The Rail Industry and Intermodal Transportation

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6.1 Introduction

To many, the concept of an intermodal movement conjures images of trains moving large numbers of trailers and containers, usually over a long distance. Certainly, the nature of North America’s geography is a significant reason for this image. The rule-of-thumb has been that a minimum distance of 500 miles is necessary before rail intermodal service becomes a viable alternative to door-to-door motor carrier transport. Because the United States has significant population centers along both ocean coasts, as well as east of the Mississippi River, rail intermodal transportation between the West Coast and Chicago and points east was a natural development in moving goods almost 2,000 miles.

Most containerized cargo that moves in international trade today is transported using intermodal services. There is usually a truck movement at both the trip origin and the trip destination, sandwiched around movement over the sea (although in Europe and Asia barges are used in specific corridors or along a coast to provide access to port and river terminals).

This chapter examines the role of the railroads in intermodal transportation. The railroad industry is described in Section 6.2. Section 6.3 traces the growth of intermodal transportation and provides a detailed overview of the railroad component of intermodal trips; it also describes key characteristics of the intermodal network and market. Section 6.4 provides an overview of both the international and domestic movement of containers and the role of rail in supporting such movements. Section 6.5 covers the key challenges facing the intermodal industry today. Sections 6.6 and 6.7 examine intermodal investment projects that provide lessons on the development of a national intermodal network.

Data and freight rail circumstances discussed in this chapter are as of 2007.

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6.2 The Rail System

The US freight-rail system has three tiers of freight railroads: Class I railroads, regional railroads, and short-line railroads.

Class I railroads are defined as having 2008 revenues of $401.4 million or more. There are seven Class I railroads operating in the United States. The Class I railroads form the backbone of the US rail system, accounting for 68% of the system mileage, 89% of the employees, and 93% of the freight revenue.

Regional railroads operate at least 350 miles of road and have annual revenues greater than $40 million, but below the Class I threshold.

Short-line railroads include all other freight railroads. They are defined as railroads operating less than 350 miles of track and earning less than $40 million annually. They include local line-haul railroads and switching and terminal operations railroads.

The national rail network is shown in Figure 6-1. The primary corridors, which represent the high-volume freight corridors, total about 52,340 miles of track (centerline miles), representing about half of all Class I operated miles in the United States and about one-third of the 140,810 miles in the country’s rail freight network. (For comparison, the Dwight D. Eisenhower System of Interstate and Defense Highways comprises about 47,000 route miles, and the National Highway System, which incorporates the Interstate System and other major US and state freight highways, comprises about 162,000 route miles.)
6.3 Rail Intermodal Transportation

6.3.1 Overview

The evolution of the intermodal transportation of freight reflects the geographic expansion of the United States. The initial westward movement of the population and of economic activity from the East Coast led to the development of canals that provided slow, but reliable, line-haul transport for heavier goods. With the introduction of the railroad, the nation’s freight network became much more extensive and dependent on connected cargo movements. As early as 1847, the New York, New Haven and Hartford Railroad worked with the Fall River Steamship Line to develop coordinated freight moves. Later, the Long Island Railroad experimented by transporting trucks to and from New York City, and the first movement of freight by truck trailers on a railroad car was made in 1926 by the Chicago, North Shore, and Milwaukee Railroad.

It was not until the nation began to build the national road network, however, that the next major phase of intermodal growth occurred. The construction of the Interstate System, authorized by Congress in 1956, provided substantial government funding for a national road network that supported the growth of the motor carrier industry, which competed directly with the railroads. Whereas today many motor carrier companies and railroads have reached agreements in providing door-to-door service, cooperation in the early years was hampered by a wide variety of regulations. As noted by John Mahoney,

> In 1931, the Interstate Commerce Commission (ICC) issued a decision in the container service case, which was an additional roadblock to faster rail-motor intermodal development. The decision required that rail rates for intermodal containers be related to the class rate structure. More specifically, it required that no container traffic move at less than the carload rate—or more than one class lower than the any-quantity basis applicable to the commodities in question. The carload rate on the highest-rated commodity would have to be applied to the whole container load if it was higher than third class. Varying rates (to accommodate different commodities being carried in a container), with minimum rates ranging from 4,000 to 10,000 pounds, were prohibited.

In addition to regulatory barriers that dampened interest in intermodal movements, railroads also showed little interest in investing in the facilities and infrastructure necessary to increase intermodal business or in standardizing

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1 It is interesting to note that General John J. Pershing was one of the first military officers to advocate such a (highway) system. After World War I, he recommended the creation of a domestic road system to serve military needs, and he dispatched one of his staff officers to survey the route. It took 62 days for the survey team to cross the nation. The team was headed by Lt. Col. Dwight D. Eisenhower—who ultimately was a key proponent of the 1956 legislation, and for whom the Interstate System was ultimately named.

intermodal equipment. Thus, during the 1950s and 1960s, intermodal services developed on competing equipment types. The Pennsylvania Railroad developed its TrucTrain product around the concept of trailers moving on flatcars. The New York Central Railroad—having to cope with New York City tunnel clearances—developed its Flexi-Van domestic containerization system. Ultimately, the Pennsylvania Railroad approach became the accepted standard, and the Trailer Train Company was formed to pool—and standardize—all intermodal flatcars.

By the 1970s, although some railroads were beginning to experiment with different intermodal services, the industry still relied on the movement of bulk commodities, such as coal and grain, for much of its revenue. A large portion of the intermodal business was merchandise business that was converted from boxcar to intermodal (although data for this period are not robust enough to determine the level of conversion). Many railroads developed specific intermodal services to compete with trucks in selected corridors. Most of these were over long distances (e.g., the Atchison, Topeka & Santa Fe Railroad’s SuperChief, which ran between Los Angeles and Chicago), although some occurred over short distances (e.g., the Illinois Central Gulf Railroad’s Slingshot, between Chicago and St. Louis.)

Facing difficult financial conditions during the late 1970s and early 1980s, the rail industry and Congress took several actions that created a new structure for rail services in the United States, and which have had important influences on the development of intermodal service. Congress created Conrail out of the bankruptcies of seven northeastern railroads. The Rock Island and Milwaukee railroads went bankrupt and were liquidated. Then in 1980 one of the most important events in US railroad history occurred—the deregulation of the railroad industry. In a deregulated market environment, railroads had more flexibility in providing the types of services to the markets that made the most sense from a business perspective. In particular, deregulation led to the following three key changes:

• Railroads were given greater leniency to shed marginal assets, which were often branch lines (also known as light-density lines). Many of these branch lines became successful short-line operations, primarily due to nonunion labor, lower overhead costs, and less demanding maintenance-of-way standards. Many major railroads, glad to be rid of the overhead, worked out...

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3 It is interesting to look at the case of the Consolidated Rail Corporation (Conrail). In the period of 1976 to 1980, it spent almost $3 billion to completely renovate its physical plant: track, locomotives, cars, facilities, etc. Despite this incredible investment, almost nothing was invested in intermodal service. At the time of Conrail’s formation, Operation Independence was an energy policy formulated by the federal government that placed great reliance on the development of domestic coal resources. Although governmental policies were aimed at reducing petroleum fuel consumption, intermodal still remained in a stepchild status. However, Conrail’s intermodal franchise became a key component of its initial public offering (in 1987) and its acquisition in 1997.

4 Officially known as the Chicago, Rock Island and Pacific Railroad (CRIP) and the Chicago, Milwaukee, St. Paul & Pacific Railroad (CMStP).
agreements to maintain traffic flow on the branch lines. Even with this shedding of assets, however, railroads still had excess network capacity.

- Railroads were able to negotiate contracts directly with a customer, rather than having to adhere to ICC–tariff rates. As a result, much of the traffic that was lost during the previous 20 years was regained, and new traffic was generated given the railroads’ ability to customize services to its customers. In fact, customers often generated new service ideas, such as double-stack trains for international (and later, domestic) containers.

- Railroads reduced the size of a crew from five workers to two workers. The final step of this reduction was the 1991 adoption of Presidential Emergency Board Number 219, which stipulated that displaced excess workers were guaranteed a portion of their salary, while allowing railroads to reduce costs and grow their business.5

Deregulation has completely transformed the railroad industry. As shown in Figure 6-2, rail volume and productivity dramatically increased in the years following deregulation. Intermodal services played a large part in this success. International trade, much of which was transported in containers on steamship lines, grew rapidly in the 1980s and 1990s. Traditional domestic rail customers also increased the volume of goods moved, and major new customers entered the market.

➤ Figure 6-2 Rail economic trends since Staggers Act (1981=100)

5 To illustrate the magnitude of this savings, ATSF trains between Los Angeles and Chicago had previously transited 14 crew districts with five-person crews (necessitating 70 crew members). After Presidential Emergency Board Number 219 was adopted, the same trip transited seven crew districts with two-person crews, which required only 14 crew members—a reduction of 80%.
Thus, by the 1980s railroads were able to fill excess capacity, and customers enjoyed reliable and cost-effective service. Intermodal development was no longer hampered by a lack of interest on the part of railroad senior management, who had long questioned whether intermodal services could ever be truly profitable. Intermodal service was now being mainstreamed in the company organization and became an important aspect of a railroad’s commercial portfolio. Growth in intermodal service from 1958 to 2008 in the United States and Canada is shown in Figure 6-3; during the 50-year period, intermodal traffic grew at an average annual rate of more than 10%.

Not surprisingly, in the United States and elsewhere, customer needs and motivations drove the process of experimenting with new and innovative rail services. Initially, marketing goals drove the leading intermodal shippers to choose intermodal movements. In other words, market demand created intermodal solutions. For example, APL, a major shipping line, wanted to serve East Coast destinations without sending its vessels through the Panama Canal. United Parcel Service (UPS), a major package delivery firm, wanted to serve all 48 of the contiguous states. J. B. Hunt, Inc., a major trucking company, wanted to continue to expand its business while meeting new competition. None of these goals necessarily led to intermodal solutions; rather, intermodal services simply developed as a natural result of transportation providers trying to meet their customers’ requirements.

Figure 6-3  Intermodal volumes, United States and Canada, 1958–2008

SOURCE: TTX Company
6.3.2 The Market

The railroads developed intermodal services (commonly referred to as piggyback services) by creating a series of plans that defined the responsibilities of each partner participating in the transaction. In the first plan, named Plan 1, rail service substituted for line-haul motor carrier transport. The motor carrier would provide a door-to-door service to a shipper for the pickup and delivery tasks, but the railroad would provide the line-haul movement. Although the railroad offered more economical line-haul, the motor carrier’s primary motivation was often simply to connect two separate operating centers.

In Plan 2, a railroad offered door-to-door service in railroad-provided equipment (usually a trailer). Most railroads owned a trucking company subsidiary that provided pickup and delivery services. These subsidiaries had blanket operating authority from the ICC to provide pickup and delivery within the commercial zone of cities for loads that had “prior or subsequent” rail movement.6

Plan 3, where the shipper provided the trailer, was widely used by perishable goods operators when that traffic was exempted from regulation in the late 1970s. Plan 4, where the shipper provided the railcar, was used in isolated cases; its most widespread application was when ocean carriers started running their own dedicated trains. In Plan 5, a modification of Plan 1, each participant was guaranteed a specified percentage of the revenues.

Even though these plans were designed to promote efficient and productive intermodal movements, their success was dependent on many other factors, including the following:

- **Operating management skills** (the degree of comfort a shipper has, or does not have, with a carrier)—A shipper’s lack of confidence in a carrier’s operating ability will most likely give rise to more general doubts about that carrier’s intermodal services.

- **Customer service** (the degree to which a carrier responds to and accommodates the particular needs of a shipper)—Track and trace visibility, electronic data interchange (EDI), and proactive management are all essential requirements of customer service.

- **Sales** (the “face of the company” to shippers)—Shippers often judged intermodal service as inferior to motor carrier service simply because they viewed third-party sales staff, who marketed intermodal services, as railroad surrogates, rather than as brokers offering a full set of options.

- **Perceived loss and damage to the load**, as well as the precautions necessary to avoid damage—These were often viewed as more extensive (and expensive) than those required for truck movements. The resolution of any dispute

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6 ICC commercial zones were areas around jurisdictions where ICC regulations were deemed not to apply, even if the overall move was an interstate movement.
that may arise between shipper and a railroad over loss or damage was also considered an onerous experience.

Although Plan 2 was the foundation for the early intermodal market, it was difficult for the railroads to manage. The administrative functions were difficult, and the sales and service required were not part of the railroads’ culture. (Its historical roots were in the less-than-carload express business, which had been passed off to Railway Express.) In addition, relationships with motor carrier subsidiaries were often difficult. Over time, third-party agents began to work with the railroads to compete with motor carriers.

Intermodal marketing companies (IMCs) were a way for railroads to make rail intermodal “look like truck” by providing a single bill to a shipper and arranging pickup, rail line haul, and delivery. Railroads could handle more volume with less staff; they no longer needed their own customer service operations, local trucking services, or retail sales function. To support this service channel, railroads provided equipment and attractive (volume) rates. While IMCs may today be quite sophisticated and publicly traded logistics companies, initially their survival was all about individual entrepreneurship and raw arbitrage. By getting larger volumes, IMCs obtained lower rates and improved their profit margins. Railroads, however, did not always benefit as intended. Sometimes IMCs would “coload” so that they could pool their individual volumes to reach the next (reduced) rate tier. Railroad employees would sometimes direct non-IMC shipments to a preferred IMC. In almost all cases, the railroads were cannibalizing their revenues. Since the railroads were providing the equipment—and often moving just one way—they had to absorb significant costs resulting from poor equipment utilization and the need to reposition the equipment.

With rail and motor carrier deregulation, the opportunities for IMCs expanded rapidly. With the introduction of confidential contracting, IMCs would often compete among themselves on price and would approach railroads for special (i.e., reduced) rates for unique moves. IMCs traditionally requested ramp-to-ramp rates from the railroads based on competitive factors. The door-to-door truck rate served as a starting point, to which an intermodal discount was applied; the costs for pickup and delivery, as well as a fee, were then backed out to derive the ramp-to-ramp rate. The pickup and delivery costs were projected on a roundtrip that assumed loaded movement in only one direction and empty return in the other. Any benefits from improved truck dispatching went to the IMC, not their railroad partner. Railroads frequently found themselves competing against their own interests, as the same business was repeatedly won at ever-lower prices. (Railroads were often unaware they were already handling the business they were being asked to bid on, as the IMC shipments often listed the IMC as both the shipper and consignee, making the actual shipper, or beneficial owner, invisible.) In addition, billing problems were rampant, cash flow was affected, and it was not unknown for IMCs to use the lowest rate (granted for a small piece of business) as the base rate on all of their traffic.
Despite these problems, railroads supported this wholesale approach to customer marketing out of economic self-interest. They enjoyed volume growth without having to provide extensive field sales staff, customer service, or door-to-door transportation. Railroads found that the expense—as well as the difficulty and commercial risk—could be outsourced. Many carriers felt they could retain the business by supporting a variety of IMCs; if one IMC lost the business to another IMC, the railroad would keep the volume.

Eventually, railroads came to realize that this system had leveraged the railroads with large volumes, but minimal financial benefits. Quick-pay incentives (generally, 1% to 4% of the freight bill if paid within 14 to 28 days) and volume incentives (generally, 1% to 4% of the freight bill for accumulated revenues above a certain amount) were scaled back, and an IMC’s ability to use railroad-provided equipment in an inefficient (i.e., one way) manner was penalized or was eliminated altogether. In some cases, the railroads managed to unbundle the equipment expense to a third party, such as the Equipment Management Program (EMP) service operated by the Norfolk Southern and Union Pacific railroads (and their agent railroads), in which equipment incentives and penalties are assessed to reflect location surplus/deficit conditions.

As the number of railroads has declined and consolidation has taken place with mass retailers and consumer companies, more selective marketing has become a real opportunity for railroads. It is also more tempting because the only way for the railroads to raise rate levels to profitability is to undertake the entire transaction. In some cases, the railroads have allowed the IMC to remain in place only as a sales channel.

Providing door-to-door service will allow railroads to retain the benefits of efficiency and perhaps expand their product portfolio (especially to selected major accounts.) Both the Canadian Pacific Railroad and CN have long provided door-to-door services through internal subsidiaries. Most of the US railroads are exploring similar opportunities. Many customers look at these services as dedicated capacity; the belief is that railroad moves are likely to encounter fewer operational problems.

It is interesting to observe recent developments in this area. Intermodal equipment management (and risk) is often being shared with the IMCs. In fact, several IMCs have become legitimate asset owners (e.g., Hub Group), and some asset owners have added what is, in effect, an IMC offering (e.g., J. B. Hunt). Meanwhile, even though railroads have consolidated into a few major companies, new IMCs, usually started by persons who previously worked for other IMCs, continue to enter the market.

However, in this period of market transition, a proliferation of door-to-door service options can be confusing to customers. For example, PacerDoor ser-

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7 Many IMCs made a great deal of money from non line-haul benefits since they were never passed back to their actual customer. While the margins were small, these companies had extraordinary return on equity because there were practically no assets.
vices are being offered at the same time that Union Pacific, which is Pacer’s underlying rail provider, is offering a competing door-to-door product (Streamline). Success (or lack of failure) by one party might serve to strengthen the perceived bargaining position of one relative to the other.

6.3.3 The Network

The intermodal network has evolved through a number of stages. Because the original intermodal product was the less-than-carload boxcar, any rail line potentially offered a point of intermodal transfer. As the intermodal market grew, the number of intermodal ramps proliferated. The costs of opening an intermodal terminal were low; all that was required were several loading tracks and some parking space. Trailers were loaded and unloaded by “circus loading,” whereby trailers were driven over ramps onto railcars and pulled from one car to the next across bridge plates (similar to how circus wagons were loaded for transport from one city to another). Initially, the trailers were tied down with chains and binders; the development of the trailer hitch greatly improved the process.8

Although no official count exists, it is believed that the number of ramps peaked at more than 2,100 in the 1960s. Many of these ramps were seasonal and operated only for short periods of time, such as those based on agricultural cycles (i.e., watermelon and Christmas trees) or industrial production runs (e.g., snowmobiles). What circus ramps saved in capital expense, however, they more than consumed in operating expense. Access points situated throughout the network led to poor utilization of equipment. Low ramp volumes led to high labor unit costs because union employees were guaranteed a minimum of eight hours of pay. All intermodal cars on a track needed to “face” in the same direction to be loaded and unloaded, thus requiring extensive switching by the railroad. There was also a limit to how many cars could be handled on a single track. The general preference was for six to eight cars (12 to 14 trailers); anything greater than 10 cars (20 trailers) was unproductive.9 In most cases, intermodal traffic was handled just like carload freight. Cars were picked up and often rehandled at intermediate yards, and the intermodal cars were often damaged in the hump yard.10

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8 Long after the elimination of chains and binders, the process of attaching the intermodal load to the flatcar is still referred to as the tie-down process.
9 With circus ramps it is impossible to select specific critical loads without further switching to make sure that the “hot” loads were the first cars adjacent to the ramp. Such a process only increased the expense and the elapsed time to the first discharge.
10 A hump yard is a rail classification yard used to disaggregate inbound and aggregate outbound trains. Inbound cars are pushed over a hump, allowing gravity to propel the cars through a series of switches to their proper classification track. If the car moves too slowly, it will not couple with the previously humped car and will thus require additional rehandling. If a car moves too quickly, it will crash into the previously humped car and can cause damage to its contents.
Over time, railroads developed dedicated trains on routes where there was sufficient demand between two points to fill the train to capacity (e.g., Boston–Indianapolis, Chicago–Los Angeles, and St. Louis–Dallas). Such increased density required fewer but more efficient ramps, which were often mechanized with cranes and sideloaders.

As railroads became more used to intermodal service, the number of terminals continued to decrease. In the mid-1980s, the Burlington Northern Railroad formalized the hub concept and drastically reduced its number of terminals. The ramps that remained, which were usually 200 miles to 250 miles apart, were mechanized. The most shocking aspect of the Burlington Northern strategy may, however, have been its decision to hire people from the trucking industry, rather than from the railroad industry, to manage the ramps.

Over time, all intermodal ramps were either mechanized or closed (Conrail’s Pittsburgh ramp was the last to be converted, in 1995). The maturation of the industry, along with the preeminence of containers and flatcars that were unable to be handled on a circus ramp, drove the need for mechanization. Terminals have evolved as well, from very small sizes to very large, from trailer-only to container capable, and from being able to handle only a few cars to holding entire trains.

As opposed to the early days of intermodal service, when ramps were conversions of existing facilities, today’s facilities are often greenfield sites that are hundreds of acres in size. The lack of readily available land in city centers is causing many terminals to be built in locations that would have been unimaginable just 15 years ago. The technology employed is more than just mechanized lifts; sophisticated terminal operation systems, coupled with sophisticated cranes and environmental mitigation strategies, support operations that did not exist 20 years ago. It is not uncommon for the level of investment in a new terminal to approach—and even to exceed—$100 million.

### 6.3.4 Service Factors Affecting Market Size

The attractiveness of intermodal service is dependent on several factors—price, service, reliability, and fragmentation of service.

#### 6.3.4.1 Price

The price of intermodal service, which is often a cheaper alternative to motor carrier transport, is always a key factor in attracting market share. It is important to distinguish between cost and price. Price refers to the amount charged (rate) by the carrier to the shipper, while cost is the total expense realized by the shipper and receiver in the course of the move. Cost encompasses not only the price charged by the carrier, but all other related logistical expenses.

Perhaps the biggest change in the intermodal marketplace over the past several decades has been the assumption upon which rates are based. For years,
higher volumes meant lower rates. The IMC business was founded on the principle that rates became lower as volumes increased. This premise was borne out in the golden age of intermodal services (1986–1995), when stack trains and ocean carrier intermodal services were introduced. However, the circumstances supporting this approach were unique. Railroads had an immediate need for volume, and international cargo was growing exponentially. Since then, excess network capacity has been consumed, and the labor savings from reductions in crew size reduction cannot easily be replicated.

Today, railroads must support investment in service improvements in their own right. Expiration dates of legacy contracts with shippers have become industry milestones, as large business customers theoretically come into play. Wall Street anticipates these contract expirations with expectations of higher rate levels and increased profitability. To many industry observers, one of the most painful sights is a company seeking to obtain legacy contract rates without any of the risk or investment incurred by the pioneers. Pacer International and J. B. Hunt, among others, have legacy contracts with attractive rates befitting their “first-mover” status. Their competitors often bemoan the rate inequities—although they never seized their own opportunities for obtaining such an arrangement. In the rare instance when they achieve a rate decrease, these coattail companies immediately resort to a price war against competitors with a better rate base—and are distressed when such a strategy becomes “a race to the bottom.”

6.3.4.2 Service

The use of intermodal services tended to increase when the tolerance for transit delay increased. Shipments to warehouse and distribution centers can typically absorb the most travel delay, so intermodal use was concentrated in raw material and intermediate distribution services. Finished goods destined for actual consumption, in contrast, usually moved by truckload.

To provide door-to-door service, railroads often had to enter into arrangements with other parties. In a motor carrier movement, the trucker is often at the customer’s door at the start of the business day. In an intermodal move, however, the drayman (trucker) from the destination ramp must wait for notification of when the container is on the ground, and thus does not usually reach the customer until much later (e.g., between 9 am and 11 am). Loading dock personnel often attend to the motor carrier right away, in the perception that the intermodal load is less time-sensitive. A two-tiered system thus developed at loading docks—truckload carriers with advance appointments were taken on time and promptly (un)loaded, while intermodal loads, considered to be less urgent, had to wait to be handled. This bifurcated handling not only

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11 Some customers maintain that current capacity constraints inhibit market freedom as large shippers have little chance of taking all their business from one railroad to another because it is unlikely that the other railroad has sufficient capacity to immediately absorb all that volume.
reinforced the poor image of intermodal service, but also impacted its market economics, as follows:

- Asset utilization was degraded. While truckload carriers were immediately loaded or unloaded and were therefore able to serve their next load, intermodal truckers had to wait longer. Enhancing asset velocity improves profitability.

- Service was further degraded. An intermodal trucker with an early morning appointment can have an entire day’s worth of appointments disrupted by a significant delay at the first stop. This vicious cycle served to further disparage the reputation of intermodal service.

- Accessorial charges (expenses outside of the rate quoted for pure transportation services) began to accrue. These charges were either assessed by the trucking company (e.g., for delays not the fault of the driver) or by the equipment owner (e.g., daily equipment fees), and they were inevitably a source of conflict between the trucker and the customer.12

Today, intermodal service is showing remarkable sophistication in its service offerings. Whereas railroads formerly showcased schedules that were really just their “best case” offerings, today’s schedules are much more realistic. And in some cases the railroads have put financial incentives behind service guarantees. The characteristics of intermodal service that are of concern to carriers and shippers include reliability, schedule conflicts, and fragmentation.

6.3.4.3 Reliability

Service reliability is considered by many shippers to be the most important characteristic of intermodal service. Railroads frequently boast that their intermodal trains are 95% on time. However, this claim can be deceptive for two reasons.

- Schedules can be sandbagged. Published transit times are lengthened to increase the likelihood of “on-time” performance. Rather than strive to meet high performance standards, the railroads relax the standards to accommodate poor performance.

- Measuring actual shipment movement is more complex with intermodal service.13 Railroads generally provide ramp-to-ramp movement. The motor

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12 This is especially true when the actual customer is removed from the transaction. The drayman has to collect the charges from the IMC or steamship line, which, in turn, must collect the charges from the customer. The drayman often feels pressure to absorb the charges, while the IMC often believes the drayman to be fabricating the charges or seeking to collect monies for problems arising from the trucker’s own mismanagement.

13 For example, assume that all components move at 95% on time. The single-component truck provides 95% service reliability. A competing intermodal move with two railroads and three truckers (pickup, crosstown, and delivery)—all operating at 95%—equates to a 77% service level. If you consider the four terminal lifts (ramp and deramp for each railroad), that translates to a 63% service level.
carrier, however, quotes travel times for door-to-door service, which the shipper greatly prefers.\textsuperscript{14}

Transit reliability can be influenced by many factors other than transit time deviation. Equipment condition has been a longstanding issue. Historically, the railroads have been unable to adequately inspect their fleet. Part of this problem is the result of slow and incomplete inspections at the time of interchange between participants. Another concern is equipment life-cycle, which often requires repairs or replacements (and the corresponding financial resources) at different points over an asset’s useful life. In both cases, railroads have worked to improve the inspection of equipment at the intermodal gate and their maintenance and repair processes through the introduction of new technologies.

6.3.4.4 Schedule Conflicts

Railroads have been successful in making scheduling a joint decision process with their customers. Based on their requirements, customers are frequently provided specific service slots. The network is planned around these commitments, and customers cannot easily change them. This has been a shock to steamship lines, which are accustomed to delivering cargo late to the railroads and never expect to face delays.

Cooperation also exists between railroads. Some joint services are offered, which are cobranded by two or more railroads. The industry has also worked to improve service through the Chicago hub. The Chicago Transportation Coordination Office was created in 1999 following a series of service problems that highlighted the need for a cooperative effort. The office has made run-through trains less prone to service interruption, helping to reduce the number of units interchanged by rubber-tire highway moves.

Improved scheduling points to the difference between speed and reliability. Today’s consumers seek time-definite transit first and speed second, whereas in the past they assumed that the fastest transit was also the most reliable (or that it at least provided a wider margin of error). Slower and less expensive transit that is time definite is frequently considered more desirable.

6.3.4.5 Fragmentation and “Seamlessness”

Service fragmentation has historically been a major obstacle to attracting customers. Over the years, railroads abrogated their control over more and more aspects of the business, including pickup and delivery, equipment supply, and terminal operations. Many of these decisions were guided by economics. As

\textsuperscript{14} The transit time comparison has a clear passenger analogy. If you are bumped from a flight that is on time, the airline will show 100% on time for the flight—even though your actual transit time does not reflect that level of service. If your itinerary requires two flights, and the first is late so that you do not connect with the second flight (which operates on time), the airline will show 100% on time for the second flight—and 50% overall—even though your actual transit time does not reflect that level of service.
railroads reduced their workforce and effectively outsourced functions, however, their control over the service product became more and more diluted. Meanwhile, an “unadulterated,” substitutable product became available from motor carriers, where one phone call resulted in a service under the direct control of one party the entire time, with one freight bill. Although many people view fragmentation as the proliferation of parties involved in a movement, geographical considerations also contribute to fragmentation. For motor carriers, the trailers left at a customer site can later be loaded without thought as to the ultimate destination. In contrast, intermodal rail transportation requires determining whether service is available to the desired destination and whether it is economical.

**6.3.5 Historically Important Customers**

Intermodal service has continued to mature and improve over time. The railroads were major players in the development of intermodal service, but four of their customers were also major participants in the development of the intermodal services we take for granted today. While there are significant differences among these four customers, there are certain common characteristics, as follows:

- All four had visionary managers—often years ahead of their industry contemporaries—who understood the possibilities of intermodal service.
- All were truly committed to an intermodal solution. It was a strategic change in their business model as opposed to an interim step that might be subsequently reversed.
- All worked through numerous challenges to achieve success.

**6.3.5.1 United Parcel Service (UPS)**

Like the railroad industry itself, UPS represents a successful reinvention of a business model. UPS was originally a local delivery service for department stores in Seattle (serving shoppers without personal automobiles). It expanded its market by obtaining operating authority in the commercial zones of major cities on the two coasts and the Great Lakes.\(^{15}\)

This worked until after World War II, when vast numbers of the population moved to the suburbs, shopping centers became dominant centers of retail activity, and the preeminence of the personal automobile eliminated the need for local delivery. Looking for new markets, UPS decided to serve manufacturers, wholesalers, and distributors. From 1956 through 1974, UPS painstakingly acquired interstate and intrastate operating authorities so that they could serve the continental United States through a network of 150 sorting hubs. The resulting service strategy was successful; however, as the business grew and ex-

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\(^{15}\) In 1956, UPS’s market included 18 of the nation’s largest cities.
panded, UPS had to overcome two challenges with a traditional trucking model—volumes were frequently inconsistent (there was a great deal of fluctuation by day of the week, and week of the month), and many of the markets were highly imbalanced. To overcome these obstacles, UPS turned to the railroads for substituted line-haul service, in most cases choosing rail for moves longer than 600 miles.

UPS was important because it was the first shipper to foster strong relationships with the railroads’ operations departments. This allowed UPS to stress that each load was really thousands of parcels and that a single service failure would be catastrophic. The company’s industrial engineering perspective and targeted focus on service quality proved contagious, generating improvements throughout the entire railroad product.

### 6.3.5.2 United States Postal Service

Like UPS, the United States Postal Service (USPS) was an early—and significant—user of rail intermodal service. And like UPS, USPS fostered a cross-cultural approach to its business, with operations, sales, and pricing personnel actively involved in developing desired services. Its initial approach did, however, differ. For UPS, service requirements were very high, but price was never the primary issue; it was not uncommon for UPS personnel to be on-site at major intermodal facilities to coordinate loads going to and from trains. USPS, in contrast, acted much more like a traditional customer. Perhaps this was due to its quasi-public nature and the constant challenge to contain expenses in the face of postage rate increases. Many of the initiatives that USPS forced onto the railroad became part of the foundation of intermodal services. Rate differentials for different levels of service (e.g., manifest freight, basic intermodal, and expedited intermodal) were developed. USPS was one of the first customers to insist on EDI for tracking and tracing, which developed into one of the first computer-based service performance systems. The entire order system was automated so that billing and payment could be handled electronically. In essence, USPS caused the railroads to expand beyond their comfort zone of serving as railroad providers to become transportation providers.16 USPS came to understand the possibilities of leveraging railroad and private equipment.17

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16 An example is mail moving between Springfield, Mass., and Nashville, Tenn. Traditionally, this had been a rail move from Springfield to Nashville. However, in the 1986 contract, it became apparent that this would not meet the service requirements. The route provided by Conrail became Springfield to Columbus by rail, and then by truck to Nashville. Not only did Conrail “short haul” itself, but it became responsible for almost 400 miles of trucking.

17 For example, Conrail traditionally priced railroad-provided equipment at higher levels than private equipment. However, by the mid-1980s ocean carriers were paying USPS an incentive to load their empty containers for shipment back to the West Coast. This was a “double dip” because USPS obtained a lower line-haul rate (from using private equipment), as well as the incentive. Facing their own equipment imbalance, Conrail ultimately priced westbound private equipment at significantly higher rates.
6.3.5.3 American President Lines
In the late 1970s, American President Lines (APL) was the largest United States liner company in the Pacific trades. At that time, however, APL was not financially strong enough to maintain all-water service to the Atlantic and Gulf ports. In the late 1970s, APL pioneered the “liner train,” which allowed the company to serve eastern ports without providing direct calls to Atlantic ports. Utilizing mini-landbridge (MLB) tariffs, containers were discharged on the West Coast and sent by rail to East Coast destinations. This strategy was then applied to designated inland hubs. In order to fulfill westbound liner train commitments, APL made alliances with third parties (e.g., Transway), which provided westbound loading of APL containers.

Unfortunately, the railroads could not always perform well. Problems ranged from train delays due to inclement weather to railroad ramps’ inability to handle containers. The winter of 1977–1978 was disastrous in Chicago and New Jersey. APL sent teams of people from their Oakland headquarters to oversee railroad operations. Thus was born APL’s core strategy that the best way to partner with a railroad was to let them run trains—and nothing else. With this strategy, APL went on to successfully implement double-stack transportation and domestic containerization.

6.3.5.4 J. B. Hunt Transportation
Following motor carrier deregulation in 1979, several truckload firms aggressively pursued the new market opportunities that had become available. J. B. Hunt—the company and the man—was a leader in what came to be known as the advanced truckload firm (ATLF), which developed a new business model for truckload transportation. Although 48-state authority made all markets theoretically available, ATLFs carefully selected markets they wanted to serve, and customized their service accordingly. This allowed for volume growth, which in turn enhanced efficiency in the selected markets. Operations and marketing were closely integrated to take advantage of economies of scope and scale. To ensure operational flexibility and cost-effective labor expense, the traditional unionized employee base was increasingly replaced with nonunion company drivers.

Although this model was very successful, high rates of growth were not sustainable. In 1989, J. B. Hunt became the first ATLF to cooperate with the railroads when it developed an intermodal product through a joint venture, called Quantum, with the Santa Fe Railway. The model was based on door-to-door pricing by J. B. Hunt, with revenue shared between the two parties. The initial equipment consisted of 48-foot trailers, and the targeted market was California to the Midwest.

Since that time, J. B. Hunt’s intermodal division has become the largest part of the company, making the most revenue as it expanded in terms of scope, scale, and strategy. Equipment transitioned to 53-foot domestic containers mov-
InTransModal TransportaTIon: movIng FreIghT In a global economy

ing in double-stack service. Perhaps most important, the truckload and intermodal divisions were managed as separate business units, with unique and distinct requirements. The commercial approach has been to manage product lines as a portfolio, rather than as a fungible market that can be interchanged.

6.3.6 Equipment

As the intermodal market evolved, equipment availability and standardization were constant issues. Three companies—Railway Express Agency (REA), Flexi-Van, and TTX—played key roles in developing intermodal equipment that has been the mainstay of intermodal service.

REA, a major owner of intermodal trailers, developed the REA Express Unit Haul System, which was based on 20-foot vans using specially designed flatcars. Like a great deal of intermodal business, this intermodal deployment represented a conversion from boxcar. Although the system was successful, its specialized equipment inhibited substantial volume growth.

Flexi-Van was owned by the New York Central Railroad and held a patent on a device that made possible the transfer of a container between railcar and truck without a crane. However, the New York Central was the only railroad using the equipment, and therefore its specialized nature was never adopted throughout the industry. The equipment was a technical success, but not commercially successful. Flexi-Van went on to become an early leasing company.

TTX (originally named the Trailer Train Company) is owned by the major railroads. Started in 1956 by the Pennsylvania Railroad as an equipment pool for intermodal cars, the company was instrumental in developing a standard intermodal car that could be interchanged among all railroads.¹⁸

6.3.6.1 Trailers and Containers

Throughout its history, intermodal equipment has evolved to meet customer needs. For most of the time, railroads lagged behind the trucking industry in the development and use of innovative technologies. By 1980, for example, motor carriers were using the 45-foot trailer as their standard. The railroads, however, remained committed to the 40-foot trailer and were still buying them as late as 1980. When the railroads finally began to use the 45-foot trailer in the early 1980s, the motor carriers had already transitioned to the 48-foot trailer. Not only were the railroads slow to adapt to 45-foot equipment, but the trailers were only 96 inches wide—instead of the highway standard 102 inches—in order to support circus loading.

¹⁸ A very conservative organization, TTX did not believe that double-stack operations would work. Prior to October 1, 1989, TTX required double-stack operators to commit to taking stack cars for a minimum of five years. This was contrary to their equipment pool model, which allowed cars to be turned back on five days’ notice. The ICC ruled that such activity was leasing, which was not allowed under the antitrust immunity granted TTX’s pooling operation.
By the time railroads considered 48-foot equipment, truckers were using 53-foot trailers. But 48-foot and 53-foot trailers were a problem for the railroads. The majority of the car fleet could only accommodate one 45-foot and one 40-foot trailer. With modification, most of these flatcars (at 89.5 feet) could accommodate two 45-foot trailers; however, in order to efficiently carry 48-foot, 28-foot, or 53-foot trailers, new car designs were needed.

Railroads spent decades debating the appropriate trailer size. Many railroads believed that intermodal traffic “weighed out before it cubed out” and opposed investing in larger trailers. In 1985, Harry Bruce, president and CEO of the Illinois Central Gulf Railroad decried the investment in 45-foot trailers as wasted money “for a phantom five feet.” Others felt that the issue was not size, but age. Longer trailers were newer and therefore less likely to be damaged. Ultimately, the market dictated the widespread acceptance of highway-compatible equipment.

The transition in container design was a little more difficult. In the 1980s, “domestic containers” were really marine containers moving in domestic service. These 20-foot and 40-foot containers—in accordance with international standards—had eight corner castings (four corners, top and bottom.) These castings worked with the corner posts and the other basic components of the container frame to absorb the forces that locked units exert on containers when they are stacked on top of one another during handling and during transport. The original 45-foot, 48-foot, and 53-foot domestic containers had corner castings set as if they were a 40-foot marine container.

The boxes were sturdy, but the challenge was to make a domestic container that was as good as a highway container: 53 feet long, 102 inches wide, and with a 102-inch door opening and the same clearance throughout the box. Ultimately, a plate container was developed to meet these requirements. There were some trade-offs: the boxes could not be stacked more than two high; and without the corner castings, terminal lift devices needed to be redesigned to pick them up by tiny plates on the outside of the container.

Figures 6-4 and 6-5 show how intermodal volumes have changed by equipment segment. Figure 6-6 indicates that the relative share of ISO containers (i.e., marine containers meeting specifications issued by the International Organization for Standardization) by size has remained largely unchanged. Figure 6-7 tracks the obsolescence of 48-foot domestic containers as they were replaced by mostly 53-foot containers over a nine-year span. Figure 6-8, however, shows that domestic trailers have not changed much, most likely reflecting an industry that has backed off from investment in trailers.

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19 Bruce, speaking at the International Intermodal Expo, claimed that ICC staff looked at how 45-foot trailers were loaded and determined that most loads could have been accommodated by a 40-foot trailer.
Figure 6-4 Intermodal volumes by type, 2000–2008

Figure 6-5 Use of trailers and containers by type, 2000–2008

SOURCE: Intermodal Association of North America
**Figure 6-6** Use of ISO containers by container size, 2000–2008

![Graph showing the use of ISO containers by container size from 2000 to 2008.

**Figure 6-7** Use of domestic containers by container size, 2000–2008

![Graph showing the use of domestic containers by container size from 2000 to 2008.](SOURCE: Intermodal Association of North America)
6.3.6.2 Flatcars

From 1960 to 1990, the 89-foot flatcar, introduced by TTX as part of a successful effort to standardize equipment in the industry, was the intermodal standard. This initiative was guided by regulatory concerns. By placing two units on a car, the per-car cost pricing approach, which was being strictly enforced by the ICC, could be overcome.

In an attempt to reduce line-haul costs, the railroad industry developed lightweight cars. The first generation of these cars was the Santa Fe’s “10 Pack,” which was a 10-platform articulated car. Each platform could handle one trailer of up to 45 feet (sometimes 48 feet) in length. This was the first car to demonstrate the benefit of articulation. Instead of the usual railroad coupling between platforms, fixed articulation joints were used. In the days of the steam engine, slack action had been used between cars to compensate for the lack of tractive power in the engines. In effect, slack allowed the engine to start pulling a train one car at a time, but as the slack was taken up, the units and contents could be damaged. Eliminating slack improved the train ride quality and reduced the potential for damage to the contents. Multiple-platform cars became the preferred configuration.

The double-stack car is a very efficient line-haul solution. It encompasses all the benefits of articulation, and it reduces slack and lessens the tare weight per revenue load. Most important, it doubles the carrying capacity per unit crew cost, which allows trainload capacity to be increased without increasing the train length.
Early double-stack cars were designed for the ISO marine container with 40-foot wells. However, as domestic containerization became commonplace, stack cars came configured with 45-foot and then 48-foot wells. Although the 53-foot container was the truckload standard, it was limited to only 50% intermodal market penetration (the 48-foot container, which could ride in the well bottom, accounted for 50%; 53-foot containers would be stacked on top). Once a 53-foot well was designed, the transformation was rapid—48-foot containers with no real market value were retired, and 48-foot wells were cut down to 40-foot to handle marine containers.

In sum, while the intermodal trailer still plays a role in the market, the primary intermodal equipment type is the domestic container, with trailer traffic continuing to be converted. Railroads have recognized the train efficiencies in double-stack operations and have configured networks and terminals to accommodate it. Intermodal transportation has traditionally lagged the highway industry in equipment size and capacity, but the 53-foot container has become the common piece of equipment. Nevertheless, trailers are still a component of the intermodal business, and a wide variety of car types are still used to carry this traffic. Although the industry spent a generation developing one standard flatcar, the direction is now in the opposite direction. A wide variety of intermodal railcars, some configured just for trailers, continues to exist and challenges the economics and operation of pure intermodal networks.

6.3.6.3 Whose Equipment?

Railroads, aware of all the hidden expenses (i.e., utilization, repositioning, and repair) of container use, have sought to unbundle the equipment from their service. Customers are increasingly called upon to provide their own equipment. Frequently, shippers find themselves confronted with the following four choices.

- Pay more for railroad equipment. Many describe the Union Pacific/Norfolk Southern EMP—a domestic container program—as the “capacity of last resort” approach due to its high cost. (The railroads counter that these rates reflect the actual—and previously subsidized expense—of providing equipment.)

- Acquire their own equipment. Hub Group is a leading example of this phenomenon in which an IMC undertakes the risk and expense of equipment. After years of maintaining a strict “no assets” policy, Hub acquired a large fleet of domestic containers (and drayage providers.)

- Source equipment and underlying line-haul service from a nonrailroad. Traditionally, this meant turning to a stacktrain operator, such as Pacer Stacktrain. Today, the options include: truckload providers (e.g., J. B. Hunt and Schneider National) and IMC asset owners (e.g., Hub Group).
• Transition the business model. Many IMCs have found that the truck brokerage business is now more profitable than rail intermodal and are focusing on this sector (e.g., Matson Integrated Logistics). Ironically, at the same time, some truck brokerage companies are finding opportunities in the rail intermodal business. C. H. Robinson, the world’s largest truck brokerage, is finding intermodal opportunities with the third option described above.

All these alternatives have drawbacks, such as reduced revenue and profit. IMCs may be concerned about the third option because the underlying asset provider operates both wholesale and retail sales channels. The worry is that the asset provider might seek to undermine (or “back solicit”) their commercial relationships by approaching their customers with a direct retail approach.

Equipment leasing companies also face an uncertain role in today’s intermodal world. A generation ago, these companies were valued partners, providing necessary assets to a capital-starved industry. Leasing company financial results, however, are often inversely related to equipment utilization (e.g., as carriers improve asset management, their excess inventory and leasing company profit are reduced). Besides reduced lease payments, carriers enjoyed improved terminal dwell times and a reduced need to reposition empties.

6.3.7 Culture and Organization

Over the years, railroad intermodal has undergone a thorough transformation. Until the 1990s intermodal was almost a breed apart within railroad organizations. While in some cases (see below) the intermodal business unit was integrated within the rail organization, most railroad intermodal personnel often had informal, dual-reporting relationships with functions in marketing, sales, transportation, or operations. Functionally, however, intermodal employees focused on intermodal services. Whereas employees in the rail carload business might find themselves moved around geographically or among different business groups, intermodal employees found themselves constrained to this specialty. In some cases, an intermodal business unit (IBU) was established so that all related functions could be consolidated under a single management structure.

Some of the early debates in the railroad industry related to where intermodal ended and the railroad began. One of the early models was the New York Central Railroad, which ran its intermodal business through its trucking subsidiary that would purchase transportation services from the railroad. Such a model, with many variations, was attempted by others. However, there are two major issues with this model:
• Intermodal operations could be considered a profit center (a segment of a business for which costs, revenues, and profits are separately calculated); however, when so much of the expense comes from other profit centers in the organization, it is difficult to discern the true contribution of intermodal to a railroad’s bottom line.

• Because the truck subsidiary employees belonged to the Teamsters union, railroad employees who were affiliated with the trucking subsidiary had to join the union. Management employees had to be moved from Railroad Retirement plans to the Social Security program.20

The last attempt at having the motor carrier subsidiary manage the intermodal rail business occurred with Conrail and the Pennsylvania Truck Lines during the 1980s and early 1990s. While well intentioned, the arrangement fell apart because of incompatible goals and difficult working relationships.

The concept of a railroad IBU was first developed successfully by the Burlington Northern Railroad in the early 1980s. This model had each hub (i.e., ramp) operate with distinct profit and loss responsibility. The Santa Fe Railroad developed a similar approach in the late 1980s, and Conrail and the Norfolk Southern Railway did the same in the early 1990s.

However, by the late 1990s, the IBU concept had all but disappeared.21 This probably reflected the maturation of the intermodal business model. The early developers of intermodal concepts were individuals who had been left alone to pursue their dreams. Although lacking in funding and support, their entrepreneurial spirit led them to develop the intermodal industry. That spirit came not just from within the railroads themselves, but from a variety of participants in the intermodal business; yet most intermodal innovators had some railroad experience.

### 6.4 Containerization

Containerization was developed by Malcom McLean in 1956. A trucking executive, McLean converted tankers to move the first containers, operating under his Pan-Atlantic Steamship Corporation. On April 26, 1956, the Ideal X sailed from Newark for Houston in an experiment of “sea-land” intermodal economics. The following year, the company took delivery of the first container ship, which had a capacity of two hundred twenty-six 35-foot containers. Container movements now dominate the rail intermodal business, with both international and domestic containers using rail lines.

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20 For many years, the Teamsters union sued to be included under Railroad Retirement, instead of Social Security.

21 CSX Intermodal is the last standalone unit.
6.4.1 International Containerization

6.4.1.1 The 1968 to 1980 Period

The “beginning” of international intermodal services took place in the late 1960s and early 1970s as Sea-Land Service (as Pan-Atlantic had been renamed) established regular transatlantic and transpacific services and other carriers entered the trade. Two key factors influenced how service was provided in these early years. First, the concept of time-definite transit was well known to the trucking industry, and there were many truckers who had followed McLean into the intermodal shipping business. Carriers thus adopted the “fixed day of the week” schedule used by passenger liners.

Second was the need to develop a completely integrated network. To convince customers to use the service, carriers had to offer a myriad of capabilities to shippers. Vertical integration became the industry model. Not only did carriers need vessels intended solely for carrying containers, they required a network of company-owned terminals equipped with cranes for loading and unloading the containers from the vessels. Because such investment was not insignificant, only well-established lines could participate at first. During this period, the successful lines were those who could deliver a complete set of assets to a customer who was willing to ship by container.

To maintain fixed day-of-the-week schedules, lines developed standard schedules. However, they were still obligated to serve numerous ports. In response, the industry developed the “bridge” concept.

The pure landbridge is a shipment between two continents that transits a third (e.g., Asia to Europe via the United States.) It was considered an option when the Suez Canal was closed following the Six-Day War in 1967. The pure landbridge is very rare.

A mini-landbridge is port-to-port substitution. For example, goods destined for Houston might be shipped to Los Angeles and then moved by rail to Houston.

A micro-landbridge is movement to an inland destination.

With respect to pricing, a convoluted regulatory scheme evolved in the early 1970s whereby joint ocean-rail rates were developed under the regulatory oversight of both the ICC and the Federal Maritime Commission (FMC).

6.4.1.2 The 1980 to 1984 Period

The stage was set in the early 1980s for the coming containerization explosion, with key activities taking place on two fronts. First, due to high interest rates, companies focused on lowering their inventory costs in an effort to be more efficient, and thus the field of logistics was born. Second, the concept of just-in-time delivery became well established, coincident with the ability of containers to transit large distances in a cost-effective and reliable manner. These activities coincided with the birth of global outsourcing, and as trade expanded,
so too did the vessels (a large vessel at this time carried two thousand 20-foot equivalent units, or TEUs).

A myriad of factors caused transpacific import volumes to the United States to surge during this period, including international currency agreements, continued outsourcing of manufacturing to Asia, and an increasing demand for consumer goods in the United States. Sophisticated liner companies expanded their vertical integration into consolidation companies to handle overseas requirements for US companies. Due to a fair amount of transpacific export traffic, lines still enjoyed balanced and profitable growth.

Although rail intermodal growth during this period occurred on all three coasts (West, East, and Gulf), West Coast volumes grew at much higher rates. By 1985 just about every major transpacific carrier was serving some East Coast traffic by mini-landbridge from the West Coast. But as volumes grew, railroads experienced terminal congestion problems.22

6.4.1.3 The 1984 to 1992 Period

A golden age of deregulation, independence, and intermodal response occurred from the middle 1980s to the early 1990s. To combat rampant inflation, the US government initiated a program of transportation deregulation, with railroads and motor carriers becoming totally deregulated in 1980. The Shipping Act of 1984 partially deregulated ocean shipping. The act was especially noteworthy because of its provisions governing intermodal authority of liner conferences. For the first time, conferences were granted antitrust immunity to set intermodal rates; however, they were not allowed to establish inland divisions in which railroads were paid a percentage of the overall ocean rate. Ocean carriers and railroads had to negotiate a specific rate for the rail movement portion.

During this period, the market developed into two segments. Conference lines commanded a price premium for their perceived service levels, and specifically the ability to offer inland intermodal services. However, a number of independent, nonconference lines also entered the trade. In this bifurcated market, successful lines offered either an intermodal network or low-cost port-to-port movement. As late as 1985, however, there was still a great deal of uncertainty about how ocean intermodal services would turn out, with the major issue being the adoption of double-stack intermodal versus round-the-world services.

The introduction of double-stack container movement is perhaps the most important intermodal innovation since the introduction of containerization. Double-stack trains usually consist of 20 to 30 cars. Each car consists of five

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22 During this period, ocean containers often moved as trailers on flatcars (TOFCs) on a chassis, instead of as a container on flatcar (COFC). This allowed service to circus ramps and low-density locations that did not have a chassis supply.
articulated wells, and each well holds two containers, one on top of another. Many wells are capable of carrying two 20-foot containers instead of one 40-foot container on the bottom.

Double stacks were originally introduced by steamship lines as a method of cost reduction. These lines, specifically APL and Sea-Land, were threatened by competing lines, which provided all-water service to the East Coast at greatly reduced rates. The concept of double-stack movement was thus a way of lowering costs to remain competitive. The major double-stack savings are in railroad line haul. By using one crew to carry traffic that otherwise have required the use of two or three crews, an enormous cost savings could be realized. In addition, the reduced gross (car) weight relative to net (cargo) weight resulted in fuel and track savings. Line-haul savings with double-stack movements were estimated to be in the range of 25% to 40% over standard container-on-flatcar service.

Sea-Land developed a prototype double-stack car in the late 1970s to be used between Los Angeles and Houston. It never saw widespread use because of its bulkhead design and heavy weight. In 1983, APL converted a car designed to carry trailers through the New York rail tunnels and implemented a lashing system similar to that used on ships.

Simultaneously, the railroad industry was faced with a major dilemma. Import container traffic was one of their fastest growing areas of business, but significant service problems existed. Poor traffic balance, poor equipment utilization, and high terminal costs were all contributing to an inadequate return on investment. These problems were exacerbated by a fundamental change in the economy of the United States. In the late 1970s, when the predominant flow of traffic in intermodal service was east to west, service in the other direction—west to east—was viewed as back-haul traffic. The recession in the early 1980s caused a drastic contraction of industrial capacity in the northeastern United States, and the traffic flow adjusted to reflect this decrease in production. Traffic suddenly now became primarily west to east. Landbridge traffic that had once been back-haul was now moving in the head-haul direction.

The introduction of double-stack railcars allowed railroads to ignore the balance problem or the challenge of repositioning empty equipment. Ocean carriers assumed the responsibility for a balanced operation by contracting for a round-trip. In addition, many functions previously performed by railroad labor were now assumed by the ocean carrier or their intermediaries.

As volumes grew, vessel size grew to 3,000 TEUs, and steamship lines were able to fill these vessels using their own, independent service. The de-

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23 Weight was an important issue when 20-foot containers were handled and when containers were loaded with (heavy) export cargo.

24 During the 1970s and 1980s the City of New York tried to develop intermodal ramps in all five boroughs. It never happened.
The development of the double-stack train represented a significant technological breakthrough, which provided faster transit with reduced transportation expense. However, in order to take advantage of double-stack efficiencies, it was necessary for the railroads to have adequate vertical clearance. Two 9-foot 6-inch containers require a 20-foot 2-inch clearance; one 9-foot 6-inch container paired with an 8-foot 6-inch container requires only a 19-foot 3-inch clearance. When double-stack service started, not all routes could support the clearances needed for two high-cube containers, and lines needed to carefully pair containers. As high-cube international containers became the standard and domestic containers were introduced, 20-foot 2-inch clearance has become essential. (Although some corridors e.g., CSX New England can go no higher than 19-foot 3-inch clearance.)

Double-stack service began in several high-density corridors. Although the initial corridor was Los Angeles to Houston, the prominent corridors became Los Angeles to Chicago and Seattle/Tacoma to Chicago. When necessary rail clearances were raised and terminal improvements made, service was extended to northern New Jersey.

At the same time that double-stack movements were beginning to get a foothold in the market, a serious challenge arose from round-the-world vessel service. In 1978, McLean, who had previously sold Sea-Land Service to R. J. Reynolds, purchased US Lines for $133 million. US Lines had been resistant to intermodal movement, and this outlook seemed confirmed when McLean announced the largest vessel order ever, ordering 12 megaships from Daewoo in Korea.

This order was significant in several ways. The vessels (the Daewoo Dozen) were 40% larger than the biggest container ship afloat. Also, McLean was very mindful of the disastrous mistake he had made in the early 1970s when, thinking like the trucker he was, he had the SL-7 class of ships built to provide fast service between the United States and Europe (their 30-knot service speed is still not approached today). Unfortunately, the cost of fuel increased significantly shortly after the ships went into service, making their high speed an unaffordable luxury. The US military ended up buying the vessels from Sea-Land. The Econoships that McLean ordered for US Lines were, in contrast, designed for slower, fuel-efficient transit.

The railroads, remembering that McLean’s original idea was to use containers on ships as an alternative means of moving goods between New York and Houston, were concerned that US Lines would use behemoth vessels to offer an intercoastal transit service for heavy goods, such as canned goods and wine, that were not very time sensitive. Ultimately, however, the slow vessel speeds led to US Lines’ bankruptcy in 1986; it could not compete in the new environment of faster—and cheaper—double-stack transit.

Evergreen Lines then assumed the role previously maintained by US Lines in the industry. Evergreen Lines was a Taiwanese company founded in 1968 with
one vessel. In 1984, it introduced scheduled round-the-world service in both directions. Evergreen was the first independent line that did not participate in conferences and was thus able to offer prices at nonconference (i.e., lower) rates. Evergreen Lines was a harbinger of the future makeup of the industry.

Over time, most rail routes received the necessary vertical clearance improvements. In almost all cases, the work was paid for by the railroad. However, there have been exceptions. In some cases, routes are just cannot be improved to meet the higher clearance, with the former Albany-Worcester and Harrisburg-Baltimore Conrail lines being examples.

It is interesting to see how the western railroads handled double-stack service. Union Pacific followed the APL “buy-a-train” basis with which it was familiar. Ocean carriers committed to unit trains and provided their own cars. The Burlington Northern and Southern Pacific railways wanted to run generic trains out of their ramps. Initially they tried to have the ports of Los Angeles (Southern Pacific service) and Seattle (Burlington Northern service) market these trains, but the shipping lines were not interested. In the meantime, the Santa Fe Railroad spent years trying to get back the ocean business it had refused.

Although double-stack trains have become a ubiquitous part of today’s intermodal landscape, it has hard to imagine how difficult it was in some cases to adopt such service. The Santa Fe Railroad had the best transcontinental rail network and was an obvious first choice for double-stack service. However, its CEO dismissed the opportunity, promising that “the boat people would never run his railroad.”

### 6.4.1.4 The 1990s

One of the key characteristics of the 1990s was the increasing globalization of the manufacturing process and the resulting growth in trade movement. Global sourcing increased the number of vessel calls. As vessel size began to increase to 4,000 TEUs, lines needed help filling vessels and thus formed vessel sharing agreements (VSAs) to share space on each other’s vessels. Most lines viewed this as a temporary means to accommodate the rapid expansion of capacity and network scope.

Most VSAs made no effort to coordinate liner operations beyond vessel scheduling. Because VSA partners were often competing with one another, the role of sales organizations became critical. Many lines severed agency relationships in favor of their own organization and their own dedicated sales force.

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25 Twenty-five years after the development of double-stack service, the Norfolk Southern Railway’s Heartland Corridor is finally clearing the service route between Norfolk and Columbus.

26 One of the more notable examples is the work to clear the Sierra Nevada tunnels, which was evenly borne by the Union Pacific, APL, and the Port of Oakland in the late 1980s.

27 In these cases, containers move by double-stack service to a preliminary terminal where they are “filleted”—i.e., the top layer is moved to its own row.
Customer relationship management became a trademark feature of a successful line. During this period, inland intermodal expertise was viewed as a way of distinguishing a line's service quality from the lines with which it shared vessel space. The result, however, was often chaos. Lines with on-dock facilities tried to avoid sharing this capability so as to maintain an (often fictitious) advantage. Containers drayed off-dock frequently arrived at destinations faster than containers held for on-dock loading.

Every line also wanted to claim that it had its own train. A single train, handling containers for 10 lines, would be claimed as “their train” by each of the lines. Railroads were willing to maintain the illusion as long as volumes grew and simplicity reigned.

The 1997 Ocean Shipping Reform Act completed the deregulation process begun in 1984. By this time, many independents offered better service than traditional conference carriers. This act allowed confidential contracting, which destroyed the conferences. The introduction of 5,000-TEU to 6,000-TEU vessels forced lines to address the shortcomings of VSAs, which had failed to rationalize assets or achieve significant cost savings. The result was the creation of four alliances where much closer integration was sought. In contrast to the industry’s original model, individually owned assets no longer mattered as much as service reliability and value. Successful lines again adapted to the new reality.

The four alliances deployed capacity worldwide. Volumes on the all-water route between Asia and the East Coast of the United States grew. Importers were looking for routing alternatives, and confidential contracting offered rates that were more attractive than what had previously existed. Over time, the transcontinental movement of goods destined for the East Coast from the West Coast began a precipitous decline, but service to markets such as Chicago, Dallas, and Memphis continued to grow.

6.4.1.5 Today

Globalization defines today’s industry. Lines have had to accommodate the changing patterns of global sourcing and the supply chain management process. The rise of China’s economy has been a large factor. Capabilities that were once valuable have become less so (e.g., consolidation in Hong Kong is being replaced by factory loading in China and transloading in the United States).

Global competition resulted in mergers and financial reengineering to obtain results that would have otherwise been unobtainable. Even though vessel size exceeds 8,000 TEUs, the value of these assets is obscured by the importance of providing sophisticated information technology. As customer supply chain needs have increased in complexity, some lines have developed logistics capabilities to fulfill these needs, with varying levels of success.
6.4.2 Domestic Containerization

The concept of moving containers in the domestic market is known as domestic containerization. Traditionally, the preferred mode of transportation for freight container movement has been the highway trailer. Two early attempts at domestic containerization by the New York Central Railroad and the Southern Railway in the 1960s and 1970s failed because of chassis management problems, in contrast to the Canadian Pacific Railway’s more successful experience.

6.4.2.1. New York Central

Driven by tunnel clearance restrictions—it could not get a piggyback trailer on a railcar into its New York City facilities—the New York Central Railroad was the first railroad to attempt domestic containerization. The New York Central required approximately one chassis for every two containers.28 The first phase of the program, from 1956 to 1964-65, was fairly successful due to several factors.

• The traffic was limited to the local network (New York Central system only). Containers were not permitted to go off line.

• The traffic was well marketed and fairly balanced. There was a limited repositioning of empty containers from St. Louis to Chicago (the two western termini of the system). (TOFC loads for the New York City market were handled in North Bergen, New Jersey.)

• Most of the traffic was moved under either Plan 2 or Plan 5, both of which involved the provision of door-to-door service.29 In most cases, this was done by the railroad’s truck line subsidiary, New York Central Transport.

Because connecting railroads were uninterested in developing domestic containerization at the time—and the New York Central was not big enough to support the technology alone—the New York Central decided around 1964 to introduce a dual system to support traffic growth. It supported interline trailer-on-flatcar (TOFC) traffic, which proved to be a disastrous decision in terms of chassis management.

Customers would load containers on a chassis and send them off line. Chassis turn-time per load skyrocketed, and chassis coverage went from 50% to well over 100%. In retrospect, many believe that a market-driven solution could have avoided this problem and that incentives could have been developed to encourage shippers to load containers solely to local destinations.

28 This term is called chassis coverage. In this case, it was 50% (one chassis/two containers).
29 Both Plan 2 and Plan 5 provide door-to-door service. The distinction is in the manner in which revenue and costs are divided. Plan 2 is a railroad rate: the railroad pays the trucker(s) as subcontractor at origin and destination. Plan 5 is a joint railroad–motor carrier rate; the revenue is allocated, using an established division, between the parties to the move.
However, the New York Central chose not to pursue this option, realizing that it would require the shipper to consider the destination of the freight when loading the trailer or container. Specific loads would need to be matched to specific destinations and to specific equipment types. If intermodal was to be free running, this could not take place. Eventually, all the containers were permanently affixed to chassis, and it became an entirely TOFC operation by 1970.

6.4.2.2 Southern Railway
The Southern Railway’s experiment with domestic containerization gave rise to severe chassis problems, which were similar to those of the New York Central. It too was saddled with a dual system brought about by its connections’ refusal to utilize domestic containers. However, the Southern Railway had another problem—geography. Most of its markets were short-haul markets, meaning that the amount of time the container spent without a chassis was much shorter than in a long-haul market. Chassis shortages were fairly common, and at times hundreds of containers were waiting to be unloaded. Southern Railway’s chassis coverage was about 65%, yet due to interline movements it was insufficient. This caused terminal operation dislocation and harmed car utilization, two problems that were overwhelming. Eventually, all the containers were permanently affixed to chassis, and the Southern became an entirely TOFC operation by 1973.

6.4.2.3 Canadian Pacific Railway
The Canadian Pacific Railway has had greater success with domestic containerization. It avoided some of the traditional pitfalls of domestic containerization encountered by its American railroad counterparts for the following reasons:

• Because it is a trans-Canada railroad, the Canadian Pacific is a closed system, which allows it to control the flow of equipment.
• It provides door-to-door movement, which allows it to be in control of the equipment the entire time.
• There is a high concentration of high-volume shippers in Canada.
• Chassis investment—and management—is minimal because many truckers provide their own chassis (or flatbed.)
• Terminals are highly mechanized. They allow storage of containers on the ground and “live lifting” when truckers came in to pick up containers.

In summary, with respect to domestic intermodal movements, double-stack containerization is the standard method of intermodal movement today. Railroads have invested in the terminals, clearance strategies, and information systems to manage double-stack service. Equipment investment has been plentiful. The line-haul economics and available service have convinced
the marketplace that this is the most cost-efficient way of moving domestic intermodal goods. However, none of this would have been possible without the development of a domestic container that looked like a highway trailer in terms of weight, length, door size, and internal clearance.

6.5 Challenges to the Intermodal Industry

Intermodal transportation is today facing a large number of challenges. Some of the more important ones are described below.

6.5.1 Crosstown Movements

When more than one railroad is involved in cargo movement, the units must be interchangeable. Railcar traffic can only be interchanged by terminal switching (steel-wheel interchange). Yet steel wheel interchange is not always typical for intermodal traffic, which frequently experiences rubber-tire interchange. The latter involve units being unloaded from railcars at the first railroad’s destination terminal and then trucked to the second railroad’s terminal, where the units are loaded for further movement. Although this method adds to terminal congestion by creating two more gate moves than would exist with a steel-wheel interchange, the following reasons for rubber-tire interchange are compelling.

- Cargo modification. The trailer/container will often have goods added and/or removed before proceeding to a destination. (This is especially frequent in natural freight centers like Chicago.)

- Service requirement. The service criteria for connecting to the next rail carrier often cannot be met. This may be because steel-wheel interchange is time consuming or has obstacles (i.e., commuter train curfews), or because an inbound train is delayed arriving.

- Car shortage. The first railroad may be suffering a flatcar shortage and does not wish to relinquish scarce assets.

- Unsatisfactory loading. The trailers/containers are not loaded in block order for the receiving railroad, for a number of reasons. One reason is because the origin terminal could not maintain block order, although it had sufficient volume (for example, Los Angeles loads 300 units on a train for Chicago; although 50 units may be destined for Philadelphia, it is too hard to maintain the loads together because there are upwards of 30 different destinations). Other reasons are the proliferation of on-dock loading, the disaggregation of volume due to VSA, and the proliferation of intermodal destinations capable of handling double-stack loading.
6.5.2 Chassis Use

The development of double-stack transportation enabled railroads to greatly increase the amount of traffic they could handle on their line-haul networks. It also improved the profitability of this traffic segment. Unfortunately, it creates significant terminal operating problems when a container reaches a destination terminal. A container cannot move on the highway without the wheels provided by a chassis. Chassis generally fall into the following categories:

- Dedicated chassis that are only compatible with specific containers (e.g., J. B. Hunt). These are easy to manage and control because they operate in a closed system and are relatively difficult for others to use.

- Railroad chassis pools to support specific domestic container pools (e.g., EMP). The railroads do a fairly good job in this approach for providing chassis because these assets are intensively managed by the railroads themselves in a closed system.

- Steamship line chassis provided by a steamship line to support that particular line’s business. Very often the supply swings between surplus, causing parking congestion, and shortage, causing operational disruption. Both problems are serious. To handle surplus, some railroads have invested in chassis stacking systems that enable chassis to be stored upright (up to eight chassis in the parking space previously used by one). This is an expensive operation and often leads to rancorous disputes over damage.

When a steamship line is short of chassis, a railroad is often forced to either ground the container (i.e., place it directly on the ground) or use another chassis, either of which exponentially increases the workload. In the first case, another lift is then required to place the container on a chassis when the line finally provides one. In the second case, another lift (a “swing”) is required to move the container from the intermediate chassis to the new one. Both of these situations are disruptive. A grounded container can often end up with other containers stacked on top of it, which then requires multiple moves to get to the proper container when a chassis finally becomes available. An intermediate chassis can be a problem because it penalizes the line that had an adequate supply of chassis available.

- Leasing company chassis pools provided by leasing companies. Because of their (apparently) high daily rates, they are often viewed as a chassis supply of last resort by steamship lines. Although their daily rates appear high when compared with the steamship line cost of ownership, the cost is only incurred when the chassis is in service. Steamship lines do not track chassis utilization very well, and this alternative may not be as expensive as it appears.
Ocean carrier chassis pools. In a few locations, the problem has been addressed by creating chassis pools. These are cooperative arrangements whereby steamship lines place their chassis in a common user pool that is administered by a third party. The lines contributing equipment usually form some sort of oversight body. These pools, organized by ocean carriers under an antitrust exemption granted them by the FMC, have been effective in reducing the number of chassis required, in turn reducing terminal capacity consumed by the storage of empty chassis and repositioned chassis. While the benefits for terminal operators are obvious, the benefits to ocean carriers are not always as clear. Some lines may feel that they have an advantage in operating by themselves.30

The chassis problem is further exacerbated because ownership and control are not always clear from looking at the physical asset. Furthermore, reports of empty (or bare) chassis moves are often incomplete. The chassis problem can also cause a great deal of operational disruption. There are a large number of empty chassis moves between terminals. Like crosstown moves, chassis relocation moves just add to the burden of gate processing and equipment tracking.

6.5.3 Terminal Capacity

Intermodal growth has been somewhat constrained by a lack of line-haul and terminal capacity. In recent years, railroads have invested significantly in line-haul capacity expansion (i.e., improved signaling, double-track conversion, and additional motive power), and these projects have improved the network for all railroad customers.

Of late, terminal capacity has become the constraining factor for intermodal growth.

Although some new intermodal facilities have been built, these are often greenfield facilities removed from urban centers (e.g., Union Pacific Rochelle and BNSF Joliet, which are also known as Global III and Logistics Park Chicago, respectively). Building facilities in urban centers is often constrained by the scarcity of land parcels of suitable size and by zoning restrictions.

Although some terminals have been built by conversion (e.g., CSX 59th Street) and several others remain viable alternatives (e.g., Norfolk Southern Calumet), terminal infrastructure is difficult to change in the short run. To

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30 The reasons are often complex and can include a belief that their individual costs are lower than what could be achieved by the pool; a commercial objection to helping “less efficient” lines operate at a higher level; or a cultural aversion to participating in communal efforts. In some cases, ocean carriers just don’t understand their costs and are focused on minimizing management fees, rather than overall expense.
increase volume, capacity must be increased. The most obvious and cost-effective method to increase capacity is by improving throughput.

6.5.4 Information Availability

Transparent and reliable exchange of information has been part of intermodal transportation from the very beginning. Although information technology has greatly improved, the industry still lacks the ability to manage a problem that it cannot measure. The Chicago Listening Session held by the US Department of Transportation on November 19, 1998, revealed many information-related impediments to intermodal freight movement, including the following:

- Local and corridor data are weak.
- Drayage firms have different information needs because of differences in cost structures and types of operations.
- Small carriers, typically operating at a 2% margin (or less), cannot afford sophisticated technology solutions or expertise.
- Improved pickup and delivery scheduling at terminals by expanding information exchange among railroads and carriers could accelerate the application of technology to intermodal freight operations.

More than ten years later, some of these problems have been resolved. Access to information has become much easier, primarily because EDI has become simpler and much less expensive—and almost free in some cases.

6.5.5 On-Dock Rail

International containers using intermodal service have three movement options:

- Off dock—A container, mounted on a chassis, is transferred by truck between the marine terminal and the railroad ramp.
- Near dock—A container is transferred (with or without a chassis) between a marine terminal and an adjacent, but external, rail loading facility.
- On dock—Train loading is accomplished within the same marine terminal as the vessel operation.

Double-stack transportation developed from the West Coast, where off-dock transfer had been normal practice. APL and Sea-Land, the two industry pioneers, were reluctant to allow members of the International Longshore and Warehouse Union (ILWU) access to intermodal cargo. In the early 1980s, the San Pedro ports in Los Angeles built the Intermodal Container Transfer Facility (ICTF) off dock, because studies showed an on-dock facility to be unacceptable to shipping lines. Southern Pacific was the only railroad that participated in building the intermodal container transfer facility—the Union
Pacific and Santa Fe both felt they had sufficient terminal capacity to accommodate the envisioned trade growth. These decisions were made in the 1978–1981 period when Oakland was the preeminent West Coast port.

On-dock rail evolved almost by accident. Tacoma started its operation to offset the high drayage cost to Seattle and the railroads’ lack of interest in serving its port. In Long Beach, on-dock intermodal rail started to utilize rail infrastructure that had been built for a slab concrete business (which never materialized). However, over time, on-dock rail has become more common. The lack of sufficient rail intermodal terminal capacity on the West Coast was a critical factor in accelerating this development. Ports used on-dock capability as a competitive tool. Today, almost every major marine facility design has a proprietary on-dock facility included.

However, the seeming benefits of on-dock rail beg further scrutiny. Part of the problem is the basis for cost and service comparison. Ports and steamship lines frequently benchmark on-dock movements against other marine terminal activities (slow and expensive). Railroads and intermodal benchmark on-dock movements against other intermodal terminal operations (fast and inexpensive). Attributes of on dock movements may include ease of service and cost savings, but these alleged benefits might simply be substitutes for other operational problems. For example, claiming that on-dock movements eliminate gate congestion at marine terminals completely ignores the question of why marine terminals have such poor gate processing operations to begin with.

On-dock movements appear more expensive than off-dock movements. According to a 2001 analysis, in Southern California, the off-dock cost includes a $125 drayage cost between the marine terminal and rail ramp plus terminal gate charges. On-dock is expensive because everything—labor, equipment, and land—is high-priced. In Chicago, six workers at $25/hour can load 200 containers in a shift ($6 direct labor /lift). On-dock at Long Beach can require 20 workers at $80/hour to load the same volume ($64 direct labor/lift).

With expenses for land ($200,000 to upwards of $500,000 per acre), loading equipment, maintenance, and the like, it is not unreasonable to fully cost on-dock service at upwards of $200 per lift. Most railroads use a fully allocated lift cost of $60 to $90 in a highly concentrated and congested city. 31

Ironically, on-dock service may be inferior to off-dock movements. On-dock requires large volumes to make unit trains. Large vessels may need five or six trains to handle all of their containers. Since on-dock terminals can only handle one or two trains at a time, this volume may not be accommodated for several days, while off-dock cargo can be handled in individual units by the railroads using their existing generic train network.

Service can also be worsened by access problems. Every port with on-dock service is subject to a railroad mainline access problem. Rather than getting

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31 In many cases, it is likely that the terminal operator hides the true cost to the line by subsidizing the cost through by fees for vessel loading and unloading operations.
directly involved with overseeing intermodal movement, ports have turned to other parties. These range from having terminal/switching railroads handle unit trains to setting up coordination groups.

On-dock service also has to cope with volumes coming from several different sources. Lines no longer have two or three exclusive vessels. With vessel alliances, the same volume is spread among five or more vessels. The vessel sharing partners may well have different railroad partners and commercial priorities. (e.g., one uses BNSF and CSX Transportation and wants its Atlanta cargo to go first; another uses Union Pacific and Norfolk Southern and wants its Columbus cargo to go first). Furthermore, the proliferation of double-stack destinations spreads the same volume over more destinations. This is a challenge for optimal car utilization and may result in extensive switching.

Terminal management distraction is another on-dock problem. Most marine terminals have enough problems running vessel operations. Given terminal resource and priority conflicts, the requirements of the vessel usually prevail over other activities on the dock.

6.6 Improving Intermodal Access

The following sections describe two efforts over the past 10 years to improve intermodal access at national gateways and illustrate some of the challenges of doing so.

6.6.1 Chicago—The Heart of the Problem

Chicago remains the intermodal crossroads of North America. Six major Class I railroads (BNSF, CN, Canadian Pacific, CSX Transportation, Norfolk Southern, and Union Pacific) interchange large amounts of traffic in Chicago. Impediments to intermodal freight movement in Chicago (in addition to those noted in Section 6.5.4) include the following:

- High volumes of rubber-tire interchange (perhaps as much as one-third of rail-related moves) add to road congestion.
- Driver shortages, especially for night shifts, force carriers to schedule most moves during the day. Off-peak moves are not cost-effective; they are low-revenue moves.
- The trucker cannot afford to absorb the cost of shifting freight moves from time slot to time slot or terminal to terminal to avoid congestion. The demands of just-in-time shippers restrict flexibility in rerouting freight.
Chassis shuffling—necessitated by the need to match proprietary containers and chassis—is time-consuming and expensive for rail terminal operators.

Some believe that these problems will disappear if and when transcontinental railroad systems emerge from industry consolidation. That may be true; however, it is also possible that consolidation will exacerbate the problem since interline gateways may need to remain open as conditions of merger agreements.

One way to reduce rubber-tire crosstown traffic is to facilitate steel-wheel movement. To that extent, the CREATE (Chicago Region Environmental and Transportation Efficiency) program was established in 1999. CREATE is a partnership among the US Department of Transportation, State of Illinois, City of Chicago, Metra (commuter rail agency), Amtrak, and six Class I railroads. The public-private partnership is seeking to invest $1.5 billion in rail infrastructure, which would simultaneously benefit rail operations and the quality of life for area residents by reducing train delays and congestion. It seeks to remedy 150 years of piecemeal construction around Chicago through improved signaling, separation of passenger and freight rail operations, and reductions in automobile and pedestrian crossing of rail tracks.

CREATE was to be funded by various public and private entities. But while the related federal authorization law for transportation (the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users, known as SAFETEA-LU), was expected to contribute between $800 million and $900 million, only $100 million was actually provided. Still, $330 million was pledged, allowing phase one to move forward.

6.6.2 The Alameda Corridor

Combined, the San Pedro ports (Los Angeles and Long Beach) constitute the third largest port in the world. Not surprisingly, these ports generate a large number of rail and truck movements in the Los Angeles basin. The Alameda Corridor project was a $2.4 billion commitment to on-dock rail (in fact, on-dock rail came on-line sooner than the Corridor’s completion). After 20 years of effort, the Alameda Corridor was officially dedicated on April 12, 2002. The intermodal project was intended to significantly enhance the flow of trade in southern California and improve mobility in the Los Angeles metropolitan area. The Corridor is a 20-mile rail express line between the ports of Los Angeles and Long Beach and the city of Los Angeles, connecting the marine terminals with the transcontinental rail mainlines. Perhaps the most important feature for the local communities is that the line replaced a disjointed system of almost 90 miles of inefficient rail and eliminated almost 200 at-grade crossings.
This project certainly merited its designation as a “project of national significance.” It was the ultimate intermodal connector, financed through a public-private partnership. The $2.4 billion was assembled through an amalgamation of loans, loan guarantees, and grants.

The Alameda Corridor project is considered a good example of how both public agencies and private companies can work together to solve intermodal access problems. The following observations, however, suggest that there are still lessons that can be learned from this experience that could benefit others similarly trying to improve intermodal access.

• Remember the trucks. Regardless of what mode of transportation is used for any intermodal movement, there is almost always one truck movement. Most people have forgotten (or may never have known) that the original Alameda Corridor design was a true intermodal connector—the double rail mainline was to be accompanied by six truck lanes. The truck lanes were not included in the final plan, which is a problem because the trade growth filling the Corridor will further congest local highways.

• Protect flexibility. The Corridor was designed and constructed without an operating plan for stakeholders, many of whom now face financial challenges. When calculating investment benefit, it is necessary to predict benefits over the expected lifetime of a project. Normally, this has been an engineering decision to determine the physical life of the asset. But today, economic obsolescence can precede physical decay.

Vessel changes provide a compelling example. In 1992, vessels calling at the San Pedro ports carried an average of 3,500 TEUs, with a typical traffic mix of 40% local and 60% intermodal. Not all intermodal could move on dock—about a quarter still needed to be drayed off dock. Excluding what would move on dock, the average vessel would put 55% of the cargo (1,925 TEUs) on the local highways. Today, vessels calling at San Pedro carry an average of 7,000 TEUs. The typical traffic mix is 30% local, but intermodal consists of 40% intact loads and 30% loads that must be deconsolidated (i.e., the shipment must be separated into its original constituent shipments). The deconsolidation category, which was not significant when the Corridor was planned, reflects intact loads destined for local distribution centers in Los Angeles.32 The cargo arrives in Los Angeles in a marine box, but leaves in a domestic piece of equipment. Excluding what would move on dock, the average vessel could put 50% to 70% of the cargo (4,500 to 5,000 TEUs) onto the local highways. Larger vessels will load the same volume on dock, but put an even larger burden—and create more congestion—on the local highway system.

32 The rise of deconsolidation comes from supply chain management (i.e., inventory deferment) and economic globalization (i.e., more direct shipments from China.) In 10 years, we will doubtless see more changes.
• Ensure there is an operating plan. Many steamship lines do not like the per-TEU fee that finances the Corridor’s debt, but most of them agreed during the planning process to pay that fee, despite being unaware of what the fee would be. The same holds true for operating costs. When all costs (from all participants) are factored in, an on-dock transaction may be four or five times more expensive than an off-dock move. For most lines, it is too late to bargain. Operating costs should always be understood ahead of time.

• Remember the network. The Corridor was meant to eliminate a major transportation bottleneck. Networks sometimes remind us that as we relieve one chokepoint, others arise. In addition to increased drayage (due to vessel size and mix changes), railroads have their own unique network problems. Despite an assumption that on-dock trains would be unit trains with no need to stop at Los Angeles, most on-dock moves require prior/subsequent switching at Los Angeles, but no additional switching yards were built. There are also limits to the number of trains that can be run on the preferred intermodal route coming out of the Los Angeles Basin.

For better or for worse, the Corridor represents industrial policy—the federal government, by virtue of its funding support, selected winners and losers. The Corridor has guaranteed that the San Pedro ports will be winners for at least a generation, competing with the Port of Oakland and ports in the Pacific Northwest. Almost every major transpacific line features a dedicated San Pedro terminal with on-dock rail. These facilities were built with an underlying volume guarantee that requires lines to channel most discretionary (i.e., w) traffic through San Pedro for the foreseeable future.

6.7 Reconsidering the International Intermodal Network: The Southern California Experience

When double-stack transportation started in the early 1980s, it utilized only a very small portion of the intermodal network. The initial trains ran between Los Angeles and Chicago, with the network expanding to include New York and Seattle. There were several reasons for this exclusivity. The initial commercial arrangements required the steamship line to “buy” an entire train and supply the necessary double-stack cars, thus requiring volume aggregation. Additionally, track clearance, terminal capabilities, and chassis management further limited the routes utilized.

In the past 20 years, intermodal network capacity has significantly expanded. While terminals vary in size, all of them have mechanized lift capability and yard control systems. Most of them now handle double-stack containers—a recognition of the favorable line-haul economics of this mode. Double-stack expansion, however, gave rise to two factors that greatly complicate train loading:

• Insufficient facilities. Railroads are frequently constrained by terminal capacity and equipment availability. While double-stack operations have expanded significantly, not all terminals have fully automated or expanded stack facilities. Railroads face challenges in managing large inventories of double-stack containers, particularly during peak periods. Proper planning and coordination between railroads and terminal operators are crucial to mitigate these issues.

•码头设施不足。铁路公司经常受到终端容量和设备可用性不足的限制。虽然双层运输已经显著扩展，但并非所有终端都实现了全自动化或扩展的堆垛能力。铁路公司在管理大量的双层集装箱存货方面面临着挑战，特别是在高峰期。良好规划和协调对于铁路公司和终端运营商之间至关重要，以克服这些问题。
• As the inland network evolved to common handling of international and domestic movement, the number of possible destinations increased, resulting in a more difficult loading process at the point of origin. In 1986, for example, a steamship line might have been loading San Pedro discharge cargo to two or three destinations; in 2006, that same line might be loading to 30 different destinations.

• The loading challenge increased as the intermodal car fleet became more varied. In 1981, the industry standard was an 89-foot flatcar that could carry two units. In the subsequent 10 years, a range of car types (double-stack, spine, etc.) and configurations were introduced into service.

Outbound loading has become complicated. The major goal was to optimize loading (i.e., utilize all available car slots while keeping goods for common destinations in a block) without incurring expensive and time-consuming switching at the origin. Railroad blocking rules sometimes made this process almost impossible to accomplish in a cost-efficient manner.

One popular solution has been to load to a small group of destinations that, in turn, serve as rework points. For example, loads for Pittsburgh and Detroit might be initially loaded to Chicago (where they will either be trucked across town to their eastern rail connection or be trucked directly to their destination), while loads for Baltimore and Boston might be loaded to Harrisburg and Syracuse (and rehandled or filleted in an intraterminal move33).

Unfortunately, this does not solve southern California’s problem—it merely transfers it inland. Several railroads have attempted to load solid trains through to major destinations. Here again the problem has only been shifted. The crosstown move in Chicago has been eliminated, for example, only to be replaced by an off-dock move in Los Angeles.

As international trade grows, new solutions will be necessary to accommodate the growing volume. One possible answer is the development of an international intermodal network with attributes distinct from the existing domestic network.

6.7.1 Leverage Logistics

A first step is to truly leverage logistics. Although international trade and logistics are intertwined, they do not always meet the same requirements. For example, consider just-in-time inventory delivery systems. Just-in-time systems arose in the early 1980s, when automobile manufacturers were suffering through economic recession and high interest rates. These systems did not greatly reduce the amount of inventory in the production pipeline; rather

33 Double-stack clearance is not available beyond that point. The filleting operation converts double-stack to single-stack.
they allowed auto manufacturers to delay paying for inventory until it was actually used (thus transferring the balance sheet’s inventory cost and risk to the supplier). Just-in-time may as well have been named “just-in-case.” Transportation shipments became a case of “hurry up and wait.” Inventory was positioned near the consumption point, and many transportation carriers were required to hold inventory—often for extended durations—in their equipment.

Many steamship line executives face the delicate challenge of having to negotiate fast and reliable transit times at the same time they are being asked for extended free time by shippers. Import cargo might sit for months due to retail buyers seeking low-cost acquisition for seasonal items. As distribution centers fill, containers are treated like auxiliary warehouses. Export cargo can often sit longer, as sellers wait for buyers’ letters of credit to clear, or for a favorable time to sell traded commodities. The equipment owners, along with marine and rail terminals, are called on to absorb this slack.

Collaborative logistical planning needs to assign and update expected movements. Logistical control systems are improving, but they still need to unite the cargo information with the equipment. With such a system, import cargo would be scheduled for a time and place for the container to be unpacked, and export cargo would be scheduled for vessel sailing and destination. A system must be developed to allow cost-effective relocation of extended duration shipments to an off-site, low-cost intermediate point.

**6.7.2 Make On-Dock Moves Truly On-Dock**

The current generation of marine terminals utilizes on-dock facilities that were designed much like near-dock facilities. An import container is discharged from the vessel and comes to a point-of-rest (either on a chassis or in a stack) within the terminal. The intermodal operation is completely distinct from the vessel operation. The import is taken from its point of rest in the terminal and loaded to the railcar. The only difference between on-dock moves and near-dock moves is that the latter require transit through a gate.

Ideally, an on-dock transfer involves a single move between vessel and rail. Initially, this could eliminate the intermediate point-of-rest, which may greatly accelerate terminal throughput and increase terminal capacity without requiring additional infrastructure. Current work rules are not the only obstacle to this change. Train loading often waits on vessel discharge to accumulate critical mass for specific destinations.

Railroads would like to see trains loaded in such a way that they can depart the port without needing extensive switching and then be run as unit trains for an extended distance. This goal is difficult to achieve because alliance vessels discharge cargo for different lines with different commercial priorities. Too often, for example, trains are loaded on dock at San Pedro, but the containers are
then switched at Los Angeles into existing trains. Operations are slowed, and the uncertainty impedes operational planning. The uncertainty causes most on-dock facilities to have to provide sufficient capacity for storing empty cars, which consumes scarce land. Car turn-time and operating expense increase. In a perfect world, the rail operation would be adjacent to the quay, and the vessel crane would handle a container directly to or from the railcar. The amount of space required for on-dock operations could thus be reduced by 60% to 90%, and the amount of space available in some terminals could increase by 15% to 40%. The resulting operation would be vastly more flexible and fluid.

6.7.3 Utilize Cheap and Available Real Estate

To load containers as described above, the container sorting process would be relocated from the on-dock marine terminal and reworked. Today, intermodal terminals are located in population and industrial centers and are thus often constrained from expanding due to a lack of land or to opposition from the local community. As previously described, some of these terminals already serve as rework terminals for loading trains heading crosstown and beyond.

For the San Pedro ports, a possible location for a rework terminal would be the Inland Empire, a metropolitan area containing parts of San Bernardino and Riverside counties and located about 100 miles inland; or it could be another location farther inland, before the railroad’s mainline divides. The inland terminal, applying the logistics model to the containers, would be an intermediate warehouse supporting time-definite delivery either to the customer (for imports) or to the vessel (for exports.) The terminal would handle inbound trains for reloading to destination. Imports coming from San Pedro would have information about ultimate destination delivery requirements. An import would either be immediately reloaded or be stored there for subsequent loading. Loading would accommodate all intermodal destinations. Intact loading to connecting railroads would take place so that intermediate crosstown movements and rehandling of containers could be eliminated.

With numerous inbound trains from the port arriving, outbound trains could be scheduled to run more than once a day. The increased frequency would improve efficiency and service reliability. Scheduling algorithms would be developed so that containers could arrive at their destination terminal in sufficient time for delivery, but not so far ahead as to cause congestion. Service schedules would need to be defined and maintained to guarantee fulfillment of delivery appointments.

Export operations would be handled in a similar manner. Some lines may want to send cars directly to their on-dock facility, especially if they contain

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34 On the BNSF line, an example might be Clovis, New Mexico, where the transcontinental mainline splits to Chicago/Memphis and Texas.
empties. However, all cargo destined for San Pedro ports would have the option of discharge at the rework terminal.

Outbound train movement to San Pedro would be driven by vessel sailing confirmation. Exports are often “rolled” to subsequent vessels, and destinations are often changed. In marine terminals, this often requires multiple re-handling of stacked containers. Inland, they would remain on the ground until the marine terminal was ready to receive them. Export movement to the marine terminal might not be as simple as import handling. It will likely be necessary for exports to be discharged and queued on the ground prior to vessel loading, but with proper terminal design, this could happen adjacent to the vessel, using the same quayside tracks.

Such a rework terminal would be designed to accommodate grounded storage of containers. Pricing of storage would be attractive to the steamship lines. Additionally, marine and rail terminals, no longer accommodating the traffic dwell, would realize significant operational improvement.

6.7.4 Expand the Intermodal Market

Once established for long-haul intermodal movement, an inland terminal could then be expanded in scope. When international trade began to grow in the 1980s, most cargo was consolidated in the Far East, especially in Hong Kong. Today, US deconsolidation is increasing. It is estimated that San Pedro import cargo is evenly divided between goods for local consumption, containers that will continue intact on intermodal service, and containers that must be deconsolidated before moving.

The deconsolidation traffic has some unique attributes. Much of this traffic is currently trucked to facilities in the Inland Empire, where it is removed from the container. Ultimately, much of this cargo leaves in domestic equipment. This cargo could move by rail from the marine terminal to the inland terminal for pickup. Exports and empty containers could be returned here for movement back to the San Pedro ports.

Although it may seem a stretch, the development of an inland terminal supporting an international intermodal network might not be such a wild idea. There is not enough land at marine terminals to accommodate growth, nor enough money to continue to prop up a system that will encounter increased congestion. Incremental solutions to trade growth and intermodal demand can no longer be relied upon. A generation ago, double-stack operations radically transformed inland transportation. The industry needs another breakthrough to continue its growth.
6.8 Summary

This chapter examined the railroad’s role in intermodal freight transportation. Railroads play a critical role in moving intermodal freight in an efficient and cost-effective manner. The rail intermodal industry has experienced significant growth since the mid-1950s when the idea of moving containers on a ship and then transporting the container via truck or rail to its final destination was conceived. As many manufacturing processes became more global, international trade grew dramatically, which motivated the rail industry to develop new and different services to accommodate the demands of the new market. Not only were new technologies and infrastructure introduced into the rail industry, but new and innovative arrangements between railroads and a myriad of other actors were also introduced.

Today, intermodal freight is a substantive part of the railroad industry’s bottom line, and with a growing world economy, it will likely continue to be a major component of freight movement in the United States.