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Source: *Journal of the Transportation Research Forum*, Vol. 46, No. 3 (Fall 2007), pp. 51-68
Published by: Transportation Research Forum
Stable URL: http://www.trforum.org/journal

Origin-to-Destination Performance for General Merchandise Traffic Moving to or from Short Line Railroads

by Carl D. Martland and Steve Alpert

Since nearly 40% of rail freight traffic, other than coal or intermodal, originates or terminates on short lines, the service provided to short line customers is indicative of the service provided to rail customers in general. For a representative set of moves to or from short lines, the average trip time was 7.3 days with a standard deviation of about two days, which is similar to service levels documented in prior studies. A research program involving Class I railroads, short lines, customers, and public agencies would help develop effective strategies for improving service and equipment utilization for general merchandise freight.

INTRODUCTION

The short line and regional rail industry plays an increasingly important role in the national transportation system. Regional and short line railroads originate or terminate more than 8 million loads each year (Martland and Alpert 2006), and the traffic handled by these railroads has recently been growing at a rate higher than the rate of growth for the rail industry as a whole. In the third quarter of 2005, for example, the short lines enjoyed a 16% increase in loads handled compared to a 3% increase for the Class I railroads (Blanchard 2006). In 2004 and 2005, the Genesee and Wyoming, which owns or controls more than two dozen short lines in the United States and Canada, reported increases of revenue of 13% and 10% from existing operations (Genesee & Wyoming, Inc. 2004 and 2005).

While short lines are involved in all kinds of freight, they are especially important for general merchandise freight, i.e everything other than coal and intermodal. Shifting more of this traffic to rail is of interest to the public, because of the potential benefits in terms of improvements in highway congestion, fuel consumption, emissions, and safety. However, to shift more traffic to rail, or even to retain existing traffic, it is essential to maintain or improve the level of service that is offered. Babcock and Bunch (2003), for example, found that the number one reason that grain shippers in Kansas used truck rather than rail was that “truck service is more frequent and dependable than rail service.”

This paper presents research results from a study funded by the short line rail industry, but these results are directly relevant to the broader issues concerning railroad and public initiatives aimed at enhancing rail service and rail capacity. Service to short line customers is of general interest because such a large portion of traffic originates or terminates on short lines. The service provided to short line customers is therefore indicative of the service provided to rail customers in general, and the problems encountered by short lines in serving their customers are the same problems encountered by the Class Is in serving many of their customers.

While the short lines have enjoyed growing traffic and higher revenues in recent years, these trends will not necessarily continue indefinitely. Very significant investments in infrastructure and equipment will be needed for railroads to continue to handle their share of intercity freight (Grenzeback et al. 2004). Though the potential for continued growth is great, railroads may have trouble keeping up with demand. Customer concerns with poor service, lack of equipment, and rising rail rates were significant enough in 2005 and 2006 for the US House Subcommittee on Railroads to initiate hearings on rail capacity. If capacity and service problems persist or get worse, then growth opportunities for merchandise traffic in general and for the short lines in particular could become limited.

The short line rail industry sponsored this research as a first step in understanding what can and should be done to enhance rail system capacity and to improve service and equipment utilization. The research was guided by an advisory committee that included representatives of the sponsoring agencies plus freight transportation researchers from MIT. The primary objectives of the research were to establish the basic facts concerning the role of short lines and to document the current levels of rail service provided to general merchandise customers. The second section of the paper presents some additional background concerning general merchandise traffic, including a review of prior studies of rail service. The third section presents results concerning the role of short lines in moving different types of freight. The fourth section shows service levels for a representative sample of origin-to-destination (O-D) movements that involved short lines. The final section discusses the implications of these results for the railroads and their customers.

THE IMPORTANCE OF SERVICE FOR GENERAL MERCHANDISE CUSTOMERS

Providing reasonably fast and reliable service for general merchandise customers has long been a priority and a concern for the rail industry. While the rates per ton for shipping by rail are generally lower than trucking rates, trip times are longer and less reliable when rail is used. As a result, customers concerned with minimizing total logistics costs often choose to use trucks. Improving rail freight service is therefore an important strategy for increasing rail's share of intercity freight traffic.

Moving general merchandise freight involves complex, coordinated line and terminal operations. It is much simpler to handle unit trains of coal or grain or long-distance intermodal trains, and some railroads may prefer to concentrate on these simpler and potentially more remunerative operations. However, the industry will have difficulty maintaining or increasing their share of the freight market without providing better service for general merchandise traffic, as emphatically stated by Hunter Harrison, CEO of CN Rail:

> *"Whether you call it loose car, merchandise, or small-lot, the carload business began a steady decline in the second half of the last century, lost to trucking. For obvious reasons, though, truckers haven't made a dent in rail's share of bulk markets. Rail is the king of bulk traffic and 'hook and haul' is a railroader's dream. But most of the world's freight comes by the carload, not the trainload, as evidenced by the fact that trucking's share of freight is nine times larger than rail's. If railroads want to be serious players again, and regain a significant share of this business, they must face the carload challenge."* (Harrison 2005)

Facing the carload challenge means providing facilities, operating plans, and control systems that will produce a level of service that is acceptable to general merchandise customers. Unless and until this challenge is met, it will not be possible for railroads to dramatically increase their share of the freight market.

Railroads will not have to face this challenge on their own. Public agencies, shippers, and the public have increasingly looked to the rail industry to handle more freight in order to take advantage of the lower costs of rail and to limit the demands on the highway infrastructure. It is conceivable that a variety of public or private initiatives could be introduced that would increase the capacity of the network and make it easier and more profitable for railroads to carry a larger share of intercity freight. Studies conducted for the Federal Highway Administration, the Association of State Transportation and Highway Officials, and the National Highway Cooperative Research Program have all recommended greater use of the freight rail system. AASHTO's "Rail Bottom Line Report" calls for greater public investment in rail as a way to reduce truck traffic and investment in highways (Grenzeback et al. 2004). A study recently completed for the National Cooperative Research Program provides a guidebook for state and local planners to use in working with railroads to ensure that railroads handle a larger share of freight traffic, thereby reducing highway congestion (Bryan et al. 2006). Numerous studies, by US DOT and others, have documented the congestion and environmental benefits of diverting traffic from truck to rail (e.g. TRB Committee for Study of Public Policy for Surface Freight Transportation 1996 and Federal Highway Administration 2000). While greater public support for the rail industry is not inevitable, there is a strong case that can be made for public support of well-conceived initiatives proposed by – and partially funded by – railroads and their customers.

Well-conceived initiatives must recognize what is and what is not possible regarding rail service. Rail freight cannot be substituted for the short-haul, low-volume freight that accounts for much of the truck traffic in metropolitan areas. Rail can, however, replace truck for long-distance or high-volume moves. The types of moves for which rail becomes competitive will depend upon the rates charged and the services offered. Understanding the nature of rail service is therefore important for designing and targeting public and private initiatives to improve rail market share.

Service levels for general merchandise traffic have not changed significantly over the past 30 years. Typical trip times are seven to eight days, with considerable variability whether measured in terms of the standard deviation, the 80th percentile of the trip time distribution, or the two-day-%. The two-day-% is the maximum percentage of cars arriving within a two-day period. For a typical trip with an average of seven days, the two-day-% would be the percentage of cars arriving on days five and six, days six and seven, or days seven and eight, whichever percentage is highest. The measure is similar to "on time plus or minus a day" except that "on time" would normally be defined so as to allow extra time for weekends and a buffer against delays.

During the 1970s, a great deal of research concerning rail service and equipment utilization was conducted under the auspices of the Freight Car Utilization Research/Demonstration Program (FCUP), which was jointly funded by the railroads and the Federal Railroad Administration. One FCUP study published trip time distributions and performance measures for 63 O-D movements to or from facilities owned by General Motors, DuPont, or Allied Chemical Company (The Industry Task Force on Reliability Studies 1977). The average trip time for these moves was just under seven days and the average two-day-% was 50%. Since these O-D movements included two major commodity groups (food and chemicals) and four major car types (boxcars, covered hoppers, hoppers, and tank cars), this level of performance was believed to be indicative of rail freight service in the first quarter of 1977.

Fourteen years later, the first comprehensive assessment of freight rail trip times and reliability was carried out as part of a study of railroad reliability sponsored by the Association of American Railroads. Service measures were obtained using a 1% sample of all moves in boxcars, covered hoppers and double-stack trains for a 12-month period ending in November 1991. At that time, the average trip time was 8.8 days for freight moving in box cars and 9.0 days for freight moving in covered hoppers. For the largest boxcar moves, which would be the proper comparison for the O-D pairs considered in the current study or in the earlier FCUP study, the average trip time was 7.2 days and the average two-day-% was 49% (Little, Kwon, and Martland 1992). Performance for unit trains and intermodal trains was considerably better because those services required far less handling in terminals (Kwon, Martland, Sussman, and Little 1995).

Trip times of approximately seven days were also documented in general merchandise customer surveys conducted by BN in 1988 (Martland 1995). As part of a very comprehensive study of the effects of train control on train, yard and O-D performance, BN surveyed a group of shippers concerning rail and truck service in approximately 50 truck-competitive corridors. The average rail trip time was 7.1 days, with 85% of the shipments arriving no more than a day early or a half-day late. This reliability measure was more lenient than the two-day-%, since the definition of "on-time" included a buffer for unreliable service and varied with the day of the week that cars were shipped.

As will be seen in the fourth section, the typical trip time for major short line customers was very similar in 2006 to what was reported in these earlier studies. Despite continuing advances in technology for track, equipment, and control, the service provided to general merchandise freight has been relatively unchanged for more than 30 years.

BACKGROUND ON GENERAL MERCHANDISE TRAFFIC

While intermodal containers and coal are currently the top commodities handled by the rail industry, they are by no means the only traffic to move by rail. Almost half of rail traffic involves other commodities, including forest products, agricultural products, metal products, chemicals, automobiles, and auto parts (Association of American Railroads 2005). For the purposes of this paper, all of this other traffic is considered to be "general merchandise." This traffic moves in the traditional rail manner, with local trains picking up cars from shippers, through trains moving the cars through a series of yards, and other local trains making the final delivery. The infrastructure, operating plans, and organizational structures needed for general merchandise are more complex than what is needed for intermodal trains or unit trains. General merchandise traffic is served by more than 100 major classification yards and thousands of smaller ones. Where to classify cars and how to move blocks of cars are major concerns in transportation planning.

When handled effectively, freight can move on a fairly reliable basis with trips averaging three days to a week or so, depending upon the route. Although slower than truck, consistent rail service can be competitive because a single car will carry the equivalent of about four truckloads. However, when poorly planned, when there are shortages of equipment, or when there is insufficient terminal or line capacity, general merchandise service becomes erratic, with highly variable trip times averaging 10-15 days or more (The Industry Task Force on Reliability Studies 1977, pp. 26-31).

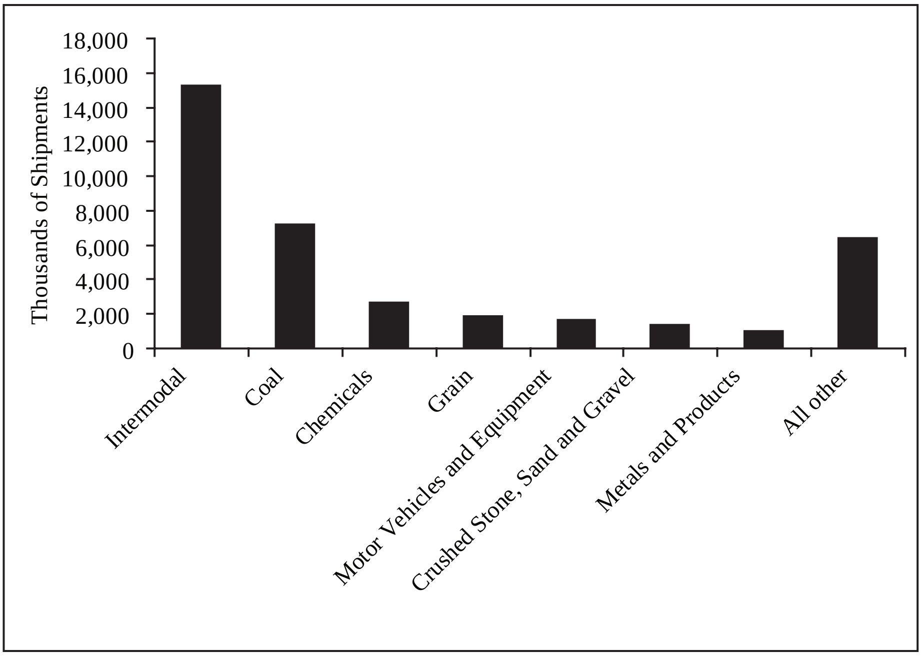
Although some short line and regional railroads handle large amounts of coal or intermodal traffic, most do not. General merchandise traffic is therefore especially important to most short lines and regional roads. To document the role of short lines, the Advisory Committee asked Railinc to provide information concerning trips that involved short lines for the period July 2005 through June 2006. Railinc is a wholly owned subsidiary of the Association of American Railroads that handles the complex electronic transfer of car location messages, waybills, trip plans, and other information among railroads. For this analysis, a short line was considered to be any railroad other than a Class I. Railinc was asked to find several measures of short line participation:

- The number and percentage of trips involving one, two, or three or more short lines.
- The number and percentage of trips that were originated or terminated by a short line.
- The number and percentage of trips for which the only short line participation was an intermediate movement across one of the major terminal switching roads, such as The Belt Railway Company of Chicago or the Terminal Railway Association of St. Louis.

The major commodities handled by the North American rail industry are shown in Figures 1 and 2. During this 12-month period, there were 39.8 million rail freight shipments, including 15.25 intermodal (including 11.73 million trailers and containers and 3.51 million other shipments on intermodal flat cars) and 7.22 million carloads of coal. The other leading commodities were chemicals; grain; motor vehicles and equipment; crushed stone, sand and gravel; and metals and metal products. The "all other" category in Figure 1 comprises the commodity groups shown in Figure 2. Rail traffic is growing in nearly all of these commodity groups. Between 1995 and 2004, the tons carried by railroads increased by 19%, with double-digit increases in all categories except pulp and paper (6.4% growth), lumber and wood products (7.6% decline), farm products (8.3% decline), and metallic ores (23.8% decline) (AAR 1996 and 2005).

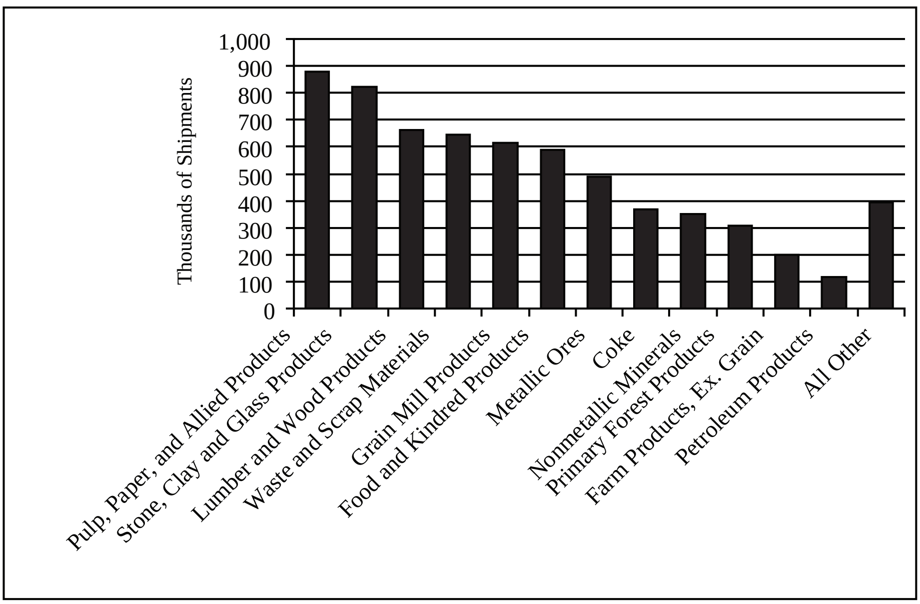
Table 1 documents the magnitude of the role played by short lines, which handled 8.4 million shipments or 23.3% of the total. In most cases, the short lines were either the originating or the terminating carrier as opposed to an intermediate participant in the movement, as they originated or terminated 21% of all rail shipments. Their role was much larger (37%) for general merchandise shipments. The leading commodities reflect the major items that move in or out of every city and town in North America.

Figure 1: Rail Trips, Major Commodities



Trips with a valie waybill, July 1, 2005 to June 30, 2006
Source of data: Martland and Alpert 2006

Figure 2: Rail Trips, Other Commodities



Trips with a valie waybill, July 1, 2005 to June 30, 2006
Source of data: Martland and Alpert 2006

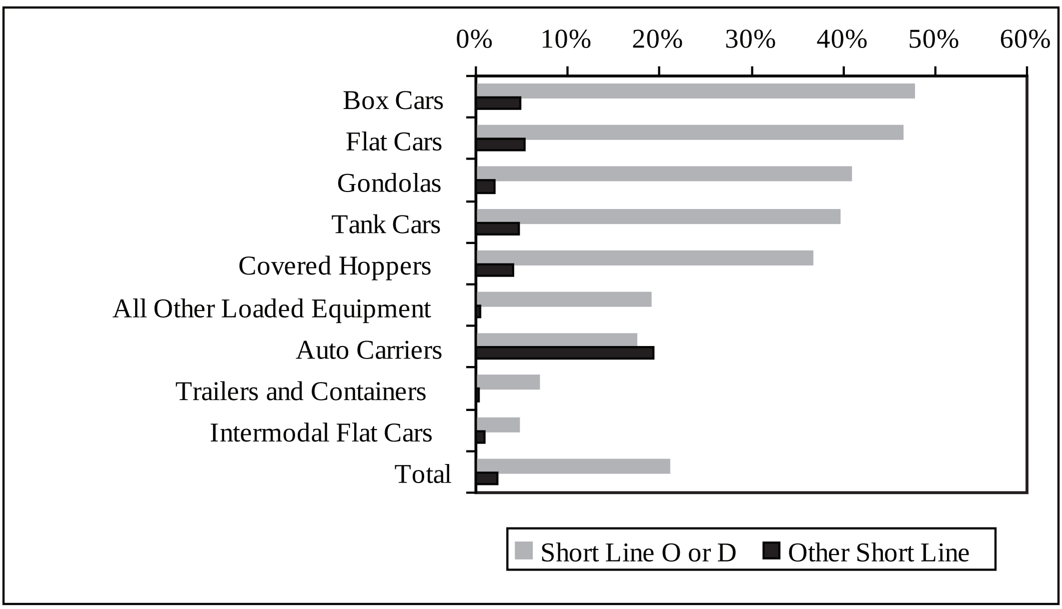
Table 1: Short Line Participation in Rail Shipments (July 1, 2005, to June 30, 2005)

Commodity	Handled by Short Lines	Short Line Origin or Destination	Terminal Road Only
All commodities	23.3%	21.0%	2.6%
Other than Coal and Intermodal	41.5%	36.9%	5.5%
Leading Commodities:			
Pulp, Paper and Allied Products	57.0%	52.4%	3.8%
Lumber and Wood Products	58.8%	52.0%	5.6%
Waste and Scrap	51.1%	48.9%	3.6%
Metals and Products	52.0%	47.4%	6.2%
Food and Kindred Products	50.4%	44.8%	6.6%

Source: Martland and Alpert 2006

Figure 3 expresses the data by car type. As would be expected given the results in the previous exhibit, the short line participation exceeds 40% for all of the general purpose equipment, while short line participation is much lower for intermodal equipment.

Figure 3: Short Line Participation in Rail Shipments, by Car Type



Source: Martland and Alpert 2006

Short line participation is substantial throughout the North American rail system (Martland and Alpert, 2006). Within the United States, taking into account both originating and terminating traffic, short line participation was highest in the East (approaching 30%) and lowest in the West (less than 20%). Short line participation was higher in Mexico and lower in Canada.

SERVICE QUALITY FOR A REPRESENTATIVE SAMPLE OF O-D MOVEMENTS

Two important aspects of rail service quality are the average trip time and trip time variability. The average trip time can be estimated as the average trip time for a random sample of car movements or as the weighted average trip time from a random sample of O-D movements (where the weights are equal to the number of moves observed for each O-D pair). Measures of variability cannot be so easily obtained, as the variability of a random sample of car movements would reflect the variation in trip times and reliability for different O-D pairs. What is of interest (to customers and therefore to carriers and researchers) is not the variability of rail trip times, but the variability of trip times for a particular O-D movement. To have some understanding of the typical levels of variability experienced by rail customers, it is necessary to measure the variability for a set of O-D pairs, which requires having information for many trips for each of the O-D pairs.

To illustrate the level of service provided to short line customers, car movement data were obtained for a representative sample of O-D movements. The sample was obtained via a multi-step process. The Advisory Committee identified short line railroads that were likely to be willing to provide data for the study; railroads were identified in each of the ASLRRA's four regions (Eastern, Southern, Central, and Pacific). Each of these railroads was invited to identify several typical O-D movements for which they were the originating or terminating carrier. After reviewing the initial set of O-D movements, the Advisory Committee sought several additional movements from other short lines to ensure that the sample included the most common types of equipment and commodities, various lengths of haul, moves involving all of the Class I railroads, and multiple movements within each of the ASLRRA's geographic regions. Each participating railroad then authorized Railinc to provide car movement data to MIT for all of the moves between these O-D pairs for a three-month period during the first half of 2006. The final sample included 39 O-D movements that originated or terminated on one of the following railroads:

- Finger Lakes Railroad, New York
- Morristown & Erie Railway, New Jersey
- Heart of Georgia Railroad, Georgia
- Arkansas and Missouri Railroad, Arkansas
- Texas and New Mexico Railroad, Texas and New Mexico
- Arizona Eastern Railway, Arizona
- Portland & Western Railroad, Oregon
- Red River Valley & Western Railroad, Montana and North Dakota
- San Luis Central Railroad, Colorado
- San Luis & Rio Grande Railroad, Colorado

The 39 movements included movements of less than 100 miles as well as movements of more than 1,000 miles. Movements originated or terminated in all regions of the country and involved rail lines and terminals in a majority of the states. While not a random sample, the sample was believed by the Advisory Committee to be representative of short line traffic in terms of distances, commodities, operating conditions and car types.

The structure and size of the sample was of interest primarily with respect to understanding railroad reliability, as discussed above. Any sample large enough to provide reasonable information concerning reliability would provide even better information concerning trip times. There were two main factors to consider with respect to reliability:

- The number of movements required to get a useful measure of reliability for a single O-D movement
- The number of O-D movements required to get a useful perspective on O-D reliability for movements to and from short lines

Both questions were considered to be matters of judgment more than matters of statistical methodology.[1] Prior studies (e.g. The Industry Task Force on Reliability Studies 1977; Kwon et al. 1995) had shown O-D performance measures for O-Ds with more than 10 moves, but the Advisory

Committee recommended looking at higher volume moves. Each railroad was therefore asked to identify O-D movements with about 50 or more shipments per quarter (i.e. 200 per year), but five of the higher-value merchandise movements actually had complete data for fewer than 25 shipments during the observation period.

The number of O-D pairs to include in the study had to be enough to be convincing to a group of professionals and of interest to researchers. The Advisory Committee felt that several dozen would be sufficient to indicate typical levels of service, and the decision was made to seek on the order of 40 ODs. The objective was not to provide a precise statistical analysis, but to provide a believable picture of the typical levels of service offered to short line customers in 2006. The time and resources available to the study also limited the number of O-Ds that could be examined in depth.

Measures of trip times and reliability were calculated using Car Location Movement (CLM) data. The CLM data are organized around events, including release from customer, pull from customer, train arrivals and departures, interchange delivery and receipt, constructive placement, and actual placement. Individual railroads report the events to Railinc, which collates the information and makes it available to the railroads for their own use in car management and service monitoring. Each railroad that participates in the route is entitled to see the CLM data for the entire movement. The short lines involved in this study authorized Railinc to forward their data to MIT for analysis.

Data were ultimately made available for 39 O-D pairs involving a total of 6,230 shipments that were initiated and completed during a 90-day period in early 2006 (generally mid-March to mid-June). These O-D pairs represented a broad range of distances, regions of the country, commodities, and car types. The O-D study included eight moves where the competitive highway distance was less than 300 miles and another seven where the distance was between 300 and 500 miles. The average distance for all 39 O-D pairs was 717 miles. Since traffic was higher for the shorter movements, the weighted average distance was substantially lower, at 559 miles. Rail circuity is normally on the order of 10-20%, so the average rail distance traveled was estimated to be on the order of 650 miles for this sample.[2] In 2004, for the industry as a whole, the average loaded car-miles per load was approximately 730 miles (AAR 2005), which is slightly longer than the average for the 39 O-D pairs.

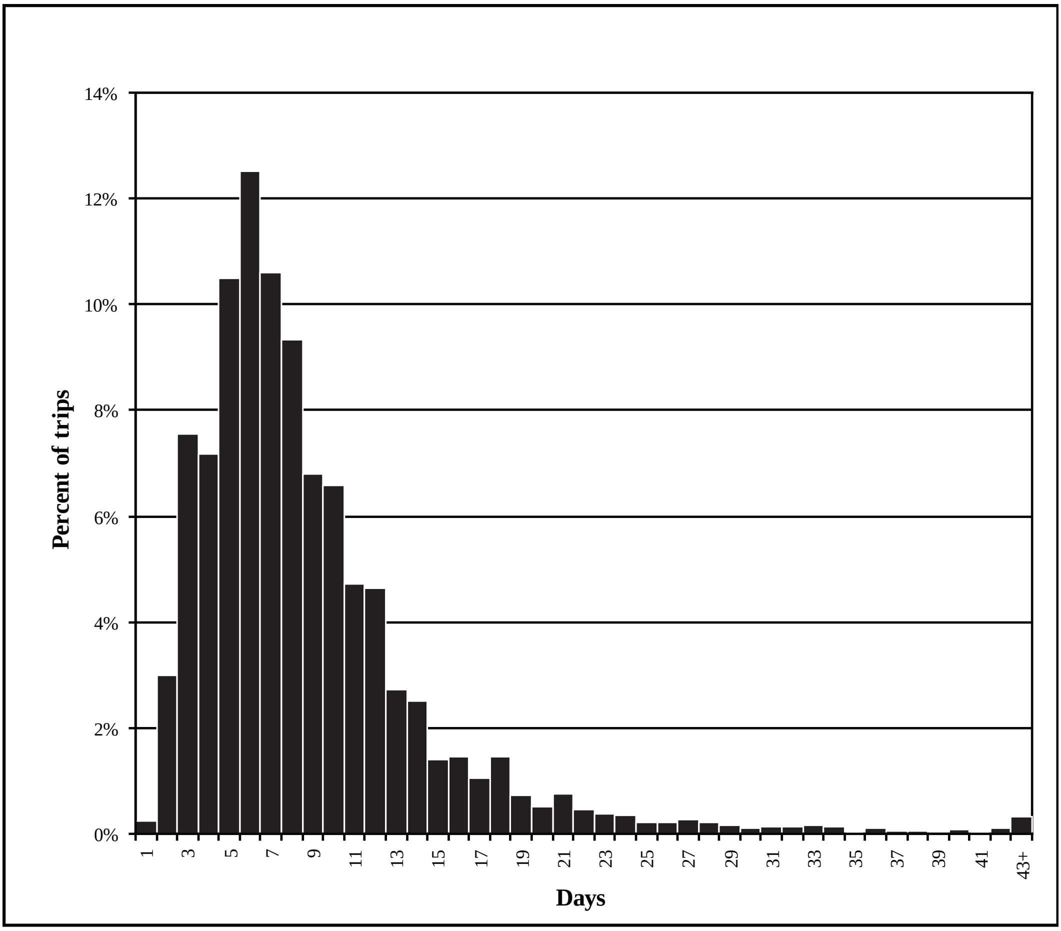
Figure 4 summarizes the performance for the sample of 6,230 moves. The trip time was measured from release until the cars were placed at the customer's siding or until the cars were offered for placement and the customer requested that they be placed at a later time (in which case the railroad reports that the cars were constructively placed). The median trip time was just under and the average trip time was just over seven days. The 90th percentile of this distribution was 15 days, the 95th percentile was 20 days, and there were even some trips that took more than a month. The average two-day-% was just under 50%. This measure, which was calculated separately for each O-D pair, ranged from 24% to 68%. The quality of service varied greatly across the sample, as a few movements received reliable service averaging less than four days, while at the other extreme a few movements received highly erratic service averaging well over two weeks. The standard deviations of trip times varied from one to three days.

Year-to-Year Variations in Service Levels: Railroad A

As discussed in the introduction, slow and unreliable service has long been a concern for railroads and their customers. The study of the 39 ODs, like the earlier studies cited in the introduction, reflect what the author and the Advisory Committee consider to be typical levels of railroad service. There may have been periods in which service was better, and there certainly have been periods when service was much worse. During the late 1990s, for example, service problems related to mergers and rapidly growing traffic volumes attracted national attention (Malachaba 1999).

Despite the perceived importance of service, i.e. of trip times and reliability, there is no ongoing program to monitor service that is sponsored either by the rail industry or by their customers.

Figure 4: Trip Time Distribution for Short Line Traffic

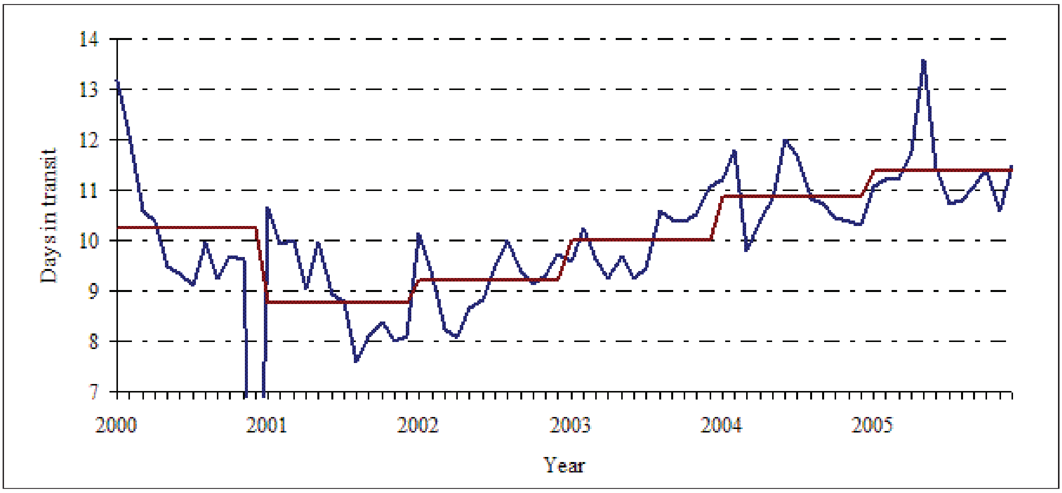


Note: 39 O-D pairs with origin or destination on a short line
6,230 loaded trips between February and June 2006

Individual railroads monitor performance on their own lines, but many or most moves involve multiple railroads. Individual customers monitor performance to their own traffic, but there is not a standard measure of trip times and reliability for the entire network. Hence, it is difficult to quantify the extent of changes in service over time. Still, the data are available to railroads and to their customers to produce measures of service that can be used routinely. For example, to illustrate what they considered to be poor service, Railroad A provided data on transit times for all cars received from one of its two Class I railroad connections for the period 2000-2006. For each shipment, the opening event was the waybill date and the closing date was the time of the interchange to the short line. The waybill date was believed to be the same as the release date (and the waybill date was indeed the same as the release date for the movements included in the 2006 O-D study).

Figure 5 shows the average trip times for this six-year period. This figure represents movements from more than 100 origins in 34 states and two Canadian provinces. Service was very slow at the beginning of 2000, then improved for a couple of years before steadily worsening through mid-2005. This figure shows both the monthly and the annual averages. The average travel time was 11.3 days in 2005 – not including the one or two days required for Railroad A to deliver the cars to the customer. This railroad and its customers clearly received poorer quality service for moves via this gateway than the average levels described in the previous section.

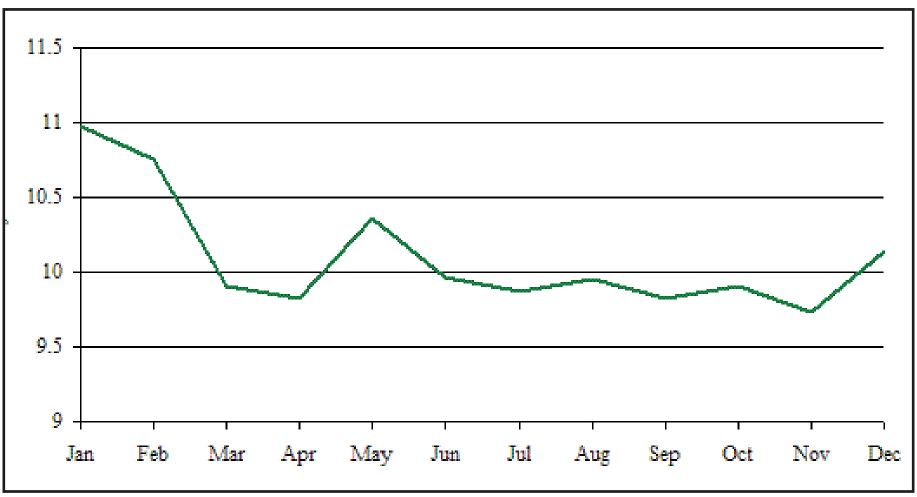
Figure 5: Transit Times from Customer to Interchange with Railroad A



Note: This figure shows the monthly and annual average transit times for 2000-2005. The monthly averages are more variable, indicating significant seasonal variations in service levels. The transit time begins with the time of origin on another railroad until interchange with Railroad A by one of its connecting Class I railroads (approximately 400 loads per month were received by Railroad A from this Class I railroad over the six-year period).

Winter is naturally a difficult period for rail operations. Figure 6 shows the month-to-month trends for 2000-2005 for Railroad A. There is a strong seasonal effect, with transit times 10-15% longer in January. Seasonal trends may also reflect variations in traffic, e.g. harvests, as well as the need to schedule maintenance.

Figure 6: Transit Times from Customer to Railroad A, by Month, 2000-2005



Note: This figure shows the average transit time in days from origin on another railroad until interchange with Railroad A by one of its connecting Class I railroads.

Components of Travel Time

On average, a large portion of the travel time was consumed in the initial and final legs of the trip. Table 2 provides some statistics for the final legs of the trip along with the mean and standard deviation for the total trip time for the sample of 39 O-D pairs. For cars that terminated on a short line, it took an average of 2.6 days – more than a third of the total trip time - to move a car from the last major yard on the Class I railroad to the final yard on the short line. This segment includes the movements to and from the interchange plus the time spent at the interchange, but it does not include any other yard time.

The statistics for the next two segments in Table 2 are based upon all moves, whether terminating on a short line or a Class I railroad. After cars arrived at the destination yard, it took another 1.6 days before they were actually placed at the customer's siding, including any time that cars spent constructively placed. This trip segment was at times very short, as some roads were able to place cars soon after they arrived at the final location. However, 41% of the cars were constructively placed, adding another long and highly variable piece of the car cycle. The cars that were constructively placed spent an average of 2.8 days waiting to be actually placed.

Table 2: Trip Time and Reliability for Movements to or from Short Lines

Trip Segment	Average Time	Average Standard Deviation
Transit Time (Release to placement or constructive placement)	7.3 days	2.8 days
Class I to final yard on the Short Line (Depart last yard on Class I through interchange until arrival at the destination location on the Short Line)	2.6 days	1.9 days
Destination Time (Arrive at final destination until actual placement)	1.6 days	2.1 days
Constructively Placed (CP until actual placement, for cars that were constructively placed)	2.8 days	3.3 days

Note: Weighted average performance for 39 O-D Pairs, February – June 2006

The total time spent on the short line can be a major portion of the car cycle. The data used in the O-D study did not include any empty events, so it was not possible to calculate the customer time or the total time on the short line railroad. However, one railroad (Railroad B) did provide data concerning the time traveling to the short line and the time spent on the short line. The data covered the period 2000 through February 2006. The time spent by cars on this short line includes the loaded move from interchange to the customer's siding, customer time, plus the time to return the empty to the Class I railroad.

Table 3 summarizes the data from Railroad B by showing the average times for the best year and the worst year. There were four moves involving railroad owned boxcars. In the best situations, these cars were delivered, unloaded, and returned in two days or less; in the worst situations, times stretched to more than a week. The other two moves involved privately owned tank cars, which were held for 1-2 months by the customers. For this short line, the variability in time related to unloading was much greater than the variability in time moving from the Class I to the short line.

Table 3: Time Spent by Cars Terminating on Railroad "B"

Move	Car Type	Car Owner	Time to Short Line (days)	Time on Short Line (days)
1	Box	RR	9.2 – 11.6	3.3 – 9.1
2	Box	RR	6.9 – 9.4	1.6 – 7.4
3	Box	RR	9.2 – 11.9	2.1 – 7.3
4	Box	RR	15.6 - 18.3	5.0 - 5.7
5	Tank	Private	11.7 - 18.6	36 – 65
6	Tank	Private	11.2 – 13.5	26 – 35

Note: Ranges in annual average times for 2000 through February 2006

Operating Practices

The individual O-D pairs provided examples of various practices that helped or hurt travel times or equipment utilization. As expected, there were some examples of difficulties in the interchange to or from the short line. In one O-D, eastbound cars were frequently carried more than 100 miles to the west for classification – and then returned back over the same route to move to their destination. The cost of moving a loaded car an extra 200 miles is far from inconsequential, and it would seem that alternative operating strategies would make it unnecessary to backtrack so far.

The potential for better rail operations can be constrained by the lack of track space at the interchange. In several of the O-Ds, the customer was unable to unload cars as quickly as they arrived. This resulted in a queue of cars awaiting unloading that backed up at first from the customer to a nearby rail yard, then to the interchange point, and eventually to a distant classification yard. Measured service deteriorates rapidly when cars are stalled in the pipeline.

There were also some O-Ds where service was adversely affected because the Class I railroad could not or did not pick up traffic within a reasonable time after it was available from the short line at the interchange. In one instance, the delay in picking up traffic was very inconsistent, varying from one to six days and contributing heavily to the variability in the total time on the Class I road.

In some cases, the moves required rather complex handling involving multiple yards and interchanges. Figure 7 shows a move that originated on one railroad, was interchanged twice to move through Chicago, moved through three major yards on a second Class I railroad, and eventually interchanged to the short line for movement to a yard for ultimate placement at the customer. This exhibit is based upon a random sample of 12 trips; it shows the average and the standard deviation for each major segment of the trip. By far the longest and most variable segments were the beginning and ends of the trip. This move illustrates a number of the problems that can be encountered in moving cars one or two at a time through a series of freight yards:

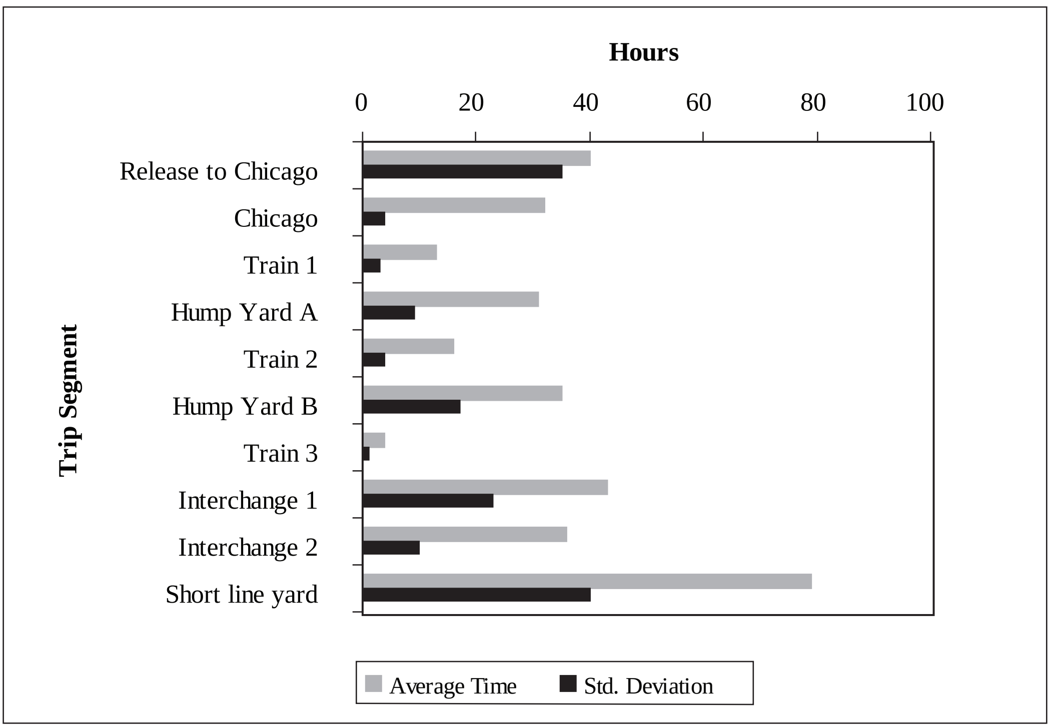
- Delays at the origin: most of the cars actually were picked up soon after release and were interchanged in Chicago in 14-16 hours, but several required an extra day or two and one was delayed for many days.
- Chicago: To get through Chicago required an interchange to one railroad, classification at a major yard, and interchange to another railroad. The whole process took 32 hours, but it was very reliable.
- Hump yards A & B: These are major classification yards. The average times were in excess of 30 hours. While this time is much longer than the benchmark performance of 16-18 hours for hump yards (Martland et al. 1994), it is typical of yard times for cars classified in major yards for the past 10 years.
- Trains 1 and 2: These are mainline trains serving major classification yards. The average train speed from Chicago to Hump Yard B was 18 hours, which reflects the normal delays

to merchandise trains on main lines. The standard deviations of travel times were typical of main line service; nearly 90% of these trains were less than three hours late (as compared to the average travel time).

- Train 3: This is a short move to the interchange location. Once cars were on this train, there were no problems in getting to the interchange.
- Interchange: The interchange is shown as two pieces. The first is the time required for a local crew to take the cars set off at the Class I yard by Train 3 to the track where cars are left for the short line to pick up. The second is the time required for the short line crew to pick up the cars after they have been left on the interchange track and bring them to the short line's yard. Both the Class I and the short line served the interchange track at most every other day, which led to the total of more than three days to move cars from the Class I yard to the short line's yard.
- Placement: When the customer is ready to receive the shipment, a local train moves it to the siding. The three days shown in this segment may have resulted in part because the short line served the customer less than daily or because the customer was not always ready to unload the car.

In this example, the train speeds and the variability in train travel times might appear to be rather poor. However, as is generally the case, yard times and yard reliability had a much greater impact on service than train speed and train reliability. Still, even though the yard times were slow and unreliable, yards were not the dominant problem. Coordination among the railroads to minimize the time required for the local moves was much more important. Finally, while the three days required in the final yard may have been at the convenience of the customer, these three days certainly would have an important impact in increasing the cycle time for the freight cars involved in this move.

Figure 7: Trip Segment Times for a Complicated O-D Movement



The O-D study also found some O-Ds that displayed little or no concern for car utilization. One O-D had average trip times greater than 10 days, despite the fact that cars were made available in groups of 15-30 cars for a move of less than 150 miles. The long trip times did not reflect difficulties in the rail move, but the lack of coordination between the shipper and the receiver. The product was loaded at one end of the supply chain faster than it could be unloaded at the other end of the chain. The cars in this case were supplied by the railroad, so the three-week cycle times could become a concern if it were necessary to replace or to increase the fleet assigned to this traffic. Two other moves, both less than 500 miles, had similar queuing effects. The customers were able to use the rail cars to hold their inventory, which could be a fine service provided by the railroads, but which could also become a cost problem when it is time to replace the fleet (or when better opportunities arise for using the cars).

The O-D study also included examples of innovative services, such as the ability of short lines to switch customers twice or more daily and the willingness of short lines to assist customers in designing and even financing transload facilities. There are many examples of short lines working well with Class I's to provide reasonably consistent service to customers, for a variety of different types of traffic.

CONCLUSIONS AND RECOMMENDATIONS

The Importance of General Merchandise Traffic

Broadly defined to include everything other than coal and intermodal, general merchandise is a large, diverse, and growing market for railroads and their competitors. This is the market served by most short line railroads, this is the traffic that is growing for the trucking industry, and this is the market where there is potential for shifting significant volumes of freight from truck to rail (Grenzeback et al. 2004). Since short lines originate or terminate approximately 40% of this traffic, they must be viewed as an integral part of the general merchandise rail freight system, not just in a few locations, but throughout North America.

The study provides evidence that rail can be a viable option for many short haul movements. For a fifth of the moves included in the O-D study, the competitive highway distance was less than 300 miles, indicating that short haul rail moves are not merely viable, but quite common.

Better service and more efficient operations will be needed to attract more freight to railroads and to resolve service and capacity problems. To achieve better performance, changes may be needed in both operating strategies and infrastructure. Railroads tend to operate large classification yards so as to minimize train costs and yard switching costs, with the result that yard times and car costs are both very high. Such practices may have made sense during the 1980s and much of the 1990s, when there were large surpluses of most general service car types, but they do not make sense in times of capacity constraints and car shortages. Re-examination of operating practices in light of current and projected future conditions may suggest better ways of organizing and managing the movement of general merchandise freight.

Need for Faster, More Reliable Service

The sample of O-D pairs considered in this study is large enough and diverse enough to give some good insight into current levels of rail service and equipment utilization. The typical average trip time in early 2006 was seven to eight days with a standard deviation of one to three days. This is actually similar to service levels documented in prior studies – studies that were undertaken at various time during the past 30 years in attempts to determine how to improve service so as to be more competitive with trucks. In other words, service has been a problem for railroads for a long time, and it is a problem today. Moreover, evidence from one short line suggested that service to its customers was much worse than these averages and deteriorating, from 10 days in 2001 and 2002 to 12 days by 2005.

Greater Priority for Car Utilization

There does not seem to be any over-riding concern with speed on the part of railroads or their customers. The railroads were not providing rapid service: only a couple of the 39 O-D pairs had average trip times less than five days. On the other hand, the customers did not seem to be expecting or requiring rapid service, and more than 40% of all shipments were put on constructive placement at the request of the customer. It may be that the customers currently using rail are quite comfortable with the quality of service they receive, while the railroads are quite comfortable with the overall cycle times. However, car supply will eventually begin to tighten, if only when the fleet needs to be replaced, and at that time both the customers and the railroads may benefit from a closer look at operations that result in long cycle times. Moreover, even if current customers can accept the levels of service documented in this paper, the railroads will need to attract new customers in order to increase their market share. Speed, reliability, and equipment utilization are likely to be among the major factors considered by potential customers considering whether or not to switch to rail.

Opportunity for Understanding Service Patterns

A great deal of attention has been devoted to real-time management issues, notably the complex and difficult problem of providing accurate information concerning trip plans and expected times of arrival. Less attention has been devoted to using the great mass of car movement information to understand service trends, service capabilities, capacity limits, or, more generally, the performance of the overall rail system. The results presented in this paper demonstrate that there are system-level problems that go beyond the day-to-day operation. There are very wide variations in service levels, presumably reflecting problems emanating from bottlenecks in the system and possibly reflecting inadequate consideration of service and car utilization in making operating and investment decisions. Moreover, the problems and opportunities involve the shippers as well as the railroads. The 39 O-D pairs had more than a few examples where mismatches in supply (the rate at which shipments were released) and demand (the rate at which shipments could be placed) led to extensive delays to freight cars. Even if such delays are not a concern to the customers, the cars must be held someplace, and queues of cars held awaiting loading or unloading can help clog the network.

This study suggests that there are opportunities for improving rail operations and service through better coordination among railroads and their customers. There are lessons to be learned and shared concerning how best to promote better service, how to attune service to the needs of customers, and how to achieve better utilization of equipment. Much could be done to become faster, more reliable, more efficient and more effective in loading, moving, and unloading freight. A cooperative research/demonstration could deal directly with service, equipment utilization, and capacity issues and enhance the ability of the rail industry to play a larger role in moving the nation's freight. Short lines can play an important role in such a program, because they are so often the ones who are serving rail customers.

Endnotes

1. The question of sample size for a measure like the two-day-% measure can be addressed mathematically. Suppose we view the two-day-% for the three-month observation period to be a sample of the two-day-% that would be expected for a much longer time period assuming no changes in operating conditions. Each trip will either be inside or outside the two-day interval that defines the two-day-%, and we can consider a random variable that takes the value of 1 if the trip time is within this two-day interval and 0 otherwise. The probability that it will be within the interval is the true two-day-% for the distribution. Brunk (1960 p.159) indicates that a sample size of 30 will be sufficient to have a 95% probability that the observed mean (i.e. the observed two-day-%) will be within 0.07 of the actual value.

2. Railroads are more circuitous than highways for three main reasons. First, the maximum grades on rail routes are less than what is allowed on highways. Second, the highway network tends to be denser than the rail network. Third, the rail network has multiple owners, and the traffic is often routed so as to minimize interchanges rather than distance. The actual rail mileage was compared to the highway mileage for 20 of the 39 O-Ds in this study using Rand McNally atlases for rail (1988) and truck (1997). For these O-Ds, the average length of haul was 894 miles by the rail route and 785 miles by the truck route, and the average circuity was 19%.

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Acknowledgments

This research was conducted by the MIT Rail Group for the Association of Short Line and Regional Railroads (Martland and Alpert 2006). The research was supervised by an Advisory Committee that included the following members: Steve Sullivan, Executive Director, ASLRRA; J. Reilly McCarren, CEO, Arkansas & Missouri Railroad; Michael Smith, CEO, Finger Lakes Railroad; and Richard Flynn, Intellitrans. Joseph Sussman and Henry Marcus, MIT professors with long experience in freight transportation, served as internal advisors for the project. The data sets required for the detailed analyses presented in this report were made available through Railinc.

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