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TRB's Study of Twin-Trailer Trucks

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ABSTRACT

The Surface Transportation Assistance Act (STAA) of 1982 legalized the nationwide use of twin-trailer trucks on Interstate highways and other designated primary routes. In this paper will be reviewed what is known to date about the effect this legislation has had on the trucking industry--who is using these vehicles, where, and for what purposes. This information, coupled with earlier research findings concerning twins and other heavy trucks, will be used as the basis for a brief discussion of the likely effects of twins on the design, maintenance, and operations of highway facilities. Specific topics will include road geometry, pavements, bridges, and traffic capacity. Throughout, references will also be made to other new trucks legalized by the 1982 STAA--the 48-ft single-trailer truck and 102-in.-wide trucks.

Twin-trailer trucks--truck tractors pulling two trailing units with individual lengths of 27 to 28 ft--have been operating in the United States for more than 35 years, but their operation has been

confined principally to the far West. In the Surface Transportation Assistance Act (STAA) of 1982, the Congress required states to permit the operation of twins, as well as longer semitrailer trucks (with trailer lengths of at least 48 ft) and wider semitrailers (up to 102 in.), on Interstates and primary routes designated by the Secretary of Transporta-

tion. These changes in truck size limits were intended to increase productivity in the motor carrier industry to at least partly offset increased taxes and fees enacted at the same time.

The 1982 STAA also directed that the National Research Council's Transportation Research Board monitor the effects of twin-trailer truck use on highways and highway safety. A special study committee, appointed by the National Research Council, developed a study design and began its work in June 1984. The study will be completed in June 1986.

In developing the plan for its work the study committee decided to include a thorough review of prior studies and research dealing with twins and, for the most part, rely on the continuing data collection efforts of other organizations to monitor the short-term effects of twins. This approach was selected because the committee chose to examine a broad range of possible effects including industry use and economics, safety, vehicle performance, highway design and maintenance, traffic operations, and highway administration. The study committee has completed its review and critique of prior studies and is in the midst of assembling data and information on the first 2 1/2 years of nationwide use of twins.

The purpose of this paper is to share preliminary study findings about the motor carrier industry's response to the availability of twins and other STAA vehicles on a nationwide basis. These findings address the following key questions:

- What types of firms are purchasing these vehicles?
- For what purposes?
- What are the specific advantages that these trailers offer?
- How do new equipment decisions vary by region?

Questions such as these are particularly important because their answers can be used to speculate about the long-term role and use of twins and other STAA vehicles in the United States. The use level of these vehicles affects the scope and magnitude of

virtually all impacts of interest, from highway accidents to pavement wear.

Before specific industry responses are discussed, the structure of the U.S. motor carrier industry is reviewed and the characteristics of twins and their relative advantages and disadvantages are outlined. With this background established, pre-1983 use of twins and what is known so far about post-1983 use are examined.

STRUCTURE OF THE MOTOR CARRIER INDUSTRY

The motor carrier industry is highly varied; five carrier types predominate: firms that provide shipping to the public for a fee (the common carriers), firms that ship goods to specific companies under contract (the contract carriers), independent owner-operators, companies that are not in the primary business of trucking but that instead have fleets to move their wholesale or retail goods to the points of sale (private carriers), and carriers that operate solely within state lines (intrastate and local carriers).

These definitions have been used since the Interstate Commerce Commission (ICC) began regulating the industry in the mid-1930s; however, the definitions overlap considerably. Although the deregulation of the motor carrier industry that began in 1980 has further blurred the distinctions between industry segments, the available information about the industry is still classified according to the traditional definitions (Figure 1).

The ICC regulated trucking according to how firms sold their service to the public, the types of commodities that they shipped, and the routes on which they moved. Private carriers, because they were not primarily in the business of trucking, were not regulated. Although included in the definition of the for-hire industry, movers of certain goods, particularly raw agricultural commodities, were also largely exempt from ICC regulation. Companies that only operated within a single state were completely exempt from ICC regulation.

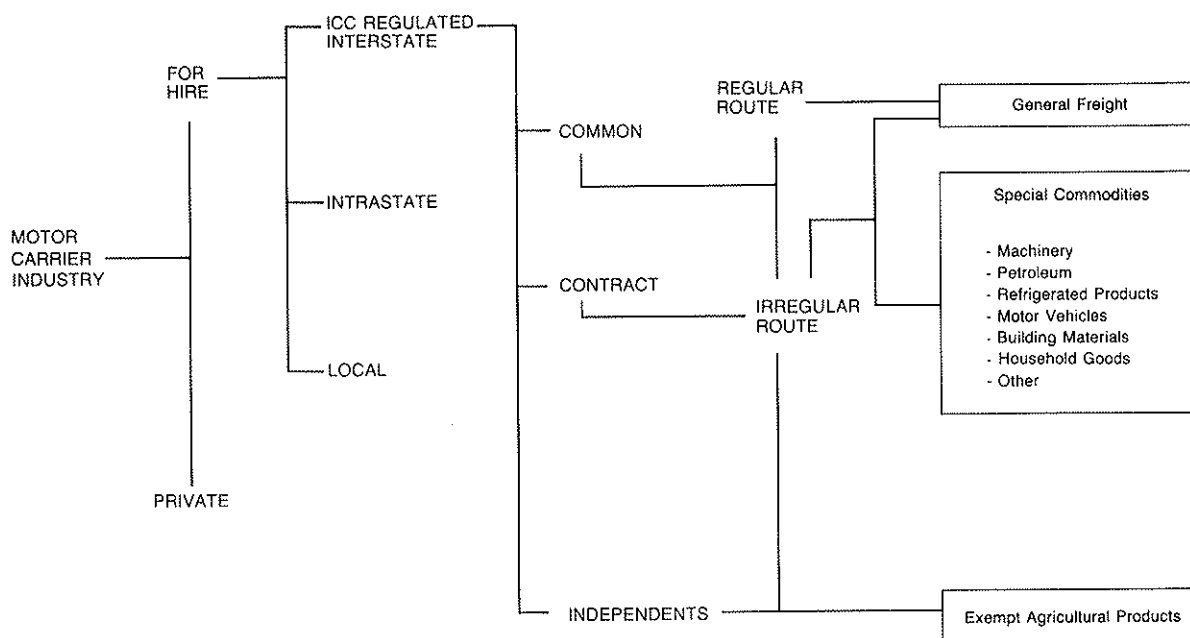


FIGURE 1 Structure of the motor carrier industry.

Unregulated Carriers

The unregulated carriers accounted for the majority (60 percent) of intercity tonnage and total revenues in 1983 (Table 1). Many national wholesale and retail stores, leasing companies, large grocery chains, utilities, governments, and oil companies own and operate private fleets. These fleets vary widely in size, from fewer than five tractor-semi-trailer combinations in many fleets to Ryder Truck Rental's more than 20,000 vehicles (5). Although this category also includes independent owner-operators, the private fleets account for the lion's share of travel by unregulated carriers. Indeed, according to the estimates in Table 1, private carriers account for 40 percent of all combination-truck travel.

Regulated Carriers

In the regulated segment of the industry, there are firms that offer shipping to the public according to established rates (common carriers) and others that move goods for individual companies only under contract (contract carriers). Contract carriers mostly transport goods classified by the ICC as special commodities. These goods tend to require a specific type of tractor-trailer combination and include, for example, automobiles, petroleum, and refrigerated products. In addition, these goods move from the factory, or point of origin, directly to the destination in what are referred to as "truckload" lots. This simply means that the carrier picks up a single shipment and moves it directly to its destination. Contract carriers may account for as much as one-third of the combination vehicle miles of travel (VMT) of regulated carriers and about 15 percent of all combination VMT (Table 1).

Common carriers transport special commodities and truckload freight also, but the majority of the largest common carriers handles less-than-truckload (LTL) shipments of general freight. The ICC classifies LTL freight as those individual shipments weighing less than 10,000 lb not as the extent to which a trailer is filled.

At terminals from which goods are headed in the same direction, individual LTL shipments are loaded into trailers and then transported to other terminals for distribution to the final destination. Common carriers transport most of the regulated

freight; they travel about twice as much and own twice as many vehicles as do contract carriers (Table 1).

The common carrier segment of the industry is characterized by a few giants surrounded by hundreds of medium-sized companies and tens of thousands of small firms. The top 10 revenue earners for 1983 were responsible for one-quarter of the total revenue of the entire regulated motor carrier industry. The share of earnings increased to 40 percent for the top 50 revenue earners and to just under 50 percent for the top 100 revenue earners (6,p.65).

Impact of Deregulation on Industry Structure

The Motor Carrier Act of 1980 lifted many of the regulatory constraints on the industry. Among the more important changes, the ICC has (a) made entry into the industry relatively simple, (b) allowed private fleets to operate more like for-hire carriers, (c) expanded the classification of exempt commodities, and (d) made it easier for carriers to add service to new points or drop existing service points in their networks.

Although it is too early to assess the full consequences of deregulation, several observations can be made about the experience during the first 5 years. First, despite a severe industrywide recession in the early 1980s, tens of thousands of new firms have sought and received ICC operating rights, mostly for common carrier service. Second, distinctions among major industry segments have been further blurred as firms have begun to offer services outside their traditional areas. Third, as existing firms have sought new markets and new firms have entered the trucking industry, competition has intensified and rates have stabilized or dropped. Finally, larger trucking firms have emerged from the recession of the early 1980s more quickly than small and medium-sized firms, and a number of the larger common carriers are pursuing expansion plans and making major equipment purchases.

CHARACTERISTICS OF TWINS

With the motor carrier industry in a period of unprecedented competitiveness and cost consciousness, the nationwide legalization of twins and other large trucks by the STAA of 1982 has provided new oppor-

TABLE 1 Motor Carrier Industry Freight, Travel, and Revenues: Regulated and Unregulated Segments, 1983

Industry Segment	Intercity Tonnage ^a		Intercity Ton-Miles ^b		Combination VMT ^c		Combination Vehicles ^d		Revenues ^e	
	Millions of Tons	Percent-age	Billions of Ton-Miles	Percent-age	Billions of Miles	Percent-age	Thousands of Vehicles	Percent-age	Billions of Dollars	Percent-age
Regulated carriers										
Common	NA	NA	NA	NA	19.1	33.2	278.4	26.2	27.7	25.3
Contract	NA	NA	NA	NA	8.8	15.3	124.7	11.7	18.8	17.2
Subtotal	756.0	39.4	227.6	41.3	27.9	48.5	403.1	37.9	46.5	42.5
Unregulated carriers										
Private	NA	NA	NA	NA	24.6	42.8	595.8	56.0	NA	NA
Exempt	NA	NA	NA	NA	4.9	8.5	65.6	6.2	NA	NA
Subtotal	1,138.0	60.1	323.4	58.7	29.6	51.5	661.3	62.1	62.9	57.5
Total	1,894.0		551.0		57.5		1,064.4		109.4	

Note: NA = not available; VMT = vehicle miles of travel.

^aTonnage by mode from Transportation in America (1,p.7).

^bTon-miles by mode from Transportation in America (1,p.6).

^cTotal travel estimated by FHWA (2, Table VM-1). Share of travel based on distribution by carrier type reported by Census Bureau (3, Table 7).

^dTotal combination vehicles estimated by FHWA (2). Share based on distribution by carrier type reported by Census Bureau (3).

^eRevenue from Transportation in America (1,p.4). Share of revenues between common and contract carriers from 1982 Financial Analyses of the Motor Carrier Industry (4, Figure 1).

tunities for increased productivity, but these opportunities are not the same for all segments of the industry. Because of the cargo they carry and the nature of their operations, some carriers will be more attracted to twins than others. In this section a summary is given of the characteristics of twins and their potential advantages and disadvantages compared with the semitrailer trucks that they typically replace.

Typical Pre-1983 Twin-Trailer Trucks

The twin-trailer truck most widely used in the United States before 1983 consists of a two-axle tractor drawing two single-axle semitrailers, each 27 ft long (Figure 2). The semitrailers are coupled by a single-axle converter dolly: a short frame mounted on an axle with a hook-and-eye connection to the front trailer and a fifth-wheel connection to the rear trailer.

The overall length of this truck is 65 ft, the maximum legal length in 25 of the 36 states where the vehicle was permitted before 1983 (the other 11 had longer maximums). Apparently the 27-ft length of each trailer and the typical use of short-wheelbased tractors of the cab-over-engine style was dictated by this common 65-ft limit. The width of the vehicle (excluding certain projections such as rear-view mirrors) is 96 in., the legal maximum on all roads in 42 states (7) and the federal maximum on Interstates (8) before 1983.

Other Pre-1983 Double-Trailer Trucks

A variety of other combinations with two trailers was in use before 1983. These include turnpike doubles--nine-axle vehicles with twin 40- or 45-ft trailers, a length of approximately 100 ft, and a maximum weight of up to 105,500 lb (legal, at least on some roads, in 14 states in 1983)--and the Rocky-Mountain double--a tractor pulling a standard length semitrailer plus a shorter second trailer, with seven or eight axles and an overall length of about 85 ft (legal in 11 states in 1983). The 1982 act had no effect on the legality of these longer or heavier doubles because it provided only for double trailers each 28 ft or less in length that are subject to the same 80,000-lb weight limit applied to single-trailer trucks.

FHWA vehicle classification count data (9) show a small number of six-axle double-trailer combinations that are identical to the twin trailer except that they have three axles on the tractor. This configuration is likely to be used increasingly while new twins are being introduced because most tractors in fleets that did not employ twins before 1983 have three axles.

Twins Legalized by the 1982 Act

The Congress in 1982 permitted twins that had trailers up to 28 ft long, unlimited overall length, and a width of 102 in. on Interstates, the federally designated network, and state-selected access roads. Figure 3 shows typical dimensions of these vehicles and of the 48-ft semitrailer combination also legalized. The overall length of the twin is at least 67 ft because the spacing between units and the tractor length of the 65-ft pre-STAA twin were already at a minimum. Twins with conventional (rather than cab-over-engine) tractors, in which the engine is under a hood forward of the cab, may be 2 to 5 ft longer.

Advantages of Twins

To trucking firms, twins can offer two primary advantages relative to semitrailer trucks--greater cubic capacity and greater operational flexibility.

Greater Cubic Capacity

The 28-ft by 102-in. twin has 31 percent more volume capacity than the standard pre-1983 single trailer and 16 percent more than the 48-ft by 102-in. single trailer that Congress also permitted in 1982 (Table 2).

The same federal gross weight limit of 80,000 lb applies to both twins and semitrailers on the Interstates. However, twins are easier to load to the maximum overall limit without exceeding federal individual axle load limits than are five-axle semitrailers, which require careful balancing of the axle loads to maximize the weight legally carried. On semitrailers 48 ft by 102 in. "cubing out" occurs; that is, the entire volume capacity of the trailer is used before the gross weight limit is

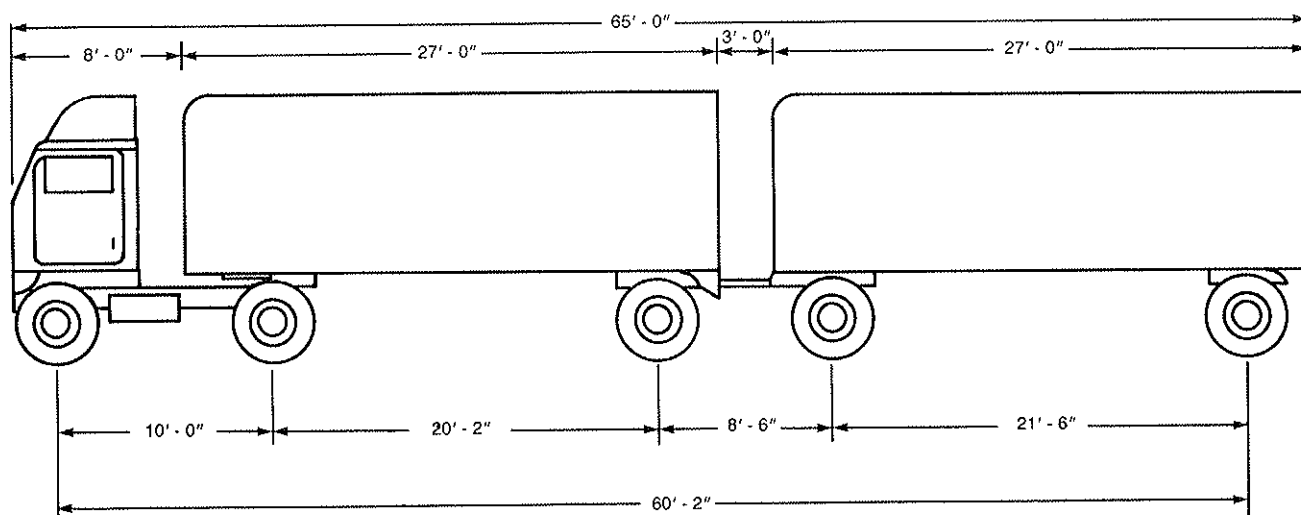


FIGURE 2 Typical dimensions of pre-1983 five-axle double-trailer combination.

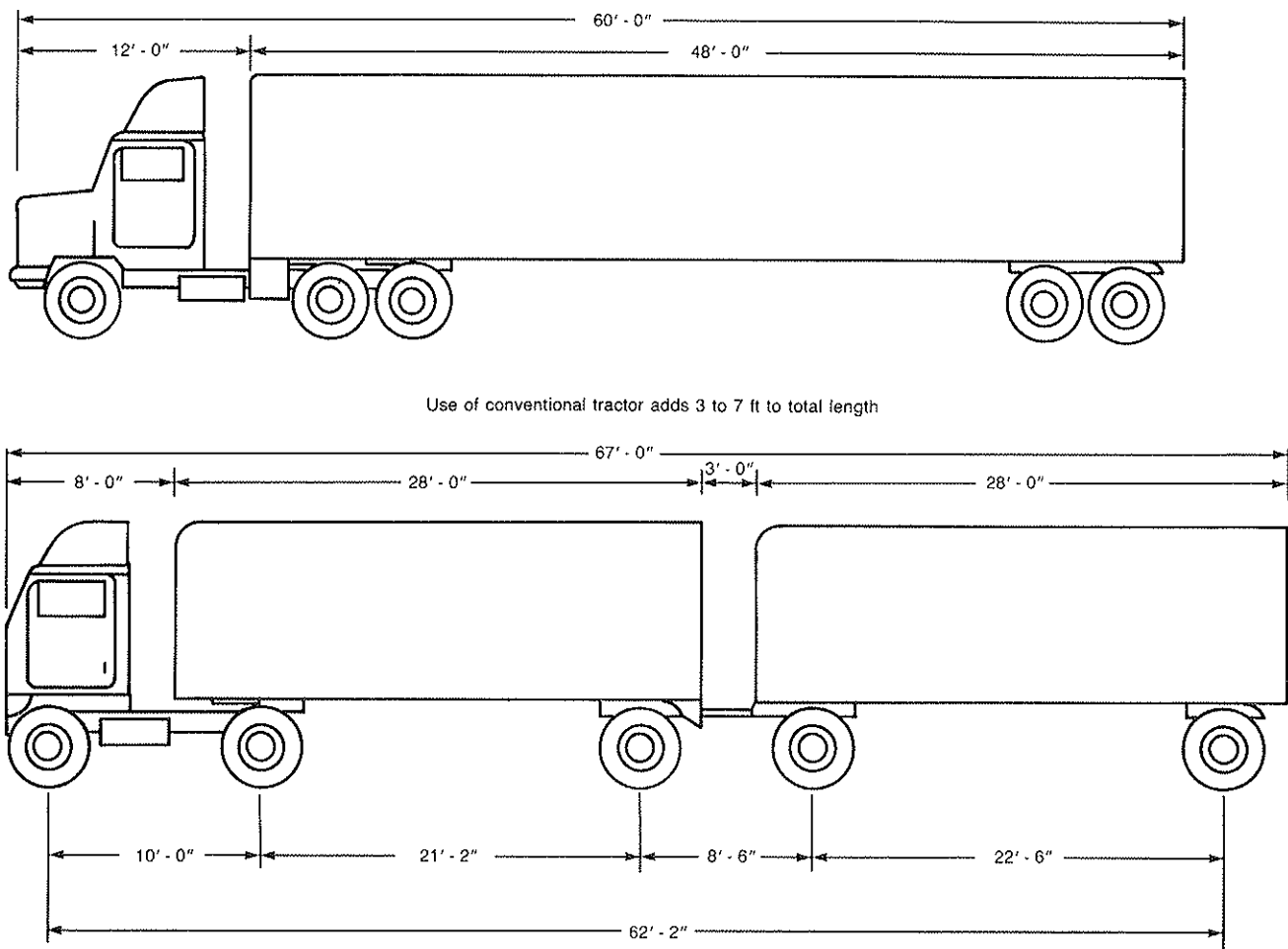


FIGURE 3 Typical dimensions of doubles and singles permitted under STAA of 1982.

TABLE 2 Typical Inside Dimensions and Volumes of Dry Van Trailers

Type and Exterior Dimensions	Inside Dimensions			Volume (ft ³)
	Width (in.)	Height (in.)	Length (in.)	
Semitrailer				
45 ft x 96 in.	93	108	533	3,098
48 ft x 102 in.	99	108	569	3,520
Twin				
27 ft x 96 in. (each)	93	108	317	3,685 (pair)
28 ft x 102 in. (each)	99	108	329	4,070 (pair)

reached at freight densities below 14.2 lb/ft³. However, twins can carry the maximum weight with cargo as dense as 12.3 lb/ft³.

Thus carriers with cargoes of relatively low density can carry larger loads with twins than with the semitrailers they replace, even if that semitrailer is the new 48-ft by 102-in. type. For example, one of the biggest common carriers in the country has an average freight density of 11.5 lb/ft³. Carriers such as this are taking advantage of this added cubic capacity to reduce their line-haul costs, which are about half of all costs to LTL common carriers (10).

Greater Operational Flexibility

For carriers that transport mixed cargoes over large networks with many pickup and delivery points, twins

can reduce the number of times that freight must be handled--unloaded and reloaded--on its journey.

For example, consider the intercity movement of LTL freight. As shown in Figure 4, LTL shipments transported in semitrailers must be handled several times between the points of origin and destination. Twin trailers offer an opportunity to bypass some of the normal handling steps in a hub-and-spoke LTL operation. A standard semitrailer might arrive at an intermediate terminal in Charlotte, North Carolina, for instance, and have part of its load removed for transport to Atlanta, Georgia, with the balance bound for Columbia, South Carolina. The space in the trailer bound for Columbia might be filled with other shipments to Columbia and the shipments bound for Atlanta would be consolidated with others in a different trailer. In contrast, a twin trailer arriving at that same terminal could bypass the break-bulk operation. The shipments in the trailer bound for Atlanta would not have to be unloaded; instead, the trailers would simply be separated. In addition to labor cost savings, time savings would be realized because the shipments bound for Atlanta could be dispatched immediately. Further cost savings could be realized if a 28-ft semitrailer was used to pick up the freight from one metropolitan area, was then attached to a tractor and another twin for the line-haul portion of the trip, and was ultimately used as the vehicle for delivery. In this case the freight would be handled only at pickup and delivery. Reduced handling means reduced terminal and break-bulk costs, which account for roughly 20 percent of LTL common carrier costs.

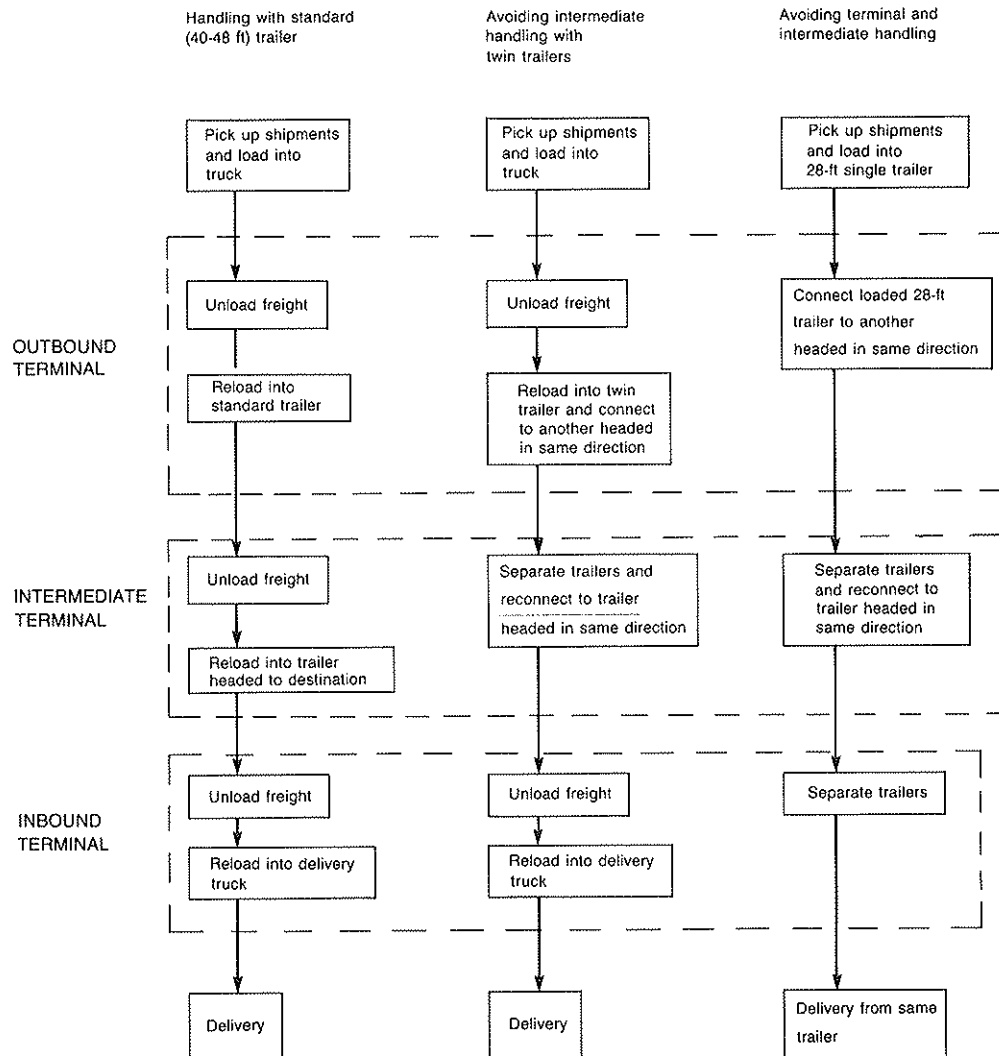


FIGURE 4 Freight handling eliminated by use of twin trailers.

Disadvantages of Twins

Twin trailers also have some disadvantages. A pair of 28-ft trailers plus the dolly sell for about 6 to 7 percent more than a 48-ft semitrailer. The additional size and the dolly also increase the tare weight by about 3,000 lb, thus reducing the potential shipment weight. For terminal-to-terminal freight operators, twins can increase the amount of vehicle handling required at the terminal. The trailers have to be separated, and if both are to be unloaded, additional labor is required to back the trailers up to the loading dock or move them around the terminal. In addition, the new twins can introduce some problems in keeping the fleet in balance when inbound freight tends to be LTL and outbound freight tends to be TL.

PRE-1983 USE OF TWINS

The use of twin trailers has been a western, and primarily a California, phenomenon. Although twins were legal in 37 states in the early 1980s, in only 9 western states (Arizona, California, Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming) and one state outside the West (Nebraska) did they account for 4 percent or more of total combination

traffic. In four states where twins were legal at the time (Delaware, Louisiana, Maryland, and Mississippi), none was observed in the FHWA vehicle classification counts before 1983.

Although historical data on twin use provide some guide to future users, national statistics can be misleading. Statistics on twin travel are dominated by California, where use of twins permitted carriers of all types to take advantage of the maximum vehicle weights. Because of the axle weight limits and spacing of axles, a pair of twin trailers could effectively carry a few thousand pounds more cargo than a single trailer. In addition, California produce farmers found twins particularly suited to some of the special characteristics of their harvesting operations. Judging from accident statistics (11), as much as one-half of all twin traffic occurred in California before 1983. Twins registered in California accounted for an even larger share of twin-trailer traffic (3). Because under the STAA of 1982 twins now have the same gross weight limits as singles, nationwide pre-1983 experience is not necessarily a good basis from which to predict future twin traffic.

To examine regional variations in the pre-1983 use of twins and isolate the California experience, the study has tabulated by regional (California, other western and mountain states, and eastern and

central states) data from the Annual Truck Weight Study (9) conducted by the states and reported to FHWA, supplemented by Bureau of Motor Carrier Safety (BMCS) accident data (12) and the Truck Inventory and Use Survey of the Bureau of the Census (3). In all tabulations, twins were compared with three-axle-tractor two-axle-semitrailer combinations, the alternative vehicle for nearly all twin applications. Key findings are as follows:

- Industry class. ICC-regulated for-hire carriers (contract and common carriers) operated 93 percent of twins in the eastern and central states before 1983 compared with 63 percent of five-axle single-trailer combinations. The ICC-regulated firms accounted for 74 percent of twin use in the other western and mountain states but only 25 percent in California. Virtually all ICC-regulated twin mileage is produced by common carriers. Nearly one-half of the California twins and one-fifth of those in other western and mountain states were privately operated. In 1983 BMCS data, large private Interstate twin users included retailers and producers of food and forest products.

- Cargoes. Operators outside California predominantly used twin trailers for general freight and small-package cargoes. Cargoes on twins were much more highly concentrated in these commodity categories than were those on semitrailer combinations. In California, in contrast, the commodities carried by twins were as varied as those in semitrailers; the largest category was agricultural and food products.

- Trailer body types. Examining trailer body types gives another indication of the users of twins. As the previous tabulations would suggest, twins in the eastern and central states and other western and mountain states were mainly enclosed dry vans, whereas twin flatbeds and bulk commodity carriers (hoppers and tank trailers) were common in California. There was no appreciable traffic of twin refrigerated vans or furniture-moving vans in any region.

In summary, in the eastern and central regions before 1983, most twins carried general freight and were operated by common carriers. In California, twins were used for purposes as diverse as those of semitrailer trucks. In other western and mountain states, twin use patterns reflected the spillover of California twin traffic but were closer to the patterns of the eastern and central regions.

POST-1983 INDUSTRY USE OF TWINS

Because of their light-density cargoes and complex networks with multiple terminals and break-bulk facilities, common carriers of LTL general freight appear to be the industry segment most able to take advantage of the capacity and operational characteristics of twins. Because of this, pre-1983 studies of truck size and weight changes generally identified this segment as the primary user of twins if they were to be legalized on a nationwide basis (as they were by the STAA of 1982 (13,p.III-1). Moreover, the pre-1983 experience, except in California, is consistent with this expectation.

Nevertheless, there are a number of uncertainties and unresolved questions. To what extent will twins be adopted for use by LTL common carriers? How does the availability of wider and longer semitrailers affect industry equipment choices? Are there other segments of the industry besides LTL common carriers that will adopt the use of twins? Is increased capacity or greater flexibility in handling and routing cargo the key factor in choosing twins? To begin

answering such questions, the TRB study has examined post-1983 trailer sales statistics and interviewed trailer manufacturers and a number of carriers. The preliminary findings of these activities are presented in the following paragraphs.

Trailer Sales

For analyzing the industry response to the availability of new truck configurations, trailer sales statistics are limited and can be misleading--the characteristics of trailers purchased in any given year do not necessarily represent the desired or ideal mix of trailer sizes. Instead they reflect the immediate equipment needs of motor carriers that are in a position to acquire new equipment. Quite possibly these carriers initially acquire newly available equipment in proportions beyond those planned for their overall long-term inventories simply because none of this equipment is on their current inventory.

Nevertheless, trailer sales statistics are the first place that changes in equipment choices by the industry would become apparent. Statistics on trailer sales by size are compiled periodically by the Truck Trailer Manufacturers Association (TTMA) (14). Their 1984 survey of van trailers took place over a period of 9 to 15 months after the effective STAA date at a time when the industry was starting to rebound from its recession and many uncertainties about the extent of the designated network had been resolved. Trailer sales in 1984 were nearly twice the 1983 levels (15).

Compared with 1982 survey results, the 1984 TTMA survey revealed a major shift in the characteristics of new trailer sales, indicating that the STAA of 1982 is having an effect on industry equipment choices (Table 3). The most dramatic shifts concerned van trailer widths and the longer semitrailers. About 70 percent of all 1984 sales were of trailers 102 in. wide, up from nearly zero in 1982. The 45-ft semitrailer dropped from three-quarters of the van market to 15 percent as the market share of the 48-ft semitrailer grew from nearly zero to more than one-half of new trailer sales. Twins (27- and 28-ft lengths) also increased their market share, but more modestly, from 8 to 22 percent.

TABLE 3 Van Trailer Sales by Size (14).

Dimension	Percentage	
	1982	1984
Length		
More than 48 ft	2 ^a	1
Exactly 48 ft	2 ^a	56
Exactly 45 ft	75	15
27-28 ft	8	22
Other	15	5
Width		
Exactly 96 in.	99.7	29.5
Exactly 102 in.	0	70.3
Other	0.3	0.2

^aIncludes all trailers with lengths greater than 45 ft.

Although these changes are significant and demonstrate that industry is beginning to use twins and the other new vehicle types, the trailer sales statistics alone do not reveal what motor carrier types purchased the new 1982 STAA trailer types, why, or how long this trend will continue.

Interviews with Trailer Manufacturers

As part of the study, staff members have interviewed eight large trailer manufacturers, which collectively sell equipment to motor carriers based throughout the United States. Twin trailers currently account for 5 to 30 percent of their market, and 48-ft semitrailers account for about 30 to 75 percent, figures that are generally consistent with the trailer sales figures discussed earlier. The manufacturers provided their assessment of the current and future market characteristics for twins, 48-ft-long semitrailers, and 102-in.-wide semitrailers.

Twins

Most of the manufacturers agreed that the primary market for twins is LTL common carriers, and so far the larger common carriers have accounted for the bulk of twin purchases. Virtually all orders are for van trailers, and regionally the sale of twins has been strongest in the Midwest and in the south-eastern states. In the Northeast, sales of twins have been sluggish, and the manufacturers cite small terminals in congested urban areas and shorter trip lengths as underlying factors that diminish the advantages of added cubic capacity and operational flexibility of twins. In the West, sales have not greatly increased because many pre-1983 twins are still in service. In addition to common carriers, the manufacturers report scattered sales to private and contract carriers, mostly serving industries, such as food and retail store chains, that move low-density commodities to many distribution points.

So far, the manufacturers report that carriers are attracted to twins because of the added cubic capacity; operational flexibility will not be a real factor, they believe, until carriers have had more experience with twins.

The trailer manufacturers disagree about the long-term outlook. Some believe that twins are most advantageous to the large LTL common carriers who are currently buying them and expect that the surge in twins sales will end shortly. Others expect that twin sales will continue to be strong as smaller LTL common carriers and more specialized contract and private carriers adopt their use.

Semitrailers 48 ft Long

Manufacturers report that the 48-ft semitrailer is becoming the industry standard. All types of carriers are purchasing them, especially truckload contract and private carriers. Although longer semitrailers are now legal in many states under grandfather clauses, the trailer manufacturers expect that sales of those longer than 48 ft will be confined to specialized users, such as can manufacturers, and will account for a tiny share of the market.

Semitrailers 102 in. Wide

Manufacturers report that the predominant width for new twin trailers is 102 in. For other trailer lengths, including the 48-ft semitrailers, it is a common but not an overwhelming choice. Some industries, such as food store chains, prefer the 96-in. width because the pallets for their commodities are designed for this width. Overall, however, manufacturers expect 102-in.-wide trailers to become increasingly popular.

Carrier Interviews

As of June 1985, study staff had interviewed four LTL common carriers with predominantly eastern and midwestern operations that range in size from 600 to 3,000 line-haul tractors in service, two California-based carriers, and one transcontinental carrier. Although a more reliable picture of the industry will be available when more interviews have been completed, the results of the early interviews are generally consistent with one another and consistent with the findings of the trailer manufacturer interviews.

Twins

All the carriers interviewed are heavily integrating twins into their operations--eastern and midwestern firms report that twins currently account for 20 to 40 percent of their line-haul vehicle miles and that in 5 years they expect this figure to be 50 to 80 percent. Although all of the carriers would be considered large, size was not so much a factor in the selection of twins as were network characteristics. Twins accounted for more than 85 percent of the fleet for the California-based and nationwide carriers.

Most of the carriers pull twins occasionally with three-axle tractors, but the incidence of the resulting six-axle twins will decline as new two-axle tractors are acquired. All the carriers interviewed are ordering identical drive trains for new tractors regardless of whether they are intended to pull twins or semitrailers.

Three of the four eastern carriers report that their major use of twins is on high-volume routes between break-bulk facilities, which takes advantage of the higher cubic capacity of twins to reduce line-haul truck miles. Although they expect to take advantage of the routing flexibility of twins, this will require substantial modification of operating practices, which they believe cannot occur until they have more experience with twins and more twins are available. One regional carrier, however, with few high-density routes, decided to adopt the use of twins primarily because of the potential for improved operating flexibility.

The use of twins to maximize flexibility and minimize capital cost is common among regional LTL carriers in the West. These carriers do not organize their terminals on the hub-and-spoke pattern characteristic of eastern and nationwide firms. Instead, they load directly to the individual terminals in their networks. With few lines having high volumes of freight and with terminals spaced much farther apart than in the East, the western carriers find the twins essential to serving their market. For example, it is quicker to load a 28-ft trailer than a longer semitrailer. Because shippers in the West expect overnight delivery within 500 mi, this ability to load and dispatch is essential for scheduling. In addition, the use of the single 28-ft trailer for pickup and delivery eliminates much of the need for an additional fleet of straight trucks.

Regionally, the carriers indicated that use of twins has been somewhat curtailed in the Northeast and a few southeastern states because of limitations of the designated network and access to the network. From an overall perspective, however, they report that the effect of these limitations is slight because twin operations have so far been concentrated on Interstate routes between break-bulk facilities. Use in the West has barely been affected, with the exception of increased purchase of 102-in.-wide twins.

Semitrailers 48 ft Long

None of the carriers interviewed plan to use 48-ft semitrailers for their LTL operations, though they do plan to continue using some 40- to 46-ft semitrailers. Those that also have truckload carrier subsidiaries indicated that these carriers were starting to use 48-ft semitrailers.

Semitrailers 102 in. Wide

All carriers are now ordering 102-in. twin trailers exclusively. Because they generally will not be ordering longer semitrailers (40 to 46 ft) for some time, the width of those longer semitrailers is not known.

SUMMARY OF FINDINGS ON INDUSTRY USE OF TWINS AND OTHER STAA VEHICLES

The review of the pre-1983 use of twins and post-1983 experience, as observed through preliminary trailer sales statistics, trailer manufacturer interviews, and LTL motor carrier interviews, suggests the following findings:

- Pre-1983 use of twins was concentrated in western states. Except in California where earlier gross weight advantages had made twins appealing for a variety of users, LTL common carriers were the most frequent users of twins. Because of their relatively low-density freight and complex networks with many terminals and intermediate break-bulk facilities, LTL common carriers can take advantage of the added cubic capacity of twins and the added routing flexibility that is provided by separating freight into two units that can be easily divided.

- The 1982 STAA has had significant effects on the motor carrier industry's equipment decisions. These effects include the increased use of twins; in 1984 twin-sized trailers accounted for nearly one-quarter of all van trailer sales, up from less than 10 percent in 1982. Even more striking is the shift in new trailer purchases to 102-in.-wide and 48-ft-long semitrailers. In 1984 trailers with 102-in. widths accounted for about 70 percent of all van sales, and the 48-ft semitrailer became the most popular van trailer length, accounting for 56 percent of van sales.

- Large LTL common carriers are the primary new users of twins. Eastern and midwestern carriers interviewed report that twins already account for 20 to 40 percent of their line-haul vehicle miles and that in 5 years they will account for 50 to 80 percent. If these percentages hold nationwide, by 1990 twins carrying LTL freight will account for 8 percent of all combination-truck traffic. This could increase during the longer run. Common carriers in the West often have fleets that consist totally of twins; thus midwestern and eastern carriers may ultimately use twins more than they now expect.

- There are scattered instances of other (non-LTL) carriers that have begun using twins. For the most part this use is related to industries that move low-density cargoes to numerous distribution or outlet points, such as food stores and retail chains. Although it is too early to tell how many

businesses of this type will adopt the use of twins, the available evidence indicates that such use will develop slowly and not be a major contributor to total VMT by twins.

- Among new users of twins, the primary motivation so far has been added cubic capacity. LTL common carriers are concentrating twins on high-volume routes between break-bulk facilities to produce an immediate reduction in line-haul vehicle miles. Later, after they have had more experience with twins and have larger fleets of them, these carriers hope to achieve further operational efficiency by exploiting the routing flexibility, and twins will begin running more frequently on non-Interstate highways.

- Common carriers in the Midwest and Southeast are quickly adopting the use of twins, but carriers in the Northeast are not. Reasons for the limited use include shorter line-haul trip lengths, which reduce the cost saving from the added cubic capacity; smaller terminals in congested urban areas, which lack the added space needed to maneuver twins; fewer primary highways on the designated network, which makes routes for twins less direct; and some problems in gaining access to terminals.

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