coordinated manner.

Figure 6-2 shows that when a transportation service is being selected, the direct cost of the transport service and the indirect cost effect on inventory levels in the logistics channel due to different delivery performance of carriers are said to be in cost conflict with each other.

The best economic choice occurs at the point where the sum of both costs is lowest.



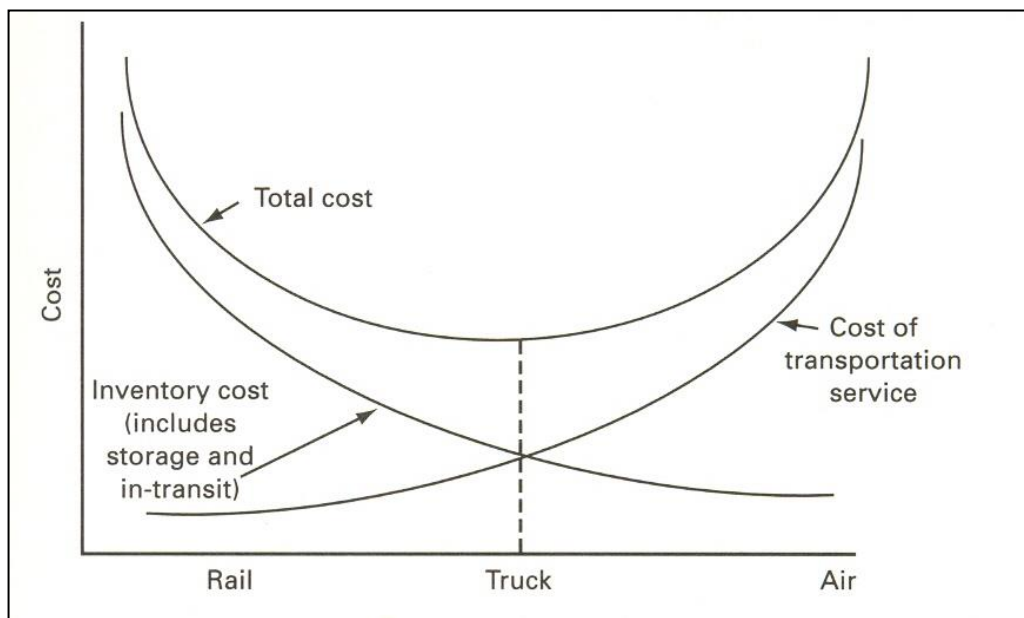


Figure 6-2: Cost Trade-off between Transportation and Inventory Costs as a Function of Transportation Service Characteristics

The total cost concept applies to more than the problem of selecting transportation service.

However, at times, decisions made by a firm in a channel of distribution affect the logistics costs of another firm. For example, the inventory policies of a buyer affect both the inventory costs of the shipper and the operating costs of the carrier.

## 10. Conclusion

We have seen that without a well-developed transportation system, logistics could not bring its advantages to the benefits to the economy. Besides, a good transport system in logistics activities could provide better logistics efficiency, reduce operation cost, and promote service quality.

Logistics and transport system need to work in tandem to bring out efficiency. In order for firms and the larger economy to exploit the benefits of an efficient logistics system, information and information system infrastructure must be in place to enhance customer service.