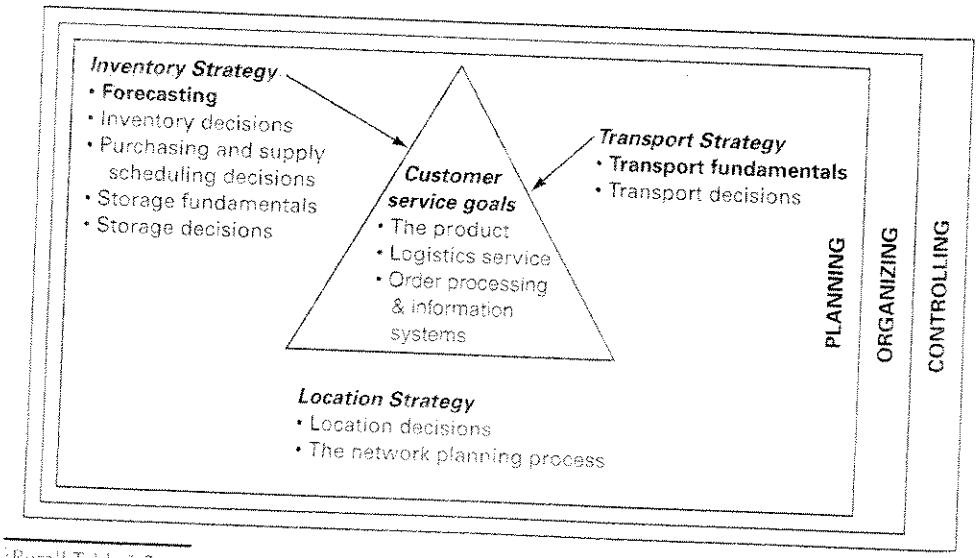
Chapter 6

Transport Fundamentals

When the Chinese write the word crisis, they do so in two characters—one meaning danger, the other opportunity.

—ANONYMOUS

Transportation usually represents the most important single element in logistics costs for most firms. Freight movement has been observed to absorb between one-third and two-thirds of total logistics costs.[1] Thus, the logistician needs a good understanding of transportation matters. Although a comprehensive discussion of transportation is not possible



[1] Recall Table 1-3 on page 14.

within the scope of this text, this chapter highlights what is essential to the logistician for his or her managerial purposes.

The focus is on the facilities and services that make up the transportation system and on the rates (costs) and performance of the various transport services that a manager might select. Specifically, we wish to examine the characteristics of the transportation service alternatives that lead to optimal performance. It is performance that the user buys from the transportation system.

Importance of an Effective Transportation System

One needs only to contrast the economies of a "developed" nation with those of a "developing" one to see the part that transportation plays in creating a high level of economic activity. It is typical in the developing nation that production and consumption take place in close proximity, much of the labor force is engaged in agricultural production, and a low proportion of the total population lives in urban areas. With the advent of inexpensive and readily available transportation services, the entire structure of the economy changes toward that of developed nations. Large cities result from the migration of the population to urban centers, geographical areas limit production to a narrow range of products, and the economic standard of living for the average citizen usually rises. More specifically, an efficient and inexpensive transportation system contributes to greater competition in the marketplace, greater economies of scale in production, and reduced prices for goods.

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.

In addition to encouraging direct competition, inexpensive, high-quality transportation also encourages an indirect form of competition by making goods available to a market that normally could not withstand the cost of transportation. Sales can actually be increased through market penetration normally unavailable to certain products. The goods from outside a region have a stabilizing effect on prices of all similar goods in the marketplace.

Application

In many markets, fresh fruits, vegetables, and other perishable products can be available at only certain times of the year due to seasonal growing patterns and lack of

good growing conditions. Yet, many such products are in season at any time during the year somewhere in the world. Rapid shipment at reasonable prices places these perishable products in markets that would not otherwise have the products available. Bananas from South America are available in New York in January, live New England lobsters are served in Kansas City restaurants throughout the year, and Hawaiian orchids are plentiful in the eastern United States in April. An efficient and effective transportation system makes this possible.

Economies of Scale

Wider markets can result in lower production costs. With the greater volume provided in these markets, more intense utilization 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 so that production can be located where there is a geographic advantage.

Observation

Auto parts manufactured in such places as Taiwan, Indonesia, South Korea, and Mexico are used in assembly operations in the United States and are sold in the U.S. marketplace. Low labor costs and high-quality production are the attractions to manufacture in these foreign locations. However, without inexpensive and reliable transportation, the cost of placing parts throughout the United States would be too high to compete with domestic production.

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 standard of living.

Observation

Crude oil can be obtained from domestic sources or it can be imported. Oil reserves in the Middle East are more accessible than they are domestically, and oil can be produced at a lower cost. With the use of large supertankers, oil can be transported to markets around the world and sold at lower prices than locally produced crude oil, if it is available at all.

Service Choices and Their Characteristics

The user of transportation has a wide range of services at his or her disposal that revolve around the five basic modes: water, rail, truck, air, and pipeline. A transport service is a set of performance characteristics purchased at a given price. The variety of transport services is almost limitless. The five modes may be used in combination (e.g., piggyback or container movement); transportation agencies, shippers' associations, and brokers may be used to facilitate these services; small-shipment carriers (e.g., Federal Express and United Parcel Service) may be used for their efficiency in handling small packages; or a single transportation mode may be used exclusively. From among these service choices, the user selects a service or combination of services that provides the best balance between the quality of service offered and the cost of that service. The task of service-choice selection is not as forbidding as it first appears, because the circumstances surrounding a particular shipping situation often reduce the choice to only a few reasonable possibilities.

To aid in solving the problem of transportation service choice, transportation service may be viewed in terms of characteristics that are basic to all services: price, average transit time, transit time variability, and loss and damage. These factors seem to be the most important to decision makers (recall Table 4-2), as numerous studies over the years have revealed.[2] It is presumed that the service is available and can be supplied with a frequency that makes it attractive as a possible service choice.

Price

Price (cost) of transport service to a shipper is simply the line-haul rate for transporting goods and any accessorial or terminal charges for additional service provided. In the case of for-hire service, the rate charged for the movement of goods between two points plus any additional charges, such as for pickup at origin, delivery at destination, insurance, or preparing the goods for shipment, makes up the total cost of service. When the shipper owns the service (e.g., a fleet of trucks), the cost of service is an allocation of the relevant costs to a particular shipment. Relevant costs include items such as fuel, labor, maintenance, depreciation of equipment, and administrative costs.

Cost of service varies greatly from one type of transport service to another. Table 6-1 gives the approximate cost per ton-mile for the five modes of transportation. Notice that airfreight is the most expensive, and pipe and water carriage are the least costly. Trucking is about seven times more expensive than rail, and rail is about four times as expensive as water or pipeline movement. These figures are averages that result from the ratio of freight revenue generated by a mode to the total

[2] For results of these studies, see James R. Stock and Bernard J. LaLonde, "The Transportation Mode Decision Revisited," *Transportation Journal* (Winter 1977), p. 56; James E. Piercy and Ronald H. Ballou, "A Performance Evaluation of Freight Transport Modes," *Logistics and Transportation Review*, Vol. 14, No. 2 (1978), pp. 99–115; and Douglas M. Lambert and Thomas C. Harrington, "Establishing Customer Service Strategies Within the Marketing Mix: More Empirical Evidence," *Journal of Business Logistics*, Vol. 10, No. 2 (1989), p. 50.

Table 6-1
Average Freight Ton-Mile Transportation Price by Mode

Mode	Price (¢/ton-mile)[a]
Rail	2.28[b]
Truck	26.10[c]
Water	0.74[d]
Pipe	1.46[e]
Air	61.20[f]

[a]Based on average per ton-mile
[b]Class 1
[c]Less than truckload
[d]Barge
[e]Oil pipeline
[f]Domestic
Source: Rosalyn A. Wilson, *Transportation in America 2000*, 18th ed. (Washington, DC: ENO Transportation Foundation, 2000), p. 19.

ton-miles shipped. While these average costs may be used for general comparisons, cost comparisons for the purpose of transport service selection should be made based on actual charges that reflect the commodity being shipped, the distance and direction of the movement, and any special handling required.

Transit Time and Variability

Repeated surveys have shown (recall Table 4-1) that average delivery time and delivery time variability rank at the top of the lists as important transportation performance characteristics. Delivery (transit) time is usually referred to as the average time it takes for a shipment to move from its point of origin to its destination. The different modes of transportation vary according to whether or not they provide direct connection between the origin and destination points. For example, shipments move on air carriers between airports or on water carriers between seaports. However, for purposes of comparing carrier performance, it is best to measure transit time door-to-door, even if more than one mode is involved. Although the major movement of a shipment may be by rail, local pickup and delivery are often made by truck if no rail sidings are available at the shipment origin and destination points.

Variability refers to the usual differences that occur between shipments by various modes. All shipments having the same origin and destination points and moving on the same mode are not necessarily in transit for the same length of time due to the effects of weather, traffic congestion, number of stop offs, and differences in time to consolidate shipments. Transit time variability is a measure of the uncertainty in carrier performance.

Statistics on carrier performance are not extensive, as no one business utilizes the total transportation system enough to provide worthwhile comparisons on a large scale. However, the military and government agencies use the domestic transportation system extensively for all kinds of commodity movements and maintain good records on delivery times. Where the data are available, selective cross-checking

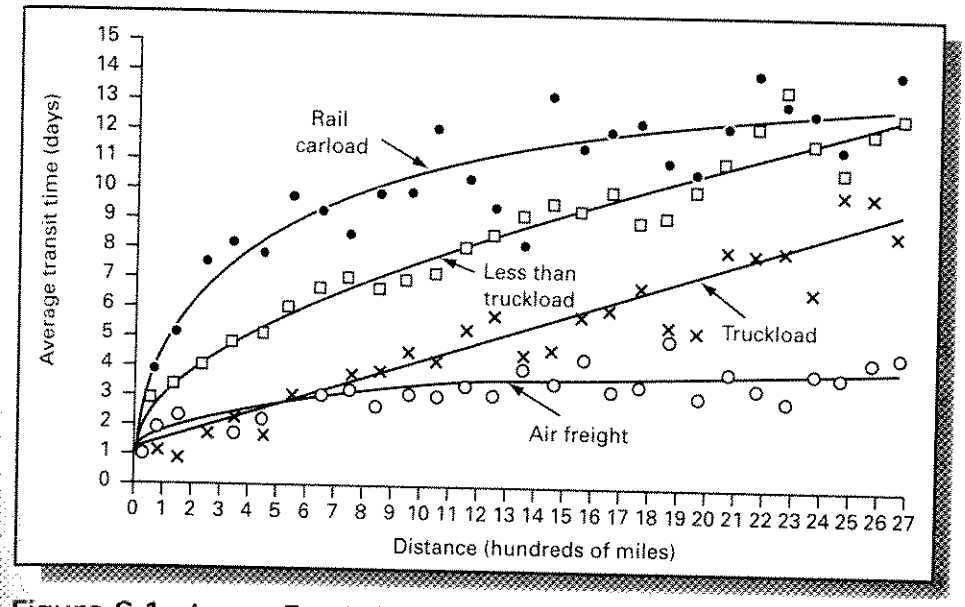


Figure 6-1 Average Transit-Time Experience for Approximately 16,000 Military and Industrial Shipments by Selected Transport Service

Source: James Piercy, "A Performance Profile of Several Transportation Freight Services," (Ph.D. diss., Case Western Reserve University unpublished, 1977).

against industrial shipments shows no significant differences between the data sources with regard to transit time variability.

One of the most extensive studies of carrier performance was carried out on more than 16,000 military and industrial shipments. Some of the results are summarized in Table 6-2 and Figure 6-1. Particularly note that over long distances, rail and air shipments approach constant average transit times, whereas truck transit times continue to increase. Of course, on the average, airfreight is the fastest mode for distances of more than 600 miles, with truckload, less than truckload, and rail following, respectively. For distances less than 600 miles, air and truck are comparable. For very short distances of less than 50 miles, the transit time is influenced more by the pickup and delivery operation than the line-haul transit time.

In terms of variability, the transport services can be roughly ranked as they were for average delivery time. That is, rail has the highest delivery time variability and air has the lowest, with truck service falling between these extremes. If variability is viewed relative to the average transit time for the transport service, air can be the least dependable and truckload the most dependable.

Loss and Damage

Because carriers differ in their ability to move freight without loss and damage, loss and damage experience becomes a factor in selecting a carrier. Product condition is a primary customer service consideration.

Table 6-2 A Comparison of Average Transit Time and Time Range for 95% of Shipments in Days by Various Transport Services for Selected Mileages

Selected Mileages	Railcarload		Less Than Truckload		Truckload		Airfreight		Air Express		Piggyback[a]	
	Avg.	95% Range	Avg.	95% Range	Avg.	95% Range	Avg.	95% Range	Avg.	95% Range	Avg.	95% Range
0–49	1.5	0[b]–3.5	1.7	0–5.1	0.8	0–3.2	—[c]	—[c]	—[c]	—[c]	—[c]	—[c]
100–199	5.2	0–11.9	3.4	0–7.7	2.0	0–5.6	2.3	0–7.7	1.9	0–5.1	3.8	0–7.4
300–399	8.3	1.4–15.2	5.0	0.4–9.6	1.9	0–4.7	1.8	0–5.9	2.1	0–5.7	4.4	1.7–7.1
500–599	9.8	2.5–17.1	6.0	0–12.0	2.7	0–6.4	3.1	1.1–6.0	1.6	0–4.1	6.6	0–13.7
700–799	8.6	0.6–16.6	7.1	0–14.5	4.1	0–8.9	3.2	0.1–6.3	2.3	0–6.1	6.2	1.0–11.4
1000–1099	12.2	2.9–21.5	7.4	1.3–13.5	4.0	1.1–6.9	3.0	0.2–5.9	1.4	0–3.7	6.1	1.5–10.7
1500–1599	11.1	5.6–16.6	8.9	0.7–17.2	5.3	0.8–9.9	4.6	0.7–9.9	1.5	0–4.9	4.6[d]	0–10.0[d]
2000–2099	11.5	1.4–21.5	11.1	3.2–18.9	8.0	0–16.1	4.0	0–9.0	1.8	0–4.6	5.1[d]	2.6–7.7[d]
2500–2599	12.4	8.3–16.6	12.3	6.7–17.9	8.8	3.3–14.3	4.4	0–10.1	3.4	0–9.6	6.7[d]	1.1–12.2[d]
3000–3099	10.6	1.5–19.7	12.9	3.8–22.0	10.4	5.9–14.9	3.2	0.7–7.0	6.0	0–23.3	5.6[d]	3.9–7.3[d]

[a]Trailer on flatcar
[b]Zero refers to shipment deliveries made in less than one day
[c]Insufficient data
[d]DeHayes' data

Source: Adapted from James Piercy, "A Performance Profile of Several Transportation Freight Services," (Ph.D. diss., Case Western Reserve University unpublished, 1977); and Daniel DeHayes, Jr., "The General Nature of Transit Time Performance of Selected Transportation Modes in the Movement of Freight," (Ph.D. diss., Ohio State University, 1968): pp. 163–177.

Common carriers have an obligation to move freight with reasonable dispatch and to do so using reasonable care in order to avoid loss and damage. This responsibility is relieved if loss and damage result from an act of God, default by the shipper, or other causes not within control of the carrier. Although carriers, upon proper presentation of the facts by the shipper, incur the direct loss sustained by the shipper, there are certain imputed costs that the shipper should recognize before making a carrier selection.

Potentially the most serious loss that the shipper may sustain has to do with customer service. The shipment of goods may be for replenishing a customer's inventory or for immediate use. Delayed shipments or goods arriving in unusable condition means inconvenience for the customer or possibly higher inventory costs arising from a greater number of stockouts or back orders when anticipated replenishment stocks are not received as planned. The claims process takes time to gather pertinent facts about the claim, takes effort on the part of the shipper to prepare the proper claim form, ties up capital while claims are being processed, and sometimes involves a considerable expense if the claim can be resolved only through court action. Obviously, the fewer the claims against a carrier, the more favorable the service appears to the user. A common reaction of shippers to a high likelihood of damage is to provide increased protective packaging. This expense must ultimately be borne by the user as well.

Single-Service Choices

Each of the five basic transportation modes offers its services directly to users. This is in contrast to the use of a "transportation middleman," such as a freight forwarder, who sells transportation services but usually owns little or no line-haul movement capability. Single-mode service is also in contrast to those services involving two or more individual transportation modes.

Rail

The railroad is a long hauler and slow mover of raw materials (coal, lumber, and chemicals) and of low-valued manufactured products (food, paper, and wood products) and prefers to move shipment sizes of at least a full carload. In 1999, the average length of haul was 712 miles,[3] with an average train speed of 20 miles per hour.[4] Average car distance traveled was 64 miles per day in line-haul service.[5] This relatively slow speed and short car distance traveled in a day reflect the fact that the majority (86 percent) of freight car time is spent in loading and unloading operations, moving from place to place within terminals, classifying and assembling cars into trains, or standing idle during a seasonal slump in car demand.

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[3] Rosalyn A. Wilson, *Transportation in America 2000*, 18th ed. (Washington, DC: ENO Transportation Foundation, 2000), p. 51.
[4] *Statistical Abstract of the U.S.: 2000*, p. 695.
[5] *Statistical Abstract of the U.S.: 1989*, p. 606.

Rail service exists in two legal forms, common carrier or privately owned. A common carrier sells its transportation services to all shippers and it is guided by the economic[6] and safety regulations of the appropriate government agencies. In contrast, private carriers are shipper owned with the usual intent of serving only the owner. Because of the limited scope of the private carrier's operations, no economic regulation is needed. Nearly all rail movement is of the common carrier type.

Common carrier line-haul rail service is primarily carload (CL). A carload quantity refers to a predetermined shipment size, usually approaching or exceeding the average capacity of a railcar to which a particular rate is applied. A multiple-carload quantity rate per hundredweight (cwt.) may be offered and is less than the less-than-carload (LCL) rate, which reflects the reduced handling time required for high-volume shipments. Nearly all rail freight today moves in carload quantities, a reflection of the trend toward volume movement. Larger freight cars are being used with an average freight car capacity of 83 tons, and single-commodity trains (called unit trains) of 100 or more cars per train are being used with rate reductions of 25 to 40 percent over single carloads.

Railroads offer a diversity of special services to the shipper, ranging from the movement of bulk commodities such as coal and grain to special cars for refrigerated products and new automobiles which require special equipment. Other offerings include expedited service to guarantee arrival within a certain number of hours; various stop-off privileges, which permit partial loading and unloading between origin and destination points; pickup and delivery; and diversion and reconsignment, which allow circuitous routing and changes in the final destination of a shipment while en route.

Truck

In contrast with rail, trucking is a transportation service of semifinished and finished products with an average length of freight haul of 717 miles for less than truckload (LTL) and 286 miles for truckload (TL).[7] In addition, trucking moves freight with smaller average shipment sizes than rail. More than half of the shipments by truck are less than 10,000 pounds, or LTL volume. The inherent advantages of trucking are its door-to-door service, involving no loading or unloading between origin and destination, as is often true of rail and air modes; its frequency and availability of service; and its door-to-door speed and convenience.

Truck and rail services show some distinct differences, even though they compete for many of the same product shipments. First, in addition to the common and private legal classification of carriers, trucking offers services as contract carriers as well. Contract carriers do not hire themselves out to service all shippers as do common carriers. Shippers enter into a contractual arrangement to obtain a service that better meets their particular needs without incurring the capital expense and administrative problems associated with private ownership of a trucking fleet.

[6]Little federal economic regulation remains since the passing of the Staggers Rail Act of 1980, which economically deregulated rail transportation. Some regulation remains at the state level.
[7]*Transportation in America 2000*, p. 51.

Second, trucks can be judged less capable of handling all types of freight than rail, mainly due to highway safety restrictions that limit the dimensions and weight of shipments. Most shipments must be shorter than the popular 40- to 53-foot trailer (unless a double or triple bottom) and less than 8 feet wide and 8 feet tall to ensure road clearance. Specially designed equipment can accept loads in different dimensions than these.

Third, trucking offers reasonably fast and dependable delivery for LTL shipments. The trucker needs to fill only one trailer before moving the shipment, whereas a railroad must be concerned with making up a train length of 50 cars or more. On balance, trucking has a service advantage in the small-shipment market.

Air

Air transportation is being considered by increasing numbers of shippers for regular service, even though airfreight rates exceed those of trucking by more than two times and those of rail by more than 16 times. The appeal of air transportation is its unmatched origin-destination speed, especially over long distances. The average length of a freight haul is 1,001 miles.[8] Commercial jets have cruising speeds between 545 and 585 miles per hour, although airport-to-airport average speed is somewhat less than cruising speed because of taxi and holding time at each airport and the time needed to ascend to and descend from cruising altitude. But this speed is not directly comparable with that of other modes because the times for pickup and delivery and for ground handling are not included. All these time elements must be combined to represent door-to-door air delivery time. Because surface freight handling and movement are the slowest elements of total door-to-door delivery time, overall delivery time may be so reduced that a well-managed truck and rail operation can match the schedule of air. Of course, this depends on individual cases.

Air-service dependability and availability can be rated as good under normal operating conditions. Delivery-time variability is low in absolute magnitude, even though air service is quite sensitive to mechanical breakdown, weather conditions, and traffic congestion. Variability, when compared with average delivery times, can rank air as one of the least reliable modes.

The capability of air has been greatly constrained by the physical dimensions of the cargo space in the aircraft and the aircraft's lifting capacity. This is becoming less of a constraint, however, as larger aircraft are put into service. For example, "jumbo" airplanes such as the Boeing 747 and Lockheed 500 (commercial version of the military's C5A) handle cargo of 125 to 150 tons. Door-to-door ton-mile costs are expected to drop to about one-half of the current cost levels through the benefits of new technology, deregulation, and productivity-improvement programs. This would make air a serious competitor with the more premium forms of surface-transport services.

Air transportation has a distinct advantage in terms of loss and damage. According to a classic study by Lewis, Culliton, and Steele,[9] the ratio of claim costs to

[8] Ibid.

[9] Howard T. Lewis, James W. Culliton, and Jack W. Steele, *The Role of Air Freight in Physical Distribution* (Boston: Division of Research, Graduate School of Business Administration, Harvard University, 1956), p. 82.

freight revenue was only about 60 percent of those for truck or rail. In general, less protective packaging is required for airfreight, if ground handling does not offer a higher exposure to damage than the en route phase of the movement and airport theft is not excessive.

Air transportation service exists in common, contract, and private legal forms. Direct air service is offered in seven types: (1) regular domestic truck-line carriers; (2) all-cargo carriers; (3) local-service airlines; (4) supplemental carriers; (5) air taxis; (6) commuter airlines; and (7) international carriers. About a dozen airlines operate currently over the most heavily traveled routes. These airlines offer cargo-carrying services in addition to their regularly scheduled passenger operations. All cargo carriers are common carriers of freight only. Service is concentrated at night, and rates average 30 percent less than those for domestic trunk-line carriers. Local-service airlines provide a "connecting" service with domestic trunk-line carriers for less populated centers. They provide both cargo and passenger service. Supplemental (charter) carriers operate much as do trunk-line carriers, except that they do not have regular schedules. Commuter airlines are like local-service carriers that "fill in" routes abandoned by trunk-line carriers since deregulation. In general, smaller aircraft are operated than those of trunk-line carriers. Air taxis are small aircraft, namely, helicopters and small fixed-wing aircraft, offering a shuttle service for passengers and cargo between downtown areas and airports. They often have only irregular service. International carriers transport freight and passengers beyond their domestic regions.

Water

Water transportation service is limited in scope for several reasons. Domestic water service is confined to the inland waterway system, which requires shippers to be located on the waterways or to use another transportation mode in combination with water. In addition, water service on the average is slower than rail. The average speed on the Mississippi water system is between five and nine miles per hour, depending on direction. The average length of a freight haul is 481 miles on rivers, 507 miles on the Great Lakes, and 1,648 miles along U.S. coasts.[10] Availability and dependability of water service are greatly influenced by the weather. Movement on the waterways in the northern part of the country during the winter is impossible, and floods and droughts may interrupt service at other times. There is tremendous capacity available in water carriers, with barge tows up to 40,000 tons, and there are individual barges with standardized dimensions 26 by 175 feet and 35 by 195 feet. Capability and handling are being increased as barge-carrying ships are being developed, and such improvements as satellite navigation with radar, refined depth finders, and auto piloting mean around-the-clock service.

Water services are provided in all legal forms, and most commodities shipped by water move free of economic regulation. In addition to unregulated private carriage, liquid cargoes in bulk moving in tank vessels and commodities in bulk such as coal,

[10] *Transportation in American 2000*, p. 51.

sand, and grain, which make up over 80 percent of the total annual ton-miles by water, are exempt. Outside of the handling of bulk commodities, water carriers, especially those in foreign service, do move some higher-valued commodities. This freight moves in containers[11] on containerized ships to reduce handling time, to affect intermodal transfer, and to reduce loss and damage.

Loss and damage costs resulting from transporting by water are considered low relative to other modes because damage is not much of a concern with low-valued bulk products, and losses due to delays are not serious (large inventories are often maintained by buyers). Claims involving transport of high-valued goods, as in ocean freight, are much higher (approximately 4 percent of ocean-ship revenues). Substantial packaging is needed to protect goods, mainly against rough handling during the loading and unloading operations.

Pipeline

To date, pipeline transportation offers a very limited range of services and capabilities. The most economically feasible products to move by pipeline are crude oil and refined petroleum products. However, there is some experimentation with moving solid products suspended in a liquid, referred to as a "slurry," or containing the solid products in cylinders that in turn move in a liquid within the pipe. If these innovations prove to be economical, pipeline service could be greatly expanded. Early experience with coal suspended in a liquid has not been favorable, because the pipes have eroded.

Product movement by pipeline is very slow, only about three to four miles per hour. This slowness is tempered by the fact that products move 24 hours a day, 7 days a week. This makes the effective speed much greater when compared with other modes. Pipeline capacity is high, considering that a 3-mph flow in a 12-in.-diameter pipe can move 89,000 gallons per hour.

Concerning transit time, pipeline service is the most dependable of all modes, because there are few interruptions to cause transit time variability. Weather is not a significant factor, and pumping equipment is highly reliable. In addition, the availability of pipeline capacity is limited only by the use that other shippers may be making of the facilities at the time capacity is desired.

Product loss and damage for pipelines is low because (1) liquids and gases are not subject to damage to the same degree as manufactured products; and (2) the number of dangers that can befall a pipeline operation is limited. There is liability for such loss and damage when it does occur because pipelines have the status of common carriers, even though many are private carriers in form.

To summarize the quality of the services offered by transportation industry, Table 6-3 shows a ranking of the various modes using the four cost and performance characteristics set forth at the beginning of this section. It should be recognized that under specific circumstances of product type, shipping distance, carrier management, user-carrier relationships, and weather conditions, these rankings may change, and the service of particular modes may not be available.

[11] Containers are standardized "boxes," usually 8 × 8 × 10 ft, 8 × 8 × 20 ft, or 8 × 8 × 40 ft, in which freight is handled as a unit and which are easily transferred as a unit to other transportation modes.

Mode of Transportation	Performance Characteristics: Cost[b] 1 = Highest	Average Delivery Time[c] 1 = Fastest	Delivery-Time Variability: Absolute 1 = Least	Delivery-Time Variability: Percent[d] 1 = Least	Loss and Damage 1 = Least
Rail	3	3	4	3	5
Truck	2	2	3	2	4
Water	5	5	5	4	2
Pipe	4	4	2	1	1
Air	1	1	1	5	3

[a] Service is assumed to be available
[b] Cost per ton-mile
[c] Door-to-door speed
[d] Ratio of absolute variation in delivery time to average delivery time
Source: Author's estimates for average performance over a variety of circumstances.

Table 6-3 Relative Rankings of Transportation Mode by Cost and Operating Performance Characteristics[a]

Intermodal Services

In recent years, there has been an increase in shipping products using more than one transportation mode in the process. Beyond obvious economic benefits, increased international shipping has been a driving force. The major feature of intermodalism is the free exchange of equipment between modes. For example, the container portion of a truck trailer is carried aboard an airplane, or a railcar is hauled by a water carrier. Such equipment interchange creates transportation services that are not available to a shipper using a single-transportation mode. Coordinated services are usually a compromise between the services individually offered by the cooperating carriers. That is, cost and performance characteristics rank between those of the carriers separately.

There are ten possible intermodal service combinations: (1) rail-truck; (2) rail-water; (3) rail-air; (4) rail-pipeline; (5) truck-air; (6) truck-water; (7) truck-pipeline; (8) water-pipeline; (9) water-air; and (10) air-pipeline. Not all of these combinations are practical. Some that are feasible have gained little acceptance. Only rail-truck, called *piggyback*, has seen widespread use. Truck-water combinations, referred to as *fishyback*, are gaining acceptance, especially in the international movement of high-valued goods. To a much lesser extent, truck-air and rail-water combinations are feasible, but they have seen limited use.

Trailer on Flatcar

Trailer on flatcar (TOFC), or piggyback, refers to transporting truck trailers on railroad flatcars, usually over longer distances than trucks normally haul. TOFC is a

blend of the convenience and flexibility of trucking and the long-haul economy of rail. The rate is usually less than for trucking alone and has permitted trucking to extend its economical range. Likewise, rail has been able to share in some traffic that normally would move by truck alone. The shipper benefits from the convenience of door-to-door service over long distances at reasonable rates. These features have made piggyback the most popular coordinated service. The number of railcars loaded with highway trailers and containers has shown a steady and dramatic increase from 554,000 in 1960 to 9,740,000 in 1996 (annualized), or 55 percent of railcar loadings.[12]

Five different plans are offered for TOFC service, depending on who owns the highway equipment and rail equipment and on the rate structure established. These plans are as follows:

- *Plan I.* Railroads transport the trailers of highway common carriers. Billing is through the highway carriers, and the railroads charge a portion of the carriers' rate or a flat fee for moving the trailer.
- *Plan II.* Railroads use their own trailers and containers and transport these on their own flatcars to provide a door-to-door service. Railroads contract with local truckers to handle assembly at originating terminals and delivery from destination terminals. Shippers deal only with railroads and receive rates comparable to those of highway common carriers.
- *Plan II 1/4.* Similar to Plan II, except railroads provide either pickup or delivery, or both.
- *Plan II 1/2.* Railroads provide the trailers or containers and the shippers provide the service of moving these to and from the rail terminals.
- *Plan III.* Shippers or freight forwarders can place their own trailers or containers, empty or loaded, on railroad flatcars for a flat rate. The rate is for ramp-to-ramp; that is, pickup and delivery are the responsibility of the shippers.
- *Plan IV.* Shippers furnish not only the trailers or containers, but also the railroad equipment on which the trailers or containers move. The railroad charges a flat rate for moving the cars, empty or loaded. The payment to the railroad is for the rails and for pulling power.
- *Plan V.* Two or more rail and truck carriers quote jointly on TOFC service. Each carrier may solicit freight for the other, which has the effect of extending the territory of each into that served by the other.

Containerized Freight

Under a TOFC arrangement, the entire trailer is transported on a railroad flatcar. However, it is also possible to visualize the trailer in two ways, that is, (1) as a container or box in which the freight is packaged; and (2) as the trailer's chassis. In a truck-rail intermodal service, it is possible to haul only the container, thus saving the dead weight of the understructure and wheels. Such a service is called container-on-flatcar (COFC).

[12] "Intermodal Traffic Creeps Upward," *Daily Trucking and Transportation News* (July 24, 1996).

The standardized container is a piece of equipment that is transferable to all surface transportation modes with the exception of pipeline. Because containerized freight avoids costly rehandling of small shipment units at the point of intermodal transfer and offers a door-to-door service capability when combined with truck, water carriers use container ships so that combinations of water-truck service can be provided. This type of service is expanding, especially due to the increase in international trade. The container can also be used in combination services with air. The most promising to date is the air-truck combination. The container is important to air transportation because the high movement costs prohibit transporting the chassis of a highway trailer. The use of large containers in air transportation has been limited by the dimensions of the existing aircraft and the small shipment sizes that air transportation predominantly handles, but as air freight rates are reduced, possibly due to larger aircraft being put into service, coordinated air-truck service should expand.

The services of coordinated transportation services will hinge on the container size that is adopted as standard. A container that is too large for trucking or that is incompatible with trucking equipment will exclude trucking from participating. The same argument holds for the other modes. The typical container sizes are 8 by 8 by 20 feet and 8 by 8 by 40 feet. Both are compatible with the standard 40-foot highway trailer and with most other modes.

Observation

Containerized freight movement began in 1956 when Malcom McClean first moved freight in ocean-borne trailers on a World War II tanker that sailed from Newark, New Jersey, to Houston, Texas. Soon after this, a ship was specially converted to stack van-sized boxes on its deck. Containerized service spread from Puerto Rico to Europe to the Pacific. McClean's idea cut terminal handling time, stealing, and insurance costs. Now, 75 percent of the U.S. ocean merchandise trade with the rest of the world is hauled in big containers instead of the crates, tubs, sacks, and boxes previously used.[13]

Agencies and Small Shipment Services

Agents

Several agencies exist that offer transportation services to shippers but own little or no line-haul equipment. Primarily, they handle numerous small shipments and consolidate them into vehicle-load quantities. Rates competitive with those for LTL are charged, and the agency, through its consolidation of the many small shipments it handles, can obtain vehicle-load rates. The freight-rate differential between large

[13] "McClean Makes Containers Shipshape, 1956," *Wall Street Journal*, November 29, 1989, B1.

and small shipments helps to offset operating expenses. In addition to consolidation, agencies provide pickup and delivery services to shippers. Transportation agencies include air and surface freight forwarders, shippers' associations, and transport brokers.

Freight forwarders are for-hire carriers of freight. They do own some equipment, but this is mainly for pickup and delivery operations. They purchase long-distance services from air, truck, rail, and water carriers. A major advantage of freight forwarders is that they can quote rates on shipments up to 30,000 pounds, while the average shipment weight handled is only about 300 pounds.

Shippers' associations are cooperative organizations operating on a nonprofit basis. Members belong to the association to realize lower shipping costs. The associations are designed to perform services similar to those of freight forwarders. They act as a single shipper in order to obtain volume rates. Each member shipper pays a portion of the total freight bill, based on the amount to be shipped.

Transport brokers are agents that bring shippers and carriers together by providing timely information about rates, routes, and capabilities. They may arrange for transportation, but assume no liability for it. They are especially valuable to carriers that use brokers to find business for them. Numerous Web sites have emerged that, for a fee, match shippers and carriers for better use of transportation equipment for carriers and lower rates for shippers.

Small-Shipment Services

Parcel post is a small-shipment delivery service offered by United States Postal Service. Shipments are limited in size and may weigh up to 70 pounds and be up to 130 inches in length,[14] and delivery is made to all points in the United States. Rates are based on the distance from the point of shipment origin to the point of delivery. Parcel post uses the service of line-haul carriers. United Parcel Service and Federal Express offer small-package services similar to parcel post, with competitive rates and performance levels. Pickup service is available and deliveries are made in all states and around the world. Premium air small-shipment services also are available that offer overnight and, in some cases, same-day delivery. Federal Express is the most popular service of this type, although UPS and United States Postal Service offer competing services.

In addition to agencies that specialize in small-shipment services, line-haul carriers also move small shipments. There is usually a flat charge when the shipment weight is below a certain minimum weight, generally 200 to 300 pounds for trucking. Service is often less favorable than for large shipments. Revenues among these services are distributed as follows: UPS truck—31.6 percent; LTL truck—39.6 percent; normal air—4.2 percent; special air[15]—24.6 percent; and rail and bus—negligible.[16]

[14]Size refers to the sum of the length (longest dimension) and girth (twice the width plus twice the depth). These limits are further reduced for first-class postal service.
[15]Federal Express, UPS, DHL, and Airborne Express.
[16]Rosalyn A. Wilson, *Transportation in America*, 17th ed. (Washington, DC: ENO Transportation Foundation, 1999), p. 19.

Company-Controlled Transportation

An available alternative to outsourcing transport of goods is to provide transportation service through company ownership of equipment or contracting for transportation services. Ideally, the user hopes to gain better operating performance, greater availability and capacity of transportation service, and a lower cost. At the same time, a certain amount of financial flexibility is sacrificed because the company must invest in a transportation capability or must commit itself to a long-term contractual arrangement. If the shipping volume is high, it may be more economical to own the transportation service than to rent it. However, some companies are forced to own or contract for transportation even at higher costs because their special requirements for service cannot be adequately met through common carrier services. Such requirements might include (1) fast delivery with very high dependability; (2) special equipment not generally available; (3) special handling of the freight; and (4) a service that is available on demand. Common carriers serve many customers and cannot always meet the specific transportation requirements of individual users.

International Transportation

The success of the transportation industry in developing a fast, reliable, and efficient transportation system has substantially contributed to the dramatically expanding level (24 times) of international trade occurring in the last 30 years (about a threefold increase in revenue for international air and water movements from 1980 to 1996 alone).[17] Inexpensive transportation has allowed domestic companies to take advantage of the differences in labor rates worldwide, to secure raw materials that are geographically dispersed, and to place goods competitively in markets far from their domestic borders. Thus, the logistician must be knowledgeable about the special requirements for moving goods internationally.

Overview

Water carriers dominate international transportation, with more than 50 percent of the trade volume in dollars and 99 percent by weight. Air moves 21 percent of the dollar trade volume, and the remainder is transported by truck, rail, and pipeline between bordering countries.

The dominance of particular transport modes is largely affected by the geography of the country and the proximity of major trading partners. Island countries, such as Japan and Australia, must use air and water modes extensively. However, many of the member countries of the European Union can make use of rail, truck, and pipeline modes.

Route choices become much more restricted than in domestic movement because goods must move through a limited number of ports and customs points in order to

[17] *Statistical Abstract of the U.S.: 1997*, p. 656.

leave or enter a country. Although this may make routing easier and more obvious as compared with domestic movements, the problems brought about by the legal requirements of moving goods between two or more countries and the more limited liability of international carriers as compared with domestic carriers can make international movement more complex. That is, international shipments must move under more documents than domestic shipments, are subject to delays brought about by the legal requirements for entering and exiting a country, and are subject to the routing restrictions of two or more countries. In addition, limited carrier liability (ocean carriers need only provide a seaworthy vessel as evidence of responsibility) results in increased protective packaging, and increased insurance and documentation costs as a hedge against potential loss. This helps to explain some of the popularity of containerization for moving high-valued goods in international markets.

Physical Plant

The physical plant for international transportation differs only in a few respects from the domestic system. The transportation equipment is of the same type except the size may differ somewhat. The physical routes are different because they cover different geographic territories than do domestic routes. However, a distinct difference is the foreign trade zone and the role that it plays in the routing of international shipments.

Customers' expenses, tariffs, duties, and taxes are assessments that governments place on imported goods. These often prove burdensome to the exporter. The exporter may find it a disadvantage to pay duties to the importing country at the time and in the form that goods are received for import, and/or the exporter might like to use the labor of the importing country or its strategic location for manufacturing and storage but finds it uneconomical because of the duties. Foreign trade zones, or free ports, eliminate this disadvantage, to the benefit of both the exporting and importing countries. There is no direct counterpart to the trade zone in domestic trade.

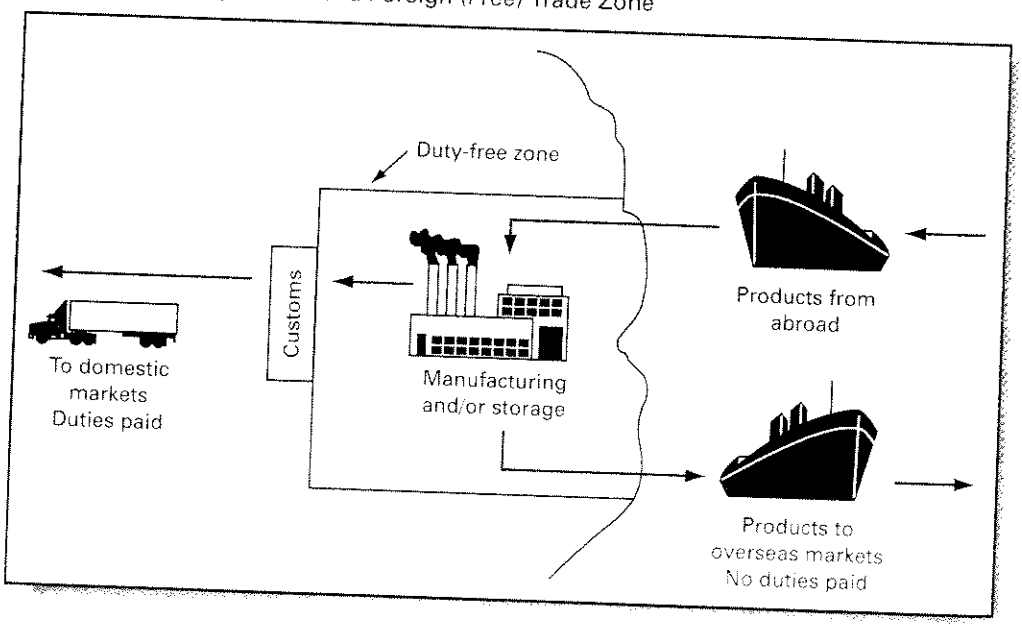
Trade zones are duty-free areas established at one or more entry points within a country, such as seaports and airports, where foreign goods may enter, be held or processed in some way, and be reshipped without incurring any duties. Figure 6-2 shows a diagram of how the trade zone operates. There are 225 general-purpose zones and 359 subzones located in the United States.[18] They can offer numerous advantages to the logistician responsible for international movement of goods. The important advantages of foreign trade zones can be summarized as follows:

1. Imported goods may be left at trade zones for storage, manipulation to change custom classification, assembly, exhibition, grading, cleaning, selling, mixing with foreign and domestic merchandise, repacking, destruction, sorting, and other services and then shipped out of the zone to another country without customs formalities or control.
2. Foreign governments pay duties on goods in the trade zone only when they enter the customer's territory of the importing country.

[18] Web site for the National Association of Foreign-Trade Zones, found at www.naftz.org.

3. Imported goods that are improperly marked for entry into the domestic market can be remarked at the trade zones, thus avoiding fines on the goods.
4. Goods may be repacked into smaller or larger quantities.
5. Goods that undergo shrinkage to spoilage, evaporation, or damage do not incur duties on the amount lost.
6. Savings sometimes can be realized through shipping goods unassembled to the zone and then assembling them.
7. The capital tied up in duties and bonds can be released for more profitable uses when products using duty-subject foreign materials are shipped to the trade zones to remain until foreign buyers are found or buyers are ready for delivery.
8. Importers may obtain privileged foreign trade status whereby duties are frozen against future increases.
9. Manufacturing conducted in trade zones incurs duties only on the imported materials and component parts in the finished product entering into the domestic market.
10. Tangible personal property is generally exempt from state and local taxes.
11. Customs security requirements provide protection against theft.
12. Merchandise may remain in a zone indefinitely.[19]

Figure 6-2 Operation of a Foreign (Free) Trade Zone



[19]Derived from an excellent discussion of trade zones by Gordon E. Miracle and Gerald S. Albaum, *International Marketing Management* (Homewood, IL: Richard D. Irwin, 1970), pp. 438–445; Pat J. Calabro, "Foreign Trade Zones—A Sleeping Giant in Distribution," *Journal of Business Logistics*, Vol. 4, No. 1 (1983), 51–64; Web site for the National Association of Foreign-Trade Zones, www.naftz.org; and Dick Morreale, "Logistics Rules of Thumb IV," www.logfac.com (August 2001).

Foreign (free) trade zones become forward bases for goods moving to or for goods received from foreign markets or suppliers. The advantages that they provide may well affect the routing of goods. Bonded warehouses, both public and private, can serve as foreign trade zones.

Application

Dorcy International Inc. is an assembler of flashlights and lanterns, the supplies for which are imported from China. Historically, Dorcy paid a 12.5 percent duty on parts as soon as they arrived on the West Coast. Now, yellow and black flashlights are freighted from China and shipped by rail to the abandoned Rickenbacker military base near Columbus, Ohio, which has become a foreign trade zone. By establishing the operation within the Rickenbacker trade zone, Dorcy has postponed duties until the goods are assembled, packed, and shipped to customers such as Sears, Wal-Mart, and Kmart—a process that can take 30 days. The delayed payment of duties can save Dorcy hundreds of thousands of dollars per year. And if the flashlights are assembled and exported to another country, no duties are paid at all. For tax purposes, it is as if the product never landed in the United States.[20]

Agencies and Services

Another distinguishing characteristic of international transportation is the number and variety of middlemen, or agents, that can assist the shipper or buyer engaged in international transportation. These include customhouse brokers, international freight forwarders, export merchants, export agents, export commission houses, import commission houses, wholesalers (or jobbers), brokers, international departments of banks, and the like. When agents are used, they provide more services than just transportation. They handle getting shipments across borders. This can include preparing paperwork for customs, coordinating customs inspections, shipment warehousing and consolidation, freight optimization, and shipment tracking. However, firms with significant international activity may establish special groups within their own traffic department to handle international transportation matters.

Example

The Parker-Hannifin Corporation is a world leader in the manufacture of hydraulic equipment such as hose, fittings, cylinders, seals, controls, and filters. Manufacturing takes place in the United States, Europe, and Asia with sales in nearly every country. International sales are handled in three ways. As shown in Figure 6-3, shipments may be handled through an agent (A). Product is trucked to a

[20]Clarke Ansberry, "For This Midwest City, Slow and Steady Wins Today's Economic Race," *The Wall Street Journal*, February 22, 2001, A1ff.

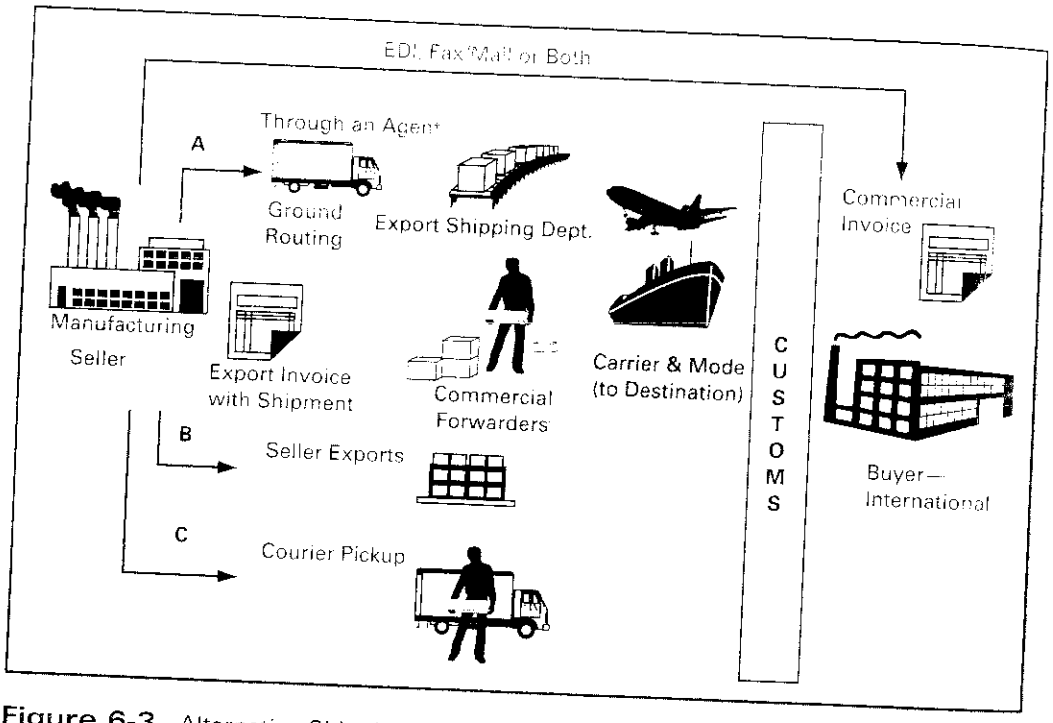


Figure 6-3 Alternative Shipping Methods for International Customers of the Parker-Hannifin Corporation

warehousing location where small shipments are consolidated into large ones. A freight forwarder, either an air or ocean carrier, is used to transport the goods to the final destination. The second alternative (B) is to ship directly with an air or ocean carrier where there is significant volume going to a particular region. This is a reasonable choice when shipments are larger than those in A. Finally, a courier service can be used (C) such as FedEx or UPS. This alternative is particularly attractive for rush orders. Air is the dominant mode used in this case. Using a variety of shipping methods allows Parker to carefully match shipping efficiency considerations with customer service needs.

Transport Cost Characteristics

The prices a logistician must pay for transportation services are keyed to the cost characteristics of each type of service. Just and reasonable transportation rates tend to follow the costs of producing the service. Because each service has different cost characteristics, under any given set of circumstances there will be potential rate advantages of one mode that cannot be effectively matched by other services.

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). Of course, all costs are variable if a long enough time and a great enough volume are considered. For purposes of transport pricing, however, it is useful to consider costs that are constant over the "normal" operating volume of the carrier as fixed. All other costs are treated as variable.

Specifically, fixed costs are those for roadway acquisition and maintenance, terminal facilities, transport equipment, and carrier administration. Variable costs usually include line-haul costs such as fuel and labor, equipment maintenance, handling, and pickup and delivery. This is not a precise allocation between fixed and variable costs, as there are significant cost differences between transportation modes, and there are different allocations depending on the dimension being examined. All costs are partly fixed and partly variable, and allocation of cost elements into one class or the other is a matter of individual perspective.

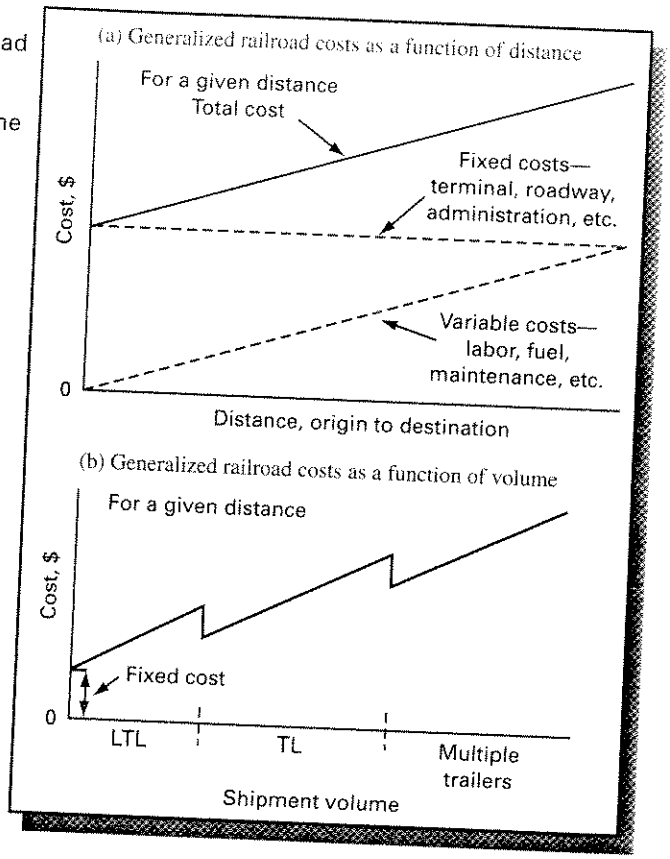
Line-haul transportation rates are based on two important dimensions: distance and shipper volume. In each case, fixed and variable costs are considered slightly different. To illustrate, consider the cost characteristics of a railroad. Total costs for service vary with the distance over which the freight must be transported, as shown in Figure 6-4(a). This is to be expected, because the amount of fuel used depends on distance, and the amount of labor for the haul is a function of distance (time). These are the variable costs. Fixed costs are substantial for rail because railroads own their roadways, terminals and switching yards, and equipment. These latter costs are treated as invariant with distance traveled. The sum of the fixed and variable cost elements gives the total cost.

In contrast, Figure 6-4(b) shows a railroad cost function based on the shipper's volume. In this case, line-haul labor is not variable, but handling costs are treated as variable. Significant reductions in the handling of shipments of at least carload quantities or trainload quantities cause discontinuities in the total cost curve such as occur between LTL, TL, and multiple-trailer shipment sizes. Volume rate reductions are usually pegged to these drops in costs.

Common or Joint Costs

It was mentioned previously that reasonable transport rates are those that follow the costs of producing the service. Beyond the problem of deciding whether a cost is fixed or variable, determining what the actual costs are for a particular shipment requires some arbitrary cost allocations, even though the total costs of operating may not be known. The reason is that many transportation costs are indivisible. Many shipments in different sizes and weights move jointly in the same haul. How much of the cost should be assigned to each shipment? Should the costs be assigned based on shipment weight to total load, on the proportion of total cubic footage used, or on some other basis? There is no simple formula for cost allocation, and production costs on a per-shipment basis remain a matter of judgment.

Figure 6-4
Generalized Railroad Costs (and Revenues) As Functions of Volume and Distance



The back haul that all carriers experience, with the exception of pipeline, is a case in point. Carriers rarely can perfectly balance the traffic between the forward movement and the return (back haul) movement. By definition, the forward haul is the heavy traffic direction and the back haul is the light traffic direction. Shipments in the back haul may be allocated their fair share of total costs of producing the back haul. This makes the cost per shipment high compared with the forward haul. The back haul may be treated as a byproduct of the forward haul because it results from producing the forward haul. All, or most of the costs, are then allocated to forward-haul shipments. Back-haul costs would be considered zero, or assigned only the direct costs to move a shipment in the back-haul direction.

There are several dangers in the latter approach. For one, rates on the forward haul may have to be set at a level that would restrict volume in this direction. In addition, back-haul rates could be set low to help cover some fixed expenses. The effect may be that the back haul gains significantly in volume and possibly surpasses the forward-haul volume. A carrier then may find itself not meeting its fixed expenses and facing rate adjustments that could greatly alter the traffic balance. The by-product has now become the main product. In addition, a significant difference in cost allocation and in rates that follow these costs may lead to questions of rate discrimination

between forward-haul and back-haul shippers. The key to discrimination is whether the service in both directions is judged to be under essentially the same conditions and circumstances.

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 under which it operates and by the relationship of the function to those of other carriers.

Rail

As a transporter of freight and passengers, the railroad has high fixed costs and relatively low variable costs. 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. Roadway maintenance and depreciation, terminal facility depreciation, and administration expenses also add to the level of fixed cost. Railroad line-haul costs, or variable costs, typically include wages, fuel, oil, and maintenance. Variable costs by definition vary proportionately with distance and volume; however, a degree of indivisibility does exist in some variable costs (labor, for example), so variable costs per unit will decrease slightly. Traditionally, variable costs have been taken as one-half to one-third of total costs, although there is a great deal of controversy over the exact proportion.

The net effect of high fixed costs and relatively low variable costs is to create significant economies of scale in railroad costs. Distributing the fixed costs over greater volume generally reduces the per-unit costs, as shown in Figure 6-5. Similarly, rail ton-mile costs drop when fixed costs are allocated over increasing lengths of haul.

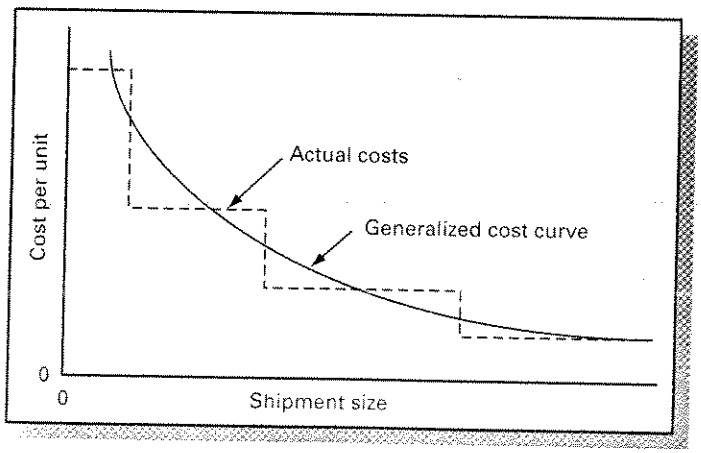


Figure 6-5
Generalized Surface Carrier Cost Structure Based on Shipment Size

Highway

Motor carriers show contrasting cost characteristics with rail. Their fixed costs are the lowest of any carrier because motor carriers do not own the roadway over which they operate, the tractor-trailer represents a small economic unit, and terminal operations do not require expensive equipment. On the other hand, variable costs tend to be high because highway construction and maintenance costs are charged to the users in the form of fuel taxes, tolls, and weight-mile taxes.

Trucking costs are mainly broken down into terminal expenses and line-haul expenses. Terminal expenses, which include pickup and delivery, platform handling, and billing and collecting, are 15 to 25 percent of total trucking expenses. These expenses, on a dollar-per-ton basis, are highly sensitive to shipment sizes below 2,000 to 3,000 pounds. Terminal expenses for shipments larger than 3,000 pounds continue to drop as pickup and delivery and handling costs are spread over larger shipment sizes. However, the reduction is far less dramatic than for small shipment sizes. The costs as a function of shipment size follow the same general form as previously shown in Figure 6-5.

Line-haul trucking costs are 50 to 60 percent of total costs. It is not clear that per-unit, line-haul costs necessarily decrease with distance or volume. However, total-unit trucking costs do decrease with shipment size and distance as terminal costs and other fixed expenses are spread over more ton-miles, but not as dramatically as rail costs.

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. Loading and unloading times are particularly slow for water carriers. High stevedoring costs make terminal costs almost prohibitive for all but bulk commodities and containerized freight where mechanized materials-handling equipment can be used effectively.

These typically high terminal costs are somewhat offset by very low line-haul costs. Without user charges for the waterways, variable costs include only those costs associated with operating the transport equipment. Operating costs (excluding labor) are particularly low because of the minimal drag to movement at slow speeds. With high terminal costs and low line-haul costs, ton-mile costs drop significantly with distance and shipment size. Thus, water is one of the least expensive carriers of bulk commodities over long distances and in substantial volume.

Air

Air transportation has many of the same cost characteristics as water and highway carriers. Airline companies generally do not own the air space nor the air terminals. 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.

In addition, airlines own (or lease) their own equipment, which, when depreciated over its economic life, becomes an annual fixed expense. In the short run, airline variable expenses are influenced more by distance than by shipment size. Because an aircraft has its greatest inefficiency in the takeoff and landing phases of operation, variable costs are reduced by the length of haul. Volume has indirectly influenced variable costs as greater demand for air transportation services has brought about larger aircraft that have lower operating costs per available ton-mile.

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.

Pipeline

Pipeline parallels the railroad in its cost characteristics. Pipeline companies, or the oil companies that own the pipelines, own the pipe, terminals, and pumping equipment. They may own or lease the right-of-way for the pipe. These fixed costs, with the addition of other costs, give pipeline the highest ratio of fixed cost to total cost of any mode. To be competitive, pipelines must work on high volume over which to spread these high fixed costs.

Variable costs mainly include power to move the product (usually crude oil or refined petroleum products) and costs associated with the operation of pumping stations. Power requirements vary markedly, depending on the line throughput and the diameter of the pipe. Larger pipes have disproportionately less circumference to cross-sectional area as compared with smaller pipes. Frictional losses, and therefore pumping power, increase with the pipe circumference, and volume increases with the cross-sectional area. As a result, costs per ton-mile decrease substantially with larger pipes, if there is sufficient throughput to justify the larger pipe. There are also diminishing returns to scale if too large a volume is forced through pipe of a given size. These general cost characteristics are shown in Figure 6-6.

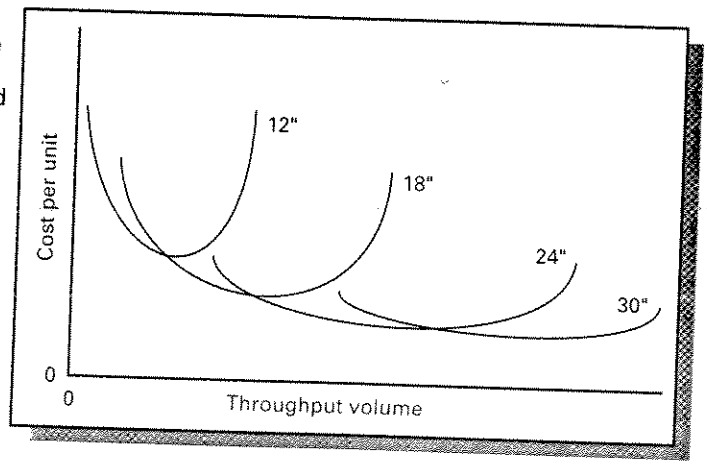


Figure 6-6
Generalized Pipeline Costs As Functions of Pipe Diameter and Throughput Volume

Rate Profiles

Transportation rates are the prices that for-hire carriers charge for their services. Various criteria are used in developing rates under a variety of pricing situations. The most common rate structures are related to volume, distance, and demand.

Volume-Related Rates

The economies of the transportation industry show that costs of service are related to the shipment size. Rate structures in general reflect these economies, as shipments in consistently high volumes are transported at lower rates than smaller shipments. Volume is reflected in the rate structure in several ways. First, rates may be quoted directly on the quantity shipped. If the shipment is small and results in very low revenue for the carrier, the shipment will be assessed either a minimum charge or an any-quantity (AQ) rate. Larger shipments that result in charges greater than the minimum charge but are less than a full-vehicle-load quantity are charged at a less-than-vehicle load rate that varies with the particular volume. Large shipment sizes that equal or exceed the designated vehicle-load quantity are charged the vehicle-load rate.

Second, the system of freight classification permits some allowance for volume. High volume can be considered justification for quoting a shipper special rates on particular commodities. These special rates are considered deviations from the regular rates that apply to products shipped in lesser volume.

Volume-related rate structures are more complex than this discussion indicates. However, because much of the following section on transport rates is concerned with volume, further discussion is deferred until later in this chapter.

Distance-Related Rates

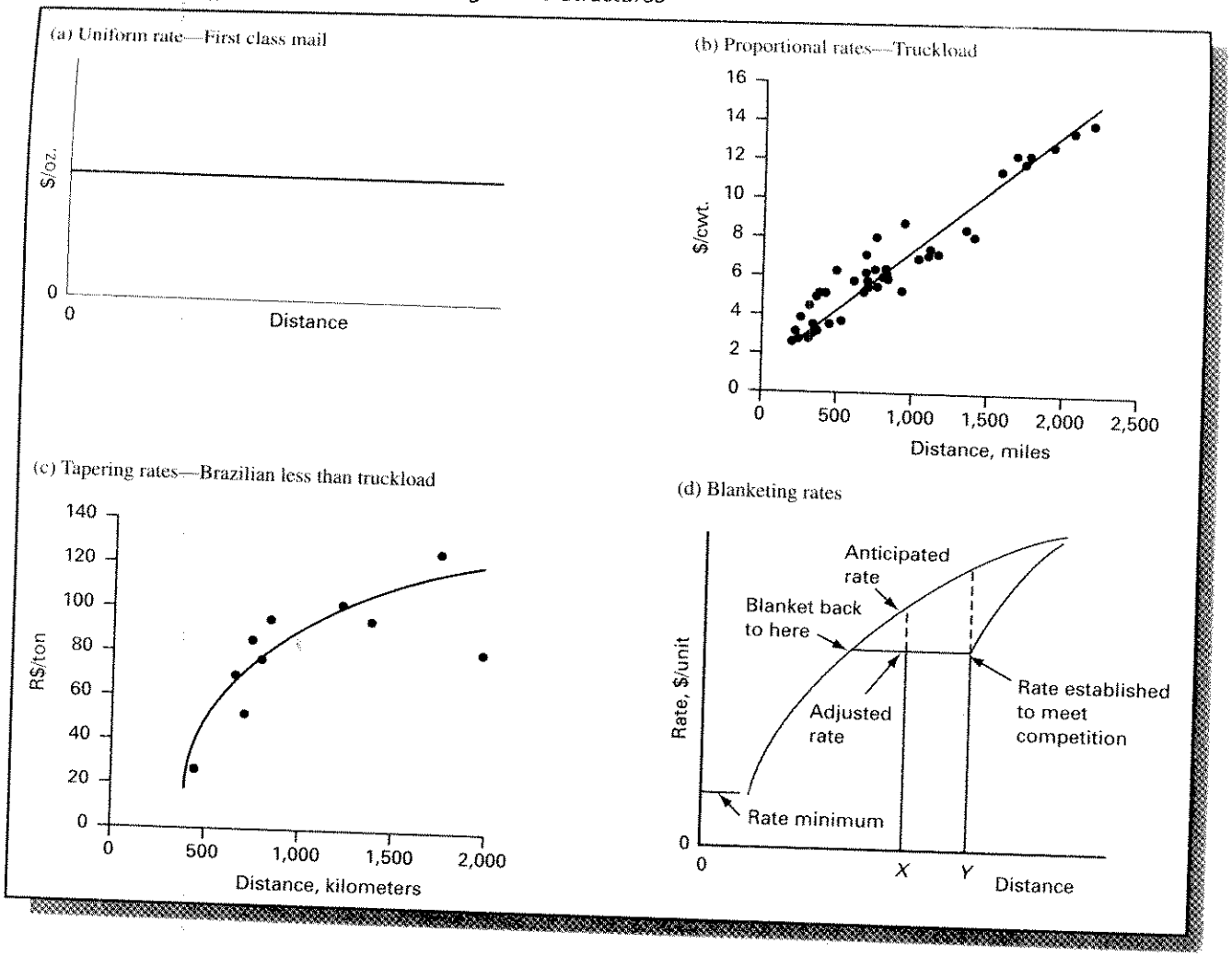
Rates, as a function of distance, range from being completely invariant with distance to varying directly with distance, with most rate structures lying between these extremes.

Uniform Rates

Simplicity can be a key factor in establishing a rate structure. The simplest of all is the uniform rate structure in which there is one transport rate for all origin-to-destination distances [Figure 6-7(a)]. An example is the first-class postage rates in the United States. The uniform rate structure for mail is justified because a large portion of the total cost for delivering mail is in handling. Handling costs are shipment, not distance, related. On the other hand, using a uniform rate structure for truck transportation, where line-haul costs are at least 50 percent of total cost, would raise serious questions of rate discrimination.[21]

[21]Discrimination is assumed to occur whenever rates do not follow the costs of producing the service in question.

Figure 6-7 Four Distance-Related Freight Rate Structures



Proportional Rates

For those carriers with significant line-haul cost components (truck and, to a lesser extent, air), a compromise between rate structure simplicity and service costs is provided by the proportional rate structure [Figure 6-7(b)]. By knowing only two rates, one can determine all other rates for a commodity by straight-line extrapolation. Although there are some obvious advantages to this simple structure, it does adversely discriminate against the long-haul shipper in favor of the short-haul shipper. Terminal charges are not recovered on the short haul. Truckload rates can have this characteristic because handling costs are minimal.

Tapering Rates

A common rate structure is built upon the tapering principle. Because in the United States terminal charges are typically included in line-haul charges, a rate structure that follows costs will show rates increasing with distance but at a decreasing rate, as shown in Figure 6-7(c). A major reason for this shape is that with increased distance of the shipment, terminal costs and other fixed charges are distributed over more miles. The degree of taper will depend on the level of fixed costs that a carrier has and the extent of economies of scale in line-haul operations. Thus, if only economies dictate the rate structure, we logically would expect greater taper for rail, water, and pipe than for truck and air.

Blanket Rates

The desire to meet the competitors' rates and to simplify rate publications and administration led carriers to establish blanket rate structures. Blanket rates are merely single rates that cover a wide area at the origin, destination, or both. The resulting rate structure is illustrated in Figure 6-7(d), with the plateau as the area of rate grouping, or blanketing. Blanket rates are most common for products being hauled over long distances and whose producers or markets are grouped in certain areas. Such products include grain, coal, lumber, and produce from California that is sold in eastern markets. Even parcel post and UPS rates that are quoted for wide zones radiating from the origin are a form of blanket transportation rates.

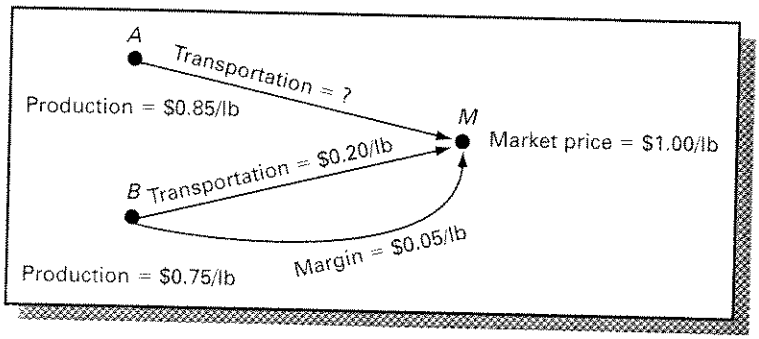
Blanketing is a form of rate discrimination, but the benefits of rate simplification for both the carriers and shippers outweigh the disadvantages. In addition, it generally offers the users of transportation services a broader selection of carriers.

At times, competition forces rates along a route to be lower than would normally be predicted from the general rate structure and the cost profile. See point *Y* in Figure 6-7(d). To offer the lower rate at *Y* can create a situation where points ahead of *Y*, such as *X*, suffer from seemingly unfair rate treatment. Carriers may wish to eliminate this type of rate inequity by making the rate for *X* and for all other points ahead of *Y* that would have a rate greater than that of *Y*, equal to *Y*'s rate. This process is called *blanketing back*.

Demand-Related Rates

Demand, or value of service, may also dictate rate levels bearing little resemblance to the costs of producing the transportation service. Recognized here is the fact that

Figure 6-8
Value of Transportation Service



users view transportation as having only so much value to them. Thus, the rates cannot exceed an upper limit if the user is to hire the carrier in question. Two dimensions suggest the value of transportation service to a shipper: the shipper's own economic circumstances and available alternative transportation services.

Example

Producers *A* and *B* manufacture and promote a product that sells for $1 per pound in market *M*, as illustrated in Figure 6-8.

A's expenses, other than transportation costs, are 85¢ per pound and *B*'s are 75¢ per pound. *B* can make a 5¢ per pound profit on the product selling for $1 per pound. Because *B* establishes the price, the maximum that *A* can reasonably pay for transportation is 15¢ per pound, at which rate there would be no profit. This is the maximum that transportation service is worth to *A*. If rates are set above this level, the product will not move.

The second dimension is seen in the two service alternatives available to *B*. If it is assumed that both alternatives have equal performance characteristics, the value of the service to *B* is the lower rate. The high-priced service would have to meet the 20¢ per pound rate to be competitive and move some of the product. Thus, demand, or competition, establishes the rate level. Competitive rates based on value of service tend to distort cost-oriented rate structures and increase the complexities of rate quotation, administration, and publication.

Line-Haul Rates

Transport prices can be classified as rates for line-haul services or special service charges. Line-haul rates refer to the charges incurred between origin and destination terminals, or door-to-door in the case of truckload motor carrier service. Special service charges are prices for additional services, such as terminal services, stop-off services, and detention of carrier equipment. Line-haul rates may be usefully classified by product, by shipment size, by route, or miscellaneous.

- Expense of, and care in, handling
- Ratings on analogous articles
- Fair relation of ratings between all articles
- Competition between articles of different description but largely used for similar purposes
- Commercial conditions and unit of sales
- Trade conditions
- Value of service
- Volume of movement for the entire country[23]

Implementation of provisions of the acts to deregulate transportation may lead to fewer factors being used for classification purposes.

Class Rates

A companion to the freight classification is a tariff, or transportation price list. Once a product has a class rating, then line-haul charges can be determined.

The class rate is a function of the distance between shipment origin and destination points as well as other factors. Shipping distances on which to base rates are found by using such standard distance tables as the *Household Goods Movers Guide*, *Rand-McNally Mileage Guide*, or other mileage guides that are acceptable to both shipper and carrier. In these guides, zip codes are frequently used to reference the location of origin and destination points. This allows clustering many addresses into a manageable number of reference points while providing acceptable accuracy representing distances. A rate table can then be constructed where rates vary by zip code (distance) and class rating, as shown in Table 6-5.

Shippers do not always pay the rates for the quantities exactly as shown in Table 6-4. That is, if a shipment were to be made up of 9,000 lb, the rate for the >5,000 lb weight break would not necessarily be used. Carriers allow the shipment size to be declared the next higher weight-break quantity and that rate used if the total charges are less than those for the straight calculation. Within every weight break, there is some quantity offering this advantage. The quantity at which the break occurs can be found by the formula

$$\text{Break weight} = \frac{\text{Rate}_{\text{Next}} \times \text{Weight}_{\text{Next}}}{\text{Rate}_{\text{Current}}} \qquad \textbf{(6-1)}$$

where

Break weight = Weight above which the next higher weight break rate should be used for lower transport costs
$\text{Rate}_{\text{Next}}$ = Rate for next higher weight break
$\text{Weight}_{\text{Next}}$ = Minimum weight of next higher weight break
$\text{Rate}_{\text{Current}}$ = Rate for true weight of shipment

[23]Charles A. Taff, *Management of Physical Distribution and Transportation*, 6th ed. (Homewood, IL.: Richard D. Irwin, 1978), pp. 356–357.

Table 6-4 National Motor Freight Classification for Selected Products

Item Number	Description	Less-Than Truckload	Truckload	Minimum Weight, lb
	ABRASIVES GROUP:			
	Alundum, Corundum, Emery or other Natural or Synthetic Abrasive Material, consisting chiefly of aluminum oxide or silicon carbide:			
1070-00	Crude or lump, LTL, in bags, barrels or boxes: TL, loose or in packages	55	35	50,000
1090-00	Flour or grain, in packages	55	35	36,000
2010-00	Refuse, including broken wheels, wheel stubs or wheel grindings, in packages; also TL, loose	55	35	40,000
2030-00	Wheels, pulp grinding, on skids or in boxes or crates	55	40	30,000
2055-00	Cloth or Paper, abrasive, including Emery Cloth or Paper or Sandpaper, in packages	55	37.5	36,000
2070-00	Accessories or Furniture, cat or dog, in boxes and having a density on pounds per cubic foot of:			
2070-01	Less than 1	400	400	AQ[a]
2070-02	1 but less than 2	300	300	AQ[a]
2070-03	2 but less than 4	250	250	AQ[a]
2070-04	4 but less than 6	150	100	12,000
2070-05	6 but less than 8	125	85	15,000
2070-06	8 but less than 10	100	70	18,000
2070-07	10 but less than 12	92.5	65	20,000
2070-08	12 but less than 15	85	55	26,000
2070-09	15 or greater	70	40	36,000
	ADVERTISING GROUP:			
	Advertising Matter, NOI, prepaid, in packages			
4660-01	Cloth or oilcloth	85	55	24,000
4660-02	Paper or paperboard, other corrugated or fluted	70	40	30,000
4740-00	Almanacs, prepaid, in packages	77.5	55	24,000

Item Number	Description	Less-Than Truckload	Truckload	Minimum Weight, lb
4745-00	traveling bags, Gloves, Head Visors or Mats, cloth, printed with advertising, prepaid, in boxes	100	70	20,000
4800-00	Calendars, prepaid:			
4800-01	Cloth, in packages; or steel, celluloid covered, in boxes	85	55	24,000
4800-02	Paper or pulpboard, in packages	70	55	24,000
4850-00	Catalogs, prepaid; or Catalog Parts or Sections, paper, prepaid; in packages	60	35	40,000
4860-00	Circulars, Books, Booklets, Leaflets, Pamphlets, Sheets or Price Lists			
4860-01	Printed entirely on newsprint	60	35	30,000
4860-02	Not printed entirely on newsprint	77.5	55	24,000
4920-00	Displays, consisting of brick or tile facings, roofing, shingles, siding or tile; mounted on panels, prepaid, in boxes or crates	70	55	24,000
4960-00	Displays, dummy articles, such as imitation butter squares, fruits, vegetables or meats, prepaid, in boxes or crates	100	70	20,000
4980-00	Displays, Figures or Images, rubber, NOI, other than foam rubber, prepaid, in boxes or crates	100	70	20,000

[a]AQ refers to Any Quantity.

Source: Adapted from Southern Motor Carriers' PC FastClass Software.

Table 6-5 Nondiscounted, Less-Than-Truckload Rates for Class 100 Product Moving From New York City, NY, to Selected Zip Sectional Centers

Zip	Location	Min.[a]	<500[b]	≥ 500[c]	≥ 1,000[c]	≥ 2,000[c]	≥ 5,000[c]	≥ 10,000[c]	≥ 20,000[c]	≥ 30,000[c]	≥ 40,000[d]
021	Boston MA	9,768	5,877	4,636	3,474	3,075	2,444	1,742	1,009	733	687
029	Providence RI	9,351	5,401	4,276	3,203	2,866	2,271	1,592	882	662	601
041	Portland ME	8,460	5,854	4,597	3,441	3,206	2,537	2,269	1,321	965	931
122	Albany NY	12,838	6,665	5,288	4,038	3,459	2,971	2,218	1,315	1,022	980
152	Pittsburgh PA	13,263	6,957	5,246	4,015	3,446	2,976	2,215	1,265	970	945
194	Philadelphia PA	10,825	5,132	4,069	3,071	2,561	2,083	1,423	735	554	525
198	Wilmington DE	11,110	5,290	4,195	3,174	2,648	2,167	1,501	805	619	567
200	Washington DC	13,262	6,890	5,553	4,310	3,666	3,069	2,235	1,293	988	936
212	Baltimore MD	11,084	5,579	4,421	3,361	2,843	2,373	1,689	942	716	674
232	Richmond VA	11,296	6,158	4,899	3,744	3,218	2,756	2,021	1,154	875	860
282	Charlotte NC	12,973	6,502	5,992	4,873	3,867	3,082	2,521	1,217	979	876
292	Columbia SC	13,248	6,842	6,310	5,146	4,099	3,271	2,709	1,385	1,110	998
303	Atlanta GA	14,826	8,196	7,494	6,114	4,965	3,973	3,344	1,836	1,490	1,336
331	Miami FL	14,396	9,142	8,495	6,779	5,575	4,290	4,200	2,278	1,829	1,654
336	Tampa FL	14,081	8,664	8,046	6,416	5,232	4,037	3,948	2,131	1,708	1,545
379	Memphis TN	13,313	6,928	6,395	5,214	4,159	3,320	2,758	1,429	1,141	1,030
402	Louisville KY	12,787	7,474	6,425	4,787	4,323	3,546	2,784	1,905	1,625	1,422
432	Columbus OH	12,276	6,856	5,902	4,340	3,920	3,221	2,483	1,702	1,450	1,268
441	Cleveland OH	12,161	6,710	5,781	4,238	3,826	3,142	2,412	1,656	1,409	1,229
452	Cincinnati OH	12,504	7,112	6,118	4,525	4,085	3,354	2,608	1,784	1,526	1,330

462	Indianapolis IN	12,672	7,331	6,301	4,683	4,229	3,471	2,713	1,860	1,584	1,384
482	Detroit MI	14,808	8,639	7,418	5,598	5,017	4,143	3,308	2,411	2,069	1,805
532	Milwaukee WI	13,097	7,848	6,739	5,051	4,564	3,738	2,963	2,028	1,727	1,511
554	Minneapolis MN	14,165	9,043	7,754	5,901	5,339	4,334	3,520	2,414	2,059	1,807
606	Chicago IL	15,128	8,451	7,379	5,586	4,999	4,093	2,856	1,957	1,664	1,458
631	St. Louis MO	13,289	8,074	6,927	5,213	4,707	3,855	3,069	2,104	1,793	1,565
701	New Orleans LA	17,032	10,849	9,530	7,720	6,402	5,100	3,750	2,028	1,625	1,462
722	Little Rock AR	13,993	8,851	7,587	5,760	5,203	4,249	3,435	2,353	2,007	1,756
731	Oklahoma City OK	14,976	9,886	8,463	6,486	5,864	4,785	3,923	2,690	2,290	2,006
752	Dallas TX	17,353	10,775	9,226	7,114	6,414	5,221	4,011	2,748	2,343	2,052
782	San Antonio TX	17,313	11,882	10,139	7,863	7,095	5,799	4,831	3,380	2,895	2,534
802	Denver CO	16,345	11,830	9,543	7,949	6,895	6,072	4,685	4,140	3,602	3,367
850	Phoenix AZ	18,650	13,626	10,987	9,161	7,945	6,991	5,461	4,812	4,185	3,912
900	Los Angeles CA	20,614	14,954	12,094	10,092	8,727	7,672	6,065	5,365	4,660	4,341
921	San Diego CA	19,560	14,345	11,555	9,632	8,349	7,356	5,764	5,097	4,434	4,145
933	Bakersfield CA	18,778	13,803	11,094	9,274	8,033	7,091	5,541	4,893	4,247	3,992
946	Oakland CA	18,931	13,927	11,192	9,355	8,102	7,153	5,595	4,938	4,290	4,030
972	Portland OR	19,725	14,473	11,657	9,720	8,424	7,424	5,819	5,144	4,472	4,184
981	Seattle WA	18,896	14,173	11,389	9,519	8,247	7,286	5,709	5,031	4,376	4,115

[a]Minimum charge in cents (¢)
[b]Rates in cents per hundred pounds (¢/cwt.)
[c]When a charge computed at the true weight exceeds the charge computed on the next at the weight breakpoint, the lesser charge will apply.
[d]Charges will be the lowest that can be computed, either by using the applicable LTL rate at actual or estimated weight, or by using the TL rates.
Source: Published rates of the Yellow Freight System, Inc.

Example

Suppose 15,000 lb of aprons used as advertising material is to be shipped by truck from New York City to Detroit, Michigan. The class rating for this product (item 4745-01 in Table 6-4) is 100. From a trucker's rate list (Table 6-5), the class 100 tariff is found to be $33.08 per cwt. for shipments between 10,000 and 20,000 lb, and $24.11 per cwt. for shipments greater than 20,000 lb. The carrier offers a 60 percent discount from the rate list. Calculate the break weight as (24.11 × 20,000) ÷ 33.08 = 14,576 lb. Since the shipment is greater than 14,576 lb, ship as if it is 20,000 lb using the $24.11/cwt. rate. Therefore, shipping charges are $24.11 × 200 cwt. = $4,822.00. Taking the discount of 0.60 × $4,822.00 = $2,893.20. The net charge is $4,822.00 – 2,893.20 = $1,928.80.

Recall that the class tariff is similar to list prices found on many products. These rates are widely disseminated and generally known among shippers and carriers. They can be obtained from various carriers' Web sites or on disks that are supplied free of charge by the carriers. Among carriers, these list rates are quite similar and provide little basis for competition. Hence, it is a common practice for carriers to deeply discount from these rates in order to offer attractive rates to win a shipper's business. Discounts frequently range from 40 to 70 percent. The discount rate is negotiated between shipper and carrier.

Application

A chemical company produces and ships a high proportion of its paint and corrosion-prevention products from the Cleveland, Ohio, area to many points throughout the United States. Most shipments are small and at less-than-truckload weights. Any given shipment is not of sufficient weight nor are the shipments directed to a few enough points to justify its truckers offering it special rates. Instead, the truckers allow a 40 percent discount from the class tariff to retain this valued customer.

Contract Rates

Although the class rate structure provides a general way in which rates for a wide range of merchandise can be determined, many carriers are quoting special rates to shippers. These rates reflect a number of circumstances around an individual shipment or shipper, such as volume of the shipment(s), direction of the movement, and overall value as a customer. These rates may or may not be built on a systematic basis. Contract rates are meant to take precedence over the more general class rates. These may be special, one-of-a-kind rates reflecting individual shipping situations.

Before transportation deregulation, commodity rates were special rates quoted in the rate tariff to represent special shipping circumstances that were not covered by the general class rate structure. These rates were lower than class rates and took

precedence over them. Since deregulation, commodity rates seem to be fading into the background in favor of the contract rate, which serves the same purpose.

The bulk of the total miles shipped in the economy use these specially quoted rates. However, most of the shipments that are small use the general class rates for rate quoting simplicity.

Freight-All-Kinds

When carriers quote single rates for a shipment regardless of the classification of the commodities that make up the shipment, the rate is referred to as a freight-all-kinds (FAK) rate or an all-commodity rate (ACR). Freight forwarders are frequent users of this type of rate because they primarily deal with mixed shipments. The rates follow the costs of providing the transportation service rather than the value of the service.

By Shipment Size

Rates and actual transportation charges vary depending on the quantity tendered, that is, on shipment size. Rates are quoted on a dollar-per-hundred-pound (cwt.) basis and can be different depending on where the shipment size falls in relation to prescribed minimum quantities established in the rate tariff. Any number of minimum quantities may appear in the tariff. There may be multiple minimum quantities, for example, 5,000-lb, 10,000-lb, 20,000-lb, and 30,000-lb minimums. There may be only a single rate for all quantities, which is referred to as an any-quantity (AQ) rate.

Railroads, truckers, and transportation brokers customarily have a lower quantity limit on which to base charges, or they have a flat minimum charge such that actual charges cannot drop below this minimum. It is common to find rates quoted by class rating and with a minimum charge. Because class ratings are for less-than-vehicle loads and vehicle loads with a single minimum vehicle-load quantity, then there also is a less-than-vehicle-load rate and a vehicle-load rate in addition to the minimum charge.

Some tariffs may highlight weight breaks instead of the class ratings. Table 6-6 shows a sample of a truck class 100 tariff with common weight breaks to 40,000 pounds.

Example

Suppose an item is rated at class 60, has a shipping weight of 1,000 pounds (10 cwt.), and is to move from Louisville, Kentucky, to Chicago, Illinois. Based on Table 6-6, the transportation charges would be \$20.43/cwt. × 10 cwt. = \$204.30.

Many carriers make their tariffs available on computer disks and distribute them to their customers for a nominal fee or free of charge. With this aid, shippers can easily rate their own shipments using five-level zip codes to identify shipment origin-destination points. The carriers can then negotiate with the shipper an appropriate discount from this general class tariff.

Table 6-6 Selected Class Truck Rates in $ per cwt. by Classification Number and Weight-Break Quantity in lb for Shipments from Louisville, Kentucky, to Chicago, Illinois

MC[a] $75.40 Class	<500	≥ 500	≥ 1,000	≥ 2,000	≥ 5,000	≥ 10,000	≥ 20,000	≥ 30,000	≥ 40,000
500	165.39	132.31	99.26	82.70	59.51	54.44	28.67	28.67	28.67
400	139.03	111.22	83.43	69.51	50.03	45.76	24.10	24.10	24.10
300	110.26	88.21	66.17	55.13	39.68	36.68	19.11	19.11	19.11
250	95.88	76.70	57.54	39.55	34.50	31.56	16.62	16.62	16.62
200	79.10	63.28	47.47	39.55	28.46	26.04	13.71	13.71	13.71
175	69.51	55.61	41.72	34.76	25.01	22.88	12.05	12.05	12.05
150	62.32	49.86	37.40	31.16	22.43	20.51	10.80	10.80	10.80
125	52.73	42.19	31.65	26.37	18.98	17.36	9.14	9.14	9.14
110	52.34	40.27	30.21	25.17	18.11	16.57	8.73	8.73	8.73
100	47.94	38.35	28.77	23.97	17.25	15.78	8.31	5.69	4.37
92.5	45.54	36.43	27.33	22.77	16.39	14.99	7.89	5.41	4.15
85	42.19	33.75	25.32	21.09	15.18	13.89	7.31	5.01	3.85
77.5	39.79	31.83	23.88	19.90	14.32	13.10	6.90	4.72	3.63
70	37.39	29.91	22.44	18.70	13.46	12.31	6.48	4.44	3.41
65	35.48	28.38	21.29	17.74	12.77	11.68	6.15	4.21	3.23
60	34.04	27.23	20.43	17.02	12.25	11.20	5.90	4.04	3.10
55	32.60	26.08	19.56	16.30	11.73	10.73	5.65	3.87	2.97
50	31.16	24.93	18.70	15.58	11.21	10.26	5.40	3.70	2.84

[a] MC = minimum charge in $

Source: Southern Motor Carriers' CZAR-LITE software.

Further examples of how actual transportation charges are computed under various circumstances are shown in Table 6-7. Although truck rates are used in the examples, the methods of computation are generally applicable to the other transportation modes as well.

Other Incentive Rates

There are additional rates that act as incentives to ship in large quantities. One such rate is the in-excess rate (see Table 6-7, example H). In-excess rates are lower than vehicle-load rates and apply to only those quantities that exceed the vehicle-load minimums. This rate encourages shippers to increase shipment size and allows carriers to better utilize the capacity of their equipment.

Carriers further encourage shippers to ship in quantities greater than vehicle-load minimums through multiple-vehicle rates and even trainload rates. Carriers can effect economies of scale on larger loads and pass these economies along to shippers

Table 6-7 Examples of Transportation Charge Computations for Different Shipment Combinations of Class Ratings, Distances, and Shipment Weights

Example	Shipment Specifications	Calculation Rate, $/cwt.	Actual Freight or Charges	Charges	Comments
A	Item 2070-02; Louisville, KY, to Chicago, IL; Volume = 300 lb.	MC = $75.40, $110.26	$110.26 × 3 = $330.78	$330.78	Class = 300 from Table 6-4; Rate from Table 6-6
B	200 lb of paper calendars; Louisville, KY, to Chicago, IL	MC = $75.40, $37.39	37.39 × 2 = $74.78 Pay minimum charge	$75.40	Class = 70 for item 4800-02 in Table 6-4; Rate from Table 6-6
C	Cat furniture; New York, NY, to Portland, OR; Volume 15,000 lb at a density of 5 lb/cu. ft.	MC = $197.25, $58.19	$58.19 × 150 = $8,728.50 Break quantity is 17,680 lb[a]	$8,728.50	Class = 100 for item 2070-05 from Table 6-4; Rate from Table 6-5
D	150 lb of books printed on glossy paper; Louisville, KY, to Chicago, IL	MC = $75.40, $39.79	$39.79 × 1.5 = $59.69 Pay minimum charge	$75.40	Class = 77.5 for item 4860-02 from Table 6-4; Rate from Table 6-6
E	18,000 lb. of bags with advertising; Louisville, KY, to Chicago, IL	LTL: $15.78 @100 TL: $6.48 @70[b]	LTL: $15.78 × 180 = $2,840.40 TL: 6.48 × 200 = $1,296.00	$1,296.00 Ship TL at lower class and rate	Class = 100 LTL and 70 TL for item 4745-00 from Table 6-4; Rates from Table 6-6
F	Grain in packages; Louisville, KY, to Chicago, IL: Volume 27,000 lb	$5.65@20,000 $3.87 @30,000	$3.87 × 300 = $1,161.00 Break quantity is 20,549 lb	$1,161.00	Class = 55 for item 1090-00 from Table 6-4; Rates from Table 6-6
G	Class 100 item; New York, NY, to Little Rock, AR; Volume = 40,000 lb; 40% rate discount	$17.56 less 40% = $10.54	$10.54 × 400 = $4,216.00	$4,216.00	Rate from Table 6-5
H	40,000 lb of refuse; Louisville, KY, to Chicago, IL	TL Class = 35 Rate @35% of 4.37 = 1.52[c]	$1.52 × 400 = $608.00	$608.00	Class = 35 for item 2010-00 from Table 6-4; Base rate from Table 6-6
I	Class 100 item; New York, NY, to Dallas, TX; 45,000 lb; Minimum volume for truckload = 36,000 lb; in-excess rate offered = $15.00/cwt.[d]	TL: Rate = $20.52	TL: $20.52 × 360 = $7,387.20 EX: $15.00 × 90 = $1,350.00 Total $8,737.20	$8,737.20	Rate from Table 6-5

[a]Break quantity = (51.44 ÷ 58.19) × 20,000 = 17,680 lb
[b]Rate for class 70 and shipping weight of 20,000 lb
[c]Rate is approximate as a percent of class 100 rate. A truckload rate is likely to be quoted separately from the tabled rates.
[d]Rate applies to all weight in excess of the minimum volume. The minimum volume moves at the CL rate.

in the form of incentive rates. They are also a competitive weapon against competing carriers. The railroads have been very effective in meeting pipeline competition for the movement of coal by the use of single-commodity trains (unit trains) and train-load rates.

Some carriers have established time-volume rates. Reduced rates are offered if a minimum tonnage is moved within a specified period. Coal is frequently moved under this arrangement.

By Route

When shipments involve full-vehicle-load movements, carriers use a per-mile charge to compute total shipping expenses. For truckloads, rates between states are frequently quoted on a per-mile basis. When the vehicle is loaded with cargo destined for more than one stop, a stop-off charge may be added to the bill. The per-mile rate is determined by the location of the last point on the route.

Example

A truck shipment of 42,000 lb originates at Atlanta, Georgia, and makes three stops for delivery at Dallas, Texas, Oklahoma City, Oklahoma, and St. Louis, Missouri. A stop-off charge of $75 per stop is assessed. The distance from Atlanta to Dallas is 822 miles, from Dallas to Oklahoma City is 209 miles, and from Oklahoma City to St. Louis is 500 miles. The per-mile cost at St. Louis is $1.65. The trip cost would be $(822 + 209 + 500) \times \$1.65 = \$2{,}526.15$. Adding three stops at $75 each gives a total transport cost of $\$2{,}526.15 + 225 = \$2{,}751.15$.

Miscellaneous Rates

A number of rates do not fit into the preceding classifications, and they are simply collected under the heading "miscellaneous." The following discussion is selective of the many special rates offered.

Cube Rates

The class rating structure is an average of many different product characteristics. When articles are very light and bulky, class ratings do not fully compensate the carrier for the costs incurred for transporting these items, so cube rates are used. Cube rates are based on space occupied rather than weight.

Import or Export Rates

To encourage foreign trade, special rates, called import or export rates, are established on inland shipments originating from or destined to foreign points. Such shipments move over domestic transportation routes at lower rates than comparable shipments with origins and destinations inland. These rates take precedence over class or commodity rates applicable to shipments via the same route.

Deferred Rates

At times, the shipper is willing to accept the possibility of increased delay in delivery compared with regular service in exchange for lower rates. The shipper is promised that delivery will be made no later than a given date. Carriers use such freight to fill out available space. Deferred service is used most often in air and water transportation.

Released Value Rates

Common carriers are responsible for the value of the goods while in their keeping. If goods are lost or damaged, the shipper can claim up to the full value of the goods. Normally, rates are based on this unlimited liability. In contrast, common carriers are permitted to establish rates based on limited liability, called released value rates. Under released value rates, the carrier's liability is limited to some fixed figure. For example, movers of household goods commonly limit claims for loss and damage to a fixed dollar-per-pound figure. Released value rates are particularly useful when the actual value of the goods is difficult to estimate.

Ocean Freight Rates

Shipments moving internationally by water represent a substantial difference from the way goods are moved domestically. Rates do not closely follow the classification schemes of domestic carriers. They are quoted on either a space or a weight basis, at the carrier's option. Ocean carriers may belong to conferences for the purposes of collective rate making. Rates are stabilized within the conference, but they may vary from conference to conference. In addition to the basic freight rate, further fees and surcharges may be added to cover such items as tolls and handling.

Special Service Charges

Carriers frequently provide special services for which extra charges are made. Although some of these charges may be included in the line-haul rates, they may be added to the freight bill over and above line-haul charges. These special services are classified as special line-haul services or as terminal services. Only the more frequently used services are discussed.

Special Line-Haul Services

These services refer to the line-haul portion of the movement and not to the terminal operation.

Diversion and Reconsignment

Diversion of a shipment refers to changing the destination of a shipment while en route. Reconsignment refers to changing the consignee of a shipment, usually after it has reached the original destination. In practice, however, no distinction is made between the terms.

Shippers have frequently used the diversion and reconsignment privilege in two ways. First, when the commodities are perishable, such as fruits and vegetables, the shipper may start a carload (or truckload) toward the general market area, and when the exact destination has been found or negotiated, the shipment will be diverted to that market. The shipper potentially can gain much from this privilege in terms of flexibility in meeting dynamic market conditions (both demand and price) at a nominal charge per carload.

Second, the carrier's equipment can be used as a warehouse. Through circuitous routing, the shipper may substantially increase the time in transit from that normally required. When a demand for the goods develops, the shipment can then be routed directly to the market. Because this practice, if abused, can greatly increase carrier costs, rail carriers especially have questioned its desirability.

Application

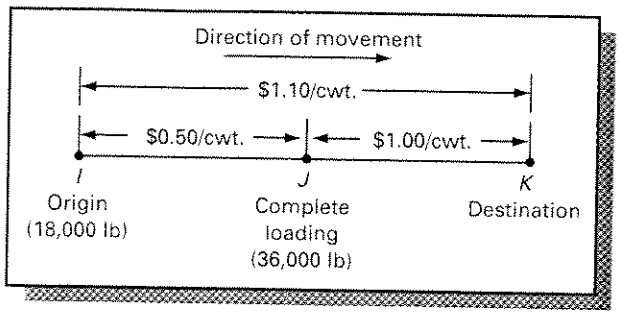
The Anchor-Hocking Glass Company manufactures dinnerware products at its plants located mainly east of the Mississippi River. Soda ash, a key ingredient in glassmaking, is mined only in the area of Green River, Wyoming. Rail shipments take at least seven days in transit to reach the plants. During one January day, the state of Ohio shut down all transit access due to a heavy snowfall. A shipment of soda ash that was already on its way from Wyoming and destined for the Ohio plant was diverted at St. Louis to the company's Houston plant. A later shipment that normally would have gone to Houston was diverted to the Ohio plant. The railroad's diversion and reconsignment privilege helped keep the glass plants operating during the unplanned event for just a small extra expense.

Transit Privileges

Rail carriers and, to a lesser extent, motor carriers have established a special service that permits shipments to be stored before moving to the final destination. A shipment, for rate purposes, is treated as if it moves directly from an origin point to a destination point, and the freight charge is composed of the through rate from origin to destination plus a small additional charge for the stop. Without such an in-transit privilege, shippers would pay the sum of the through rate from the origin to the stop-off point plus the through rate from the stop-off point to the *final* destination point, the sum of which is generally higher than the transit privilege rate. This privilege clearly reduces location disadvantages of processors and allows the carrier to better meet competition by committing the shipper to using the carrier for both segments of the haul. Grain is frequently processed (milled) and transported under this privilege.

A related service is the stop-off privilege to complete loading or to partially unload. To complete loading, a shipper may request that the carrier stop at an intermediate point between the origin and destination points, although the intermediate point need not necessarily be on a direct line between the two points. The advantage of this privilege is that the shipper can obtain a rate on the shipment as

Figure 6-9
Example of Stop-Off Privilege to Complete Loading



if it originated entirely from the starting point plus a nominal stop-off charge. This is usually less than the sum of individual rates.

Example

Consider the transportation problem shown in Figure 6-9. A shipment of 18,000 lb is originated at point *I*. An additional 36,000 lb is to be combined with it at point *J* and both shipments are to move on to point *K* for delivery. Rather than the shipper paying the individual rates between each point, the shipper may elect, where tariffs permit, to pay the rate from *I* to *K* on the entire shipment plus a stop-off charge. If the rate from stop-off point to the final destination is higher than the rate over the entire route, then the *J* to *K* rate would govern. Table 6-8 shows a comparison of the freight charges with and without a stop-off privilege.

The stop-off privilege applied to partial unloading is similar to that for complete loading. At times, it is cheaper for the shipper to consolidate several shipments moving to different destinations in order to take advantage of substantial volume rate breaks while only incurring modest stop-off charges. For partial unloading, stop offs are of two types. In the first type, all unloading is made from

Table 6-8 Freight Charges for Example Problem with and Without a Stop-Off Privilege

Loading	Route	Rate	Charges Without Stop-Off Privilege	Rate	Charges With Stop-Off Privilege
18,000 lb at *I*	*I* to *J*	$0.50/cwt.	$ 90.00	—	—
additional 36,000 lb at *J*	*J* and *J* to *K*	$1.00/cwt.[a]	540.00	$1.10/cwt.[b]	$594.00
		stop-off charge	—	stop-off charge	25.00
		Total charges	$630.00	Total charges	$619.00

[a]Based on the combined weight of 54,000 lb.
[b]Rate applies from point *I* on complete load.

the equipment in which the shipment was originally loaded [Figure 6-10(a)]. In the second type, transfer at a transloading point is made to different equipment before moving on to final the destination [Figure 6-10(b)]. Carriers do not charge for transloading; rather, the charges are made as if the partial unloading occurred entirely from the original equipment.

Rates for the stop-off privilege are based on the consolidated shipment weight moving to the final destination point. An additional charge is added for each stop made, which may or may not be based on the amount loaded or unloaded. When the stop-off privilege is used, carriers require that charges be collected at only one time. Commonly, up to three stops to unload are permitted, but some piggyback tariffs allow up to five stops. In general, the stop-off privilege will show an advantage over separately priced shipments when the greatest proportion of the total shipping occurs at points farthest from the origin point.

Figure 6-10
Examples of Stop-Off Privilege for Partial Unloading

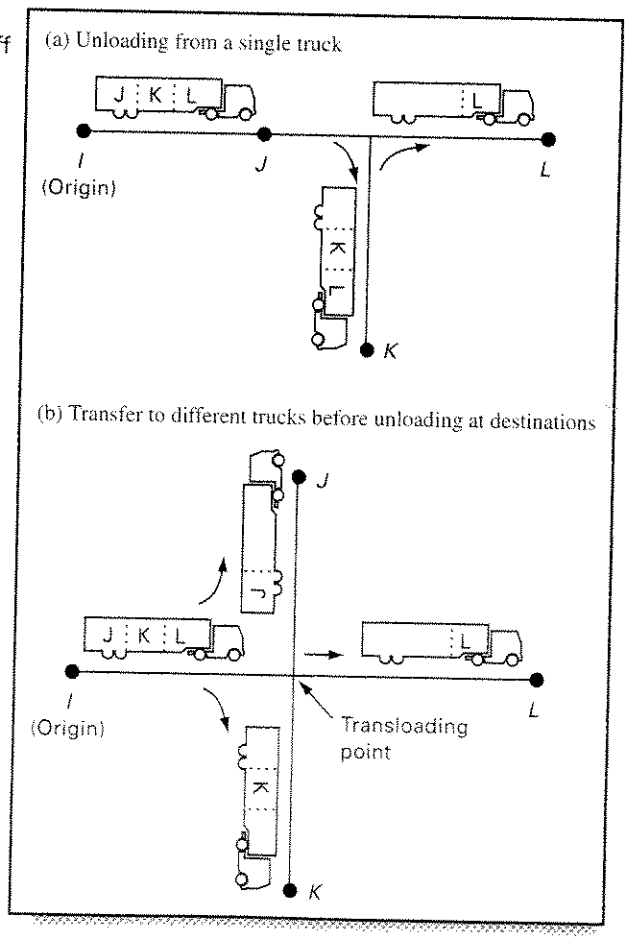


Table 6-9 A Comparison of Total Charges for Partial Unloading of Two Points With and Without a Stop-Off Privilege

Without Stop-Off Privilege				With Stop-Off Privilege			
Load, lb	Points	Rate, $/cwt.	Freight charges	Load, lb	Points	Rate $/cwt.	Freight charges
8,000	*I* to *J*	3.05	$ 244.00	30,000	*I* to *J*	3.00	$900.00
12,000	*I* to *K*	3.35	402.00			3 stops @ $15/stop[a]	45.00
10,000	*I* to *L*	3.60	360.00				
Total 30,000	Total charges		$1,006.00			Total charges	$945.00

[a]The endpoint *L* also incurs the stop-off charge.

Example

To illustrate the differences in freight charges with and without a stop-off privilege, consider the example shown in Figure 6-10(a), where $J = 8{,}000$ lb, $K = 12{,}000$ lb, and $L = 10{,}000$ lb, with a 30,000-lb minimum quantity. Table 6-9 shows the cost comparisons. A savings of $1,006 – 945 = $61 can be realized by using a stop-off privilege rather than pricing each shipment separately.

Protection

Many articles, because of their particular physical characteristics, require some type of protection in transit in addition to that normally provided. Perishable commodities may need refrigeration, icing, ventilation, or heating. Fragile commodities may require extra packing, or dunnage.[24] In these cases, carriers may furnish special equipment such as damage-free cars, refrigerated cars, and heaters, as well as the necessary labor and materials needed to provide the protective service. Whereas the extra service for some commodities is reflected in the class rating for the commodities, carriers often add charges to the freight bill to reflect their increased costs.

Interlining

Not all carriers serve all regions. When this is the case, one carrier may pick up a shipment and then give it to another carrier that serves the destination region. In this case, the first carrier pays the second, but the shipper is billed by the first. The total shipment charge must reflect profit to be made by both carriers, and the rate may be higher than if one carrier could handle the shipment from origin to destination.

[24]Dunnage refers to the cross bracings in a railroad car that prevent the load from shifting during transit, which can damage the load.

By Product

If an individual rate were quoted for each product item between all origin-destination point combinations for all transport services, an impractically large number of rates to be administered would result. To substantially reduce the number of rates needed, a product classification system was devised in which most product items are assigned to one of 31 classes ranging from class 13 to 400. Rates were quoted for class 100, and rates on products with different class ratings were generally found as a percentage of the class 100 rate. Currently, carriers do not follow this formula exactly and publish rates for specific product classes.

At one time, a number of product classification schemes existed that differed depending on the territory of the country to which it applied. Since the mid-1950s, many railroads, truckers, and water carriers have adopted a single classification code in the Uniform Freight Classification. Motor carriers also use a similar product classification scheme of the National Motor Freight Classification but with two important exceptions: (1) those products not expected to move by truck are excluded, and (2) there are 18 LTL classes ranging from 50 to 500. Water carriers either use a weight-space formula or base their rates on the rail and motor carrier product classifications. Freight forwarders use the rail-motor carrier classifications. The single-product nature of pipeline requires no classification. Classification of products moving by air is not widespread, with no national product classification system available. Table 6-4 shows a section of the National Motor Freight Classification.

As a practical matter, not all product items are separately listed in the classification or have a specific rating. Both rail and motor carrier classifications provide for this by collecting under one heading all products not separately described in the classifications and denoting these products as not otherwise indexed (NOI).[22] All NOI products have a single rating. Several examples of the NOI classification appear in Table 6-4.

Under certain circumstances, product ratings deviate from those listed in the classification and are referred to as "exceptions to the classification." These exceptions take precedence over the published ratings and are generally lower than the class rating. They are established to reflect special conditions, especially competition and operating conditions that cannot be realized under a classification that must provide an average rating for products shipped under average circumstances.

A number of factors based on *density, stowability, ease of handling,* and *liability* are taken into account in establishing a product rating. These factors can include the following:

- Weight per cubic foot as packed for shipment
- Value per pound as packed for shipment
- Liability to loss, damage, waste, or theft in transit
- Likelihood of injury to other freight with which it may come in contact
- Risks due to hazards of carriage
- Kind of container or package as bearing upon the matter of liability or risk

[22]NOI is specifically used in the National Motor Freight Classification. The Uniform Freight Classification uses NOIBN to mean the same thing, and is translated as "not otherwise indexed by name."

Terminal Services

Additional charges may be made to the freight bill for services that take place around the terminal points in a carrier's routing network. Terminal services of major importance are pickup and delivery, switching, and demurrage and detention.

Pickup and Delivery

Many carriers provide pickup and delivery service as a part of their regular service offering and include the charges as part of the line-haul rates. However, this practice is not universal. Some carriers do not provide pickup and delivery—for example, some water carrier services. When they are provided, pickup and delivery may be offered at an extra charge (as in airfreight service). When the pickup and delivery service is "free," tariffs usually limit the service to the immediate area of the carrier's terminal, that is, within the city's corporation limits, or within a mile of the terminal where there is no town.

Switching

The "line haul" for a railroad involves the movement between terminals or stations. The movement of railroad cars from private sidings and junctions to rail terminals or stations, or vice versa, is referred to as *switching*. Switching is similar to pickup and delivery, except that only railroad cars are involved. Line-haul railroads do not always have tracks connecting directly to shippers and consignees and have worked out reciprocal switching agreements with other railroads serving these points. Many railroads absorb the switching charges and the shipper pays nothing above the line-haul rate, if the line-haul shipment produces a certain level of revenue. If the transportation charge is not sufficient to permit the carrier to absorb the switching charge, or if no reciprocal arrangements can be made to serve the siding or junction, the shipper or consignee (receiver of the goods) pays the switching charge on a flat-charge-per-car basis.

Demurrage and Detention

Demurrage and detention are equivalent terms referring to penalty charges imposed on the shipper or consignee for holding the carrier's equipment beyond an allowed free time that the carrier may hold a shipment. In the case of rail cars, 48 hours is the standard free time permitted for loading or unloading. If retention of the equipment is due to reasons under the shipper's or consignee's control, the railroad may impose a daily charge. Sundays and holidays are generally considered part of free time, but they may be charged for once demurrage charges begin. Detention of trucking equipment follows a similar plan, except that free time is much shorter. A graduated upward rate scale is typically used for longer equipment retention periods for both truck and rail.

Demurrage charges may be assessed in two ways. One is the straight plan, where each piece of equipment is treated individually for determining demurrage charges. Each piece of equipment is charged based on the length of time it is detained. In contrast, the average plan represents an agreement between the carrier and the shipper to average the shipper's detention performance over a monthly period and to charge accordingly. Under this plan, releasing a railcar within the first 24-hour period carries an allowance of one credit. For each day a car is retained after the free time

period, one debit is assessed. If the sum of debits and credits at month end results in debits, the demurrage charge is applied according to an increasing scale. A net credit balance results in no demurrage charge.

Private Carrier Costing

The major reason that a company owns or leases transport equipment is to provide a level of customer service that is not always obtainable from for-hire carriers. According to a survey of 248 private trucking fleets, the reasons for having the fleets were (1) service reliability, (2) short order cycle times, (3) emergency response capability, and (4) improved customer contact.[25] Achieving a lower cost than for-hire carriage was not the motivating factor, although this may be realized if there is a sufficiently high utilization of the transport equipment.

Observation

For Domino's Pizza, Inc., the $2.6-billion-in-sales delivered pizza giant, running a private fleet is vital to the company's success. The reason why Domino's operates a private fleet is to provide customized food service deliveries to individual stores so the store managers can focus on selling pizza. When the owner opens his store each day for business, the food is there, put away and ready for use. All the owner has to do is make and sell pizza.

The fleet delivers to each store two to three times a week, making about 10,000 weekly deliveries nationwide. A total order cycle time of 48 hours is guaranteed from the time the order is placed to store delivery. No for-hire carrier with a profit motive can meet this service goal.[26]

The cost of operating privately controlled transport is determined in much the same way as with any asset. Whereas the for-hire carrier has summed up all the appropriate costs, allocated them among different hauls, and expressed them as a rate, the owner of privately controlled transportation must undertake this task if a comparison is to be made among alternative transport services. Customarily, such costs are represented on a per-mile basis. Consider a privately owned truck fleet. Costs are typically grouped into three broad categories: fixed costs, operator costs, and vehicle operating costs.

Fixed costs are those that do not vary with the distance that the vehicle travels over time. They include insurance on the vehicle, interest charges on the money tied up in the vehicles, licensing fees, equipment amortization, and expenses associated with housing the vehicles.

[25]Lisa H. Harrington, "Private Fleets: Finding Their Niche," *Transportation & Distribution* (September 1996), pp. 55–60.
[26]Ibid.

Operator costs result from driver compensation. Common expenses are wages; contributions to health and pension plans; per diem expenses while on the road, such as meals, hotel, and other living costs; contributions to Social Security, unemployment insurance, and workers' compensation; and miscellaneous expenses, such as telephone calls. A number of these costs are related to the time that the vehicle is on the road rather than the distance traveled.

Vehicle operating costs are those incurred in keeping the vehicle on the road. Typical expenses are fuel, tires, maintenance, and the like. These various costs are divided by the total fleet miles driven and then by the number of vehicles in the fleet to give an average cost per mile per vehicle. Because of the various fixed costs, the per-mile cost is sensitive to the routing and scheduling that affect the total miles driven. These per-mile costs multiplied by the distances between origin and destination points can then be compared with the rates offered by common or contract carriers. As a rule of thumb, privately owned trucks need to achieve about 80 percent of their miles loaded to be less expensive than for-hire carriers. Private trucking costs average $1.42 per mile, whereas for-hire truckload rates average about $1.33 per mile.[27]

DOCUMENTATION

The three basic document types in domestic freight transportation are the bill of lading, the freight bill, and the freight claim. International transportation has these and many more.

Bill of Lading

The bill of lading is the key document on which freight moves. It is a *legal contract* between the shipper and the carrier for the movement of designated freight with reasonable dispatch to a specified destination, arriving damage free. According to Taff, the bill of lading has the following three purposes:

1. It serves as a receipt for goods, subject to the classifications and tariffs that were in effect on the date that the bill of lading was issued. It certifies that the property described on the bill of lading was in apparent good order except as noted. The shipper and an agent for the carrier should both sign the bill of lading, but a carrier cannot avoid its liability because it does not issue a receipt or bill of lading.
2. It serves as a contract of carriage . . . [and] . . . identifies the contracting parties and prescribes the terms and conditions of the agreement.
3. It serves as documentary evidence of title. It is necessary, however, to qualify this statement. Although this is true of a negotiable bill of lading, in the case of the straight bill of lading, the person who has possession of a straight bill of lading may have title to the goods. That, however, depends upon the facts in the individual case. Such matters as the terms of sale have influence in establishing title to the goods covered by the straight bill of lading.[28]

[27]Ibid.
[28]Taff, *Management of Physical Distribution and Transportation*, pp. 516–517.

The straight bill of lading, as contrasted with the order bill of lading, is a nonnegotiable legal document. Under the straight bill of lading, the goods are consigned only to the specific person noted in the document. This bill cannot be traded or sold. Under the order bill of lading, the goods are consigned to the order of a person. This instrument may be traded or sold by endorsing the order to another person other than the one specified in the original bill. Being able to change title allows the shipper to obtain payment for the goods before they reach their destination by endorsing the order bill of lading over to a bank and receiving payment. The bank, in turn, passes the document on to the consignee's bank, the consignee, and finally the carrier. The procedure works in much the same manner as bank drafts filter through the banking system.

Freight Bill

The bill of lading ordinarily does not contain information about the freight charges, although some altered forms do include these charges. More frequently, the charges appear on a separate document, commonly referred to as a *freight bill*. The freight bill (an invoice of carrier charges) contains, in addition to freight charges, much of the same information as a bill of lading, such as shipment origin and destination, quantity shipped, product, and the persons involved.

The freight charges may be prepaid by the shipper or billed collect from the consignee. Payments for rail service are made before delivery, except that credit is extended to financially responsible shippers. Credit terms vary, depending on the carrier involved. For example, users of rail services may be allowed up to 96 hours to make payment. Motor carriers must present shippers with freight bills within seven days, and shippers have seven days to pay after receiving the bill. Transportation agencies can extend credit up to seven days. Domestic water carriers generally allow credit to 48 hours and sometimes up to 96 hours.

Freight Claims

Generally, two types of claims are made against carriers. The first arises from the carrier's legal responsibilities as a common carrier, and the second because of overcharges.

Loss, Damage, and Delay Claims

A common carrier has the responsibility to move freight with "reasonable dispatch" and without loss or damage. The bill of lading specifically defines the limits of carrier responsibility.

Observation

A common carrier is not liable for loss, damage, or delay resulting from an act of God, negligence of the shipper, act of a public enemy, or legal action taken against the shipper of the goods. Otherwise, a carrier is liable for the full value of the goods

that are lost or damaged, unless the extent of the carrier's liability is specifically limited by the bill of lading.

Losses due to "unreasonable" delay or failure to meet guaranteed schedules are recoverable to the extent of the value reduction resulting directly from the delay.

Overcharges

A claim against a carrier for overcharges results from some form of incorrect invoicing, such as application of incorrect classification, failure to use the correct rates, use of incorrect distances, simple arithmetic errors, duplicate collection of freight charges, errors in determining item weights, and differences in interpretations of rules and tariffs. Normal bill auditing may detect these errors before payment is made, and a corrected freight bill may be issued. Otherwise, up to three years is allowed for overcharge claims on interstate shipments.

International Transport Documentation

A feature distinguishing international transportation from domestic movement is the amount of documentation required for imports and exports. A listing of the more popular documents and their purposes follows.

Exporting

- *Bill of lading.* Receipt for the cargo and a contract for transportation between the shipper and the carrier.
- *Dock receipt.* Used to transfer accountability for cargo between domestic and international carriers.
- *Delivery instructions.* Provides specific instructions to the inland carrier regarding delivery of the goods.
- *Export declaration.* Required by the U.S. Department of Commerce as a source document for export statistics.
- *Letter of credit.* Financial document guaranteeing payment to the shipper for the cargo being transported.
- *Consular invoice.* Used to control and identify goods shipped to particular countries.
- *Commercial invoice.* Bill for the goods from seller to the buyer.
- *Certificate of origin.* Used to assure the buying country precisely in which country the goods were produced.
- *Insurance certificate.* Assures the consignee that insurance is provided on goods while in transit.
- *Transmittal letter.* A list of the particulars of the shipment and a record of the documents being transmitted, together with instructions for disposition of the documents.

Importing

- *Arrival notice.* Informs as to the estimated arrival time of the shipment along with some details of the shipment.
- *Customs entries.* A number of documents describing the merchandise, its origin, and duties that aid in expediting clearance of the goods through customs, with or without the immediate payments of duties.
- *Carrier's certificate and release order.* Certifies to customs the owner or consignee of the cargo.
- *Delivery order.* Issued by the consignee to the ocean carrier as authority to release the cargo to the inland carrier.
- *Freight release.* Evidence that the freight charges for the cargo have been paid.
- *Special customs invoice.* An official form usually required by U.S. Customs if the rate of duty is based upon the value, and the value of the shipment exceeds a fixed dollar amount.

Many foreign trade specialists facilitate the paperwork preparation that can aid the shipper and receiver of goods moving internationally.

Concluding Comments

Transportation is a vital component in the design and management of logistics systems. It may account for one-third to two-thirds of total logistics costs. It has been the purpose of this chapter to describe the transportation system in terms of the choices available to the users. These choices typically include the five major transport modes—air, truck, rail, water, and pipe—and their combinations. Users may hire the services or own them.

Transport services are best described by their *cost* and *performance* characteristics. These distinguish one transport service from another, and it is what a user buys from the transportation system. The cost characteristics vary from one mode to another and give rise to their rate structures. Rates are based primarily on three factors—distance, shipment size, and competition. On the other hand, carrier performance is based on the extent of shipment handling at terminals and inherent speed of the carrier. It is adequately described in terms of average transit time, transit-time variability, and loss and damage.

International transportation is an area of growing interest and concern to the logistician. The transportation equipment is the same as that used domestically, with the exception that certain transportation system elements become more important. For example, containerization is popular in international movements. The transportation routes, of course, contrast with those used domestically. The user of the international transportation system may feel overwhelmed with the increased documentation, differences in carrier liability, by various customs procedures, and the use of foreign trade zones—all of which are made complex because two or more governments have jurisdiction over the move. Fortunately, there exists a plethora of middlemen, agents, freight forwarders, and brokers to assist the shipper with international movements.

QUESTIONS

1. Why is transportation considered so important to the U.S. economy? Why is it so important to an individual firm?
2. Broadly outline what a logistics manager needs to know about transportation facilities and services.
3. What is transportation service? Contrast the following in terms of speed, reliability, availability, loss and damage, and cost of service:
   a. A shipment of lettuce from California to New York by air, piggyback, rail, or truck.
   b. A shipment of personal computer monitors from South Korea to London by air or water.
   c. A shipment of auto parts from Detroit to Mexico City by air, rail, piggyback, water, or truck.
   d. A shipment of television sets from the port of Los Angeles to five distribution centers in California by for-hire truck or by privately owned truck.
4. Identify three of the product types that are primarily moved using the five modes of transportation. Why do you think that each mode has an advantage with its particular product group?
5. There are ten possible coordinated transportation service combinations. Speculate why only two of these have gained any significant popularity.
6. Referring to Figure 6-1, explain each of the following:
   a. Less-than-truckload shipments take longer on the average for all distances than truckload shipments.
   b. There is more taper in the rail-carload curve than in the truckload curve.
   c. Airfreight movements beyond 500 miles have the same average transit time regardless of distance.
   d. Rail-carload shipments show greater transit-time variability than any of the other transport services.
7. Construct a performance characteristics table like Table 6-3 for the five basic modes of transportation for distances of 80, 100, 500, 1,000, and 3,000 miles and for the following products:
   a. Electronic equipment such as CD players, VCRs, or TVs.
   b. Coal, sand, or gravel.
   c. Perishable foods such as oranges, grapes, or celery.
8. Why has containerization become such a popular packaging method in international transportation? Why is it not used more extensively for domestic movements?
9. For-hire carriers are required to move products with reasonable dispatch and care. In your judgment, should a for-hire carrier have to pay for the following claims?
   a. A shipment takes 30 days to arrive at its destination when the carrier normally takes two weeks for delivery.
   b. A shipment of furniture is extensively damaged in a derailment.
   c. A trucker accidentally rolls over his trailerload of oranges on an icy road. Most of the load is damaged or stolen by passersby and a guardrail is damaged.
   d. A truckload of television sets is stolen after the shipping contract is signed at the shipping point but before the shipment can be delivered.
   e. An air cargo shipment is lost when the aircraft carrying it is struck by lightning.
   f. A shipment of packaged foodstuffs shows external damage when the railcar is opened at the destination.

10. For the following shipping situations, rank the basic transport modes in terms of (1) availability of the service; (2) average transit time; (3) transit-time variability; (4) price of the service; and (5) loss and damage.
    a. A 10,000-lb shipment of hardware items moving from Dallas, Texas, to Boston, Massachusetts.
    b. A containerload of men's suits moving from Hong Kong to Los Angeles, California.
    c. A 70,000-lb shipment of paper products moving from Spokane, Washington, to Denver, Colorado.
    d. A 40,000-lb shipment of sheet steel moving from Chicago, Illinois, to Cincinnati, Ohio.
    e. A 5,000-lb shipment of fresh flowers from California to New York City.
11. What role do small shipment services and agencies play in the transportation system? What common types are there? What services do they provide?
12. When does privately owned transportation become a better choice than common carrier transportation? Discuss in terms of product characteristics, customer service, and costs.
13. Discuss how a foreign trade zone might be used for:
    a. computer monitors imported to the United States from Japan.
    b. importing wines to the United States from France.
    c. importing into Taiwan from South Korea computer components that are then assembled into personal computers and shipped to Europe.
    d. importing bananas into the United States from South America.
14. A power company in Missouri can buy coal for its generating plants from western mines in Utah or from eastern mines in Pennsylvania. The maximum purchase price for coal of $20 per ton at the Missouri plant is set according to the price of competing energy forms. The cost to mine coal in the West is $17 per ton and in the East is $15 per ton. Transportation cost from the eastern mines is $3 per ton. What is the value of transportation from the western mines?
15. Shipments for a certain product originate at point *X* and are to be sent to points *Y* and *Z*. *Y* is an intermediate point to *X* and *Z*. The rate to *Y* is $1.20 per cwt., but due to competitive conditions at *Z*, the rate to *Z* is $1.00 per cwt. Apply the principle of blanketing back, and explain how it eliminates rate discrimination.
16. Using Tables 6-4, 6-5, and 6-6, determine the freight charges for the following shipments:
    a. A 2,500-lb shipment of paper place mats with printed advertising moving from New York to Los Angeles.
    b. A 150-lb shipment of rubber displays for advertising purposes moving from New York to Providence, RI.
    c. A 27,000-lb shipment of emery cloth in packages moving from Louisville, Kentucky, to Chicago, Illinois. *Note:* For any product classification number below 50, use 50 in Table 6-6.
    d. A 30,000-lb shipment of cat accessories at a density of 10 lb per cubic foot moving between Louisville, Kentucky, and Chicago, Illinois.
    e. A 24,000-lb shipment of advertising circulars not printed on newsprint moving between Louisville, Kentucky, and Chicago, Illinois. A rate discount of 40 percent is offered.

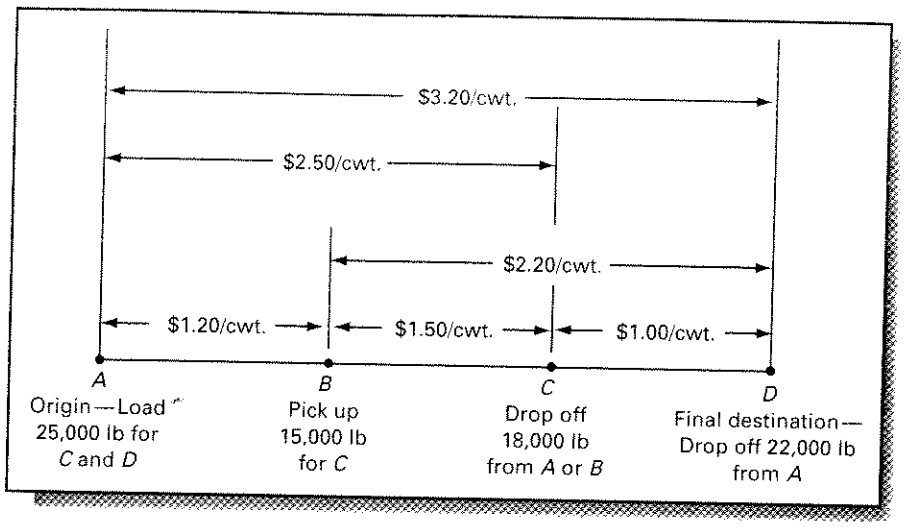


Figure 6-11 A Pickup-Delivery Problem

17. What is the difference between freight classification and class rates (tariff)? Explain the difference between a contract rate and a class rate.
18. Compare the cost structures of railroads with motor carriers and suggest how these might influence the rate structures of each.
19. A number of customers are to receive deliveries. These customers are based along a main route from a shipping point. A truck tariff has been written that allows for a stop-off privilege. What are the general characteristics of the customers in terms of their shipment weights and their locations relative to the shipment origin point that makes the stop-off privilege an attractive option?
20. Suggest the documents that might be needed for the following international movements:
    a. Importing autos from Japan destined for St. Louis, MO.
    b. Exporting computers from White Plains, New York, to Sydney, Australia.
21. A traffic manager has two options in scheduling a truck to make multiple pickups and deliveries. The pickup-delivery problem is shown pictorially in Figure 6-11. The traffic manager can ship the accumulated volumes as single shipments between the designated points or can use the stop-off privilege at $25 per stop for any or all portions of the trip. If the traffic manager wishes to minimize shipping costs, which alternative should be chosen? Assume that the final destination point incurs the stop-off charge.
22. Explain why transport rates typically vary with (a) the weight of a shipment; (b) the distance a shipment is transported; and (c) the value of the transport service.