Scheduled Railroading and The Viability of Carload Service

Prepared for the Office of Policy Federal Railroad Administration

By

Eric W. Beshers
ICF Consulting, Inc.
301-874-2516
ebeshers@icfconsulting.com

and

James R. Blaze
Randolph R. Resor
ZETA-TECH Associates
856-779-7795
blaze@zetatech.com

Final Report
March 16, 2004

Table of Contents

This page intentionally left blank

NOTICE

This document is disseminated under the sponsorship of the Federal Railroad Administration (FRA), U.S. Department of Transportation (DOT) in the interest of information exchange. The findings and recommendations of the report are entirely the authors', and do not necessarily represent official FRA/DOT policy. The U.S. Government assumes no liability for its content or use thereof.

Executive Summary

This paper, commissioned by the Office of Policy in the Federal Railroad Administration, addresses several questions around the topic of scheduled railroading. The central issue is the likely effect of scheduled operation on the financial performance of carload-merchandise service and whether carload service is likely to be financially viable over the next few decades.

Whether carload operation returns an adequate contribution, and whether anything can be done about it if it does not, has been a matter of considerable debate over the last two or three years. Carload service requires major assets: classification yards and local networks not to mention the requisite cars and locomotives. Some people in, or close to, the industry have argued that carload service is not now self-sustaining and that the best strategy for a railroad is a gradual withdrawal from this market—not replacing equipment or rehabilitating terminals and tracks when otherwise required. Others assert that carload service could be made profitable with better management. More specifically, some have argued that scheduled operation, done properly, can reduce the cost, and improve the quality, of carload service to the point that it would be self-sustaining.

FRA is interested in this question, because of the possible consequences if carload service proves to be not viable. Railroad withdrawal from this market would necessarily mean higher transport costs for these shippers and a significant increase in the volume of freight moving on highways for at least part of its journey. Further, not all, but most, of the 500-odd short lines and regional carriers are wholly dependent on carload service for their business. Disappearance of, or even a major reduction in, carload service would mean the end of commercial life for these firms.

This paper examines scheduled railroading, its likely effect on the financial viability of carload-merchandise service, and the future prospects for viable operation of carload service. There are four questions to be addressed:

1. What effect could scheduled operation have on carload costs?
2. What effect could it have on carload revenue?
3. Given answers to these questions, what is the likely future for carload service?
4. Are there any policy implications in the answer to the third question?

We came to the following answers:

1. Scheduled operation can lead to a significant reduction in carload costs.
2. It can have a limited, but positive, effect on carload revenue.
3. Given the effect on costs, and other possible efficiency improvements for carload service, there is a reasonable prospect that carload will be viable; it should be able to recover the capital required to sustain it.
4. Given the third answer, there are no implications for change in Federal policy regarding railroads.

Cost Reduction

On the basis of current experience with scheduled operation, most big railroads expect significant improvements in equipment utilization; estimates range ten to 30 percent for cars, ten to 20 percent for locomotives. We have used a fairly simple financial model to analyze the impact on carload viability of improvements on this order. The apparent result, with cost of capital at 11.0 percent, is that the contribution from carload could cover the cost of the investment stream required to support carload operation. This is particularly true at improvement levels of 15.0 percent or better; at ten percent, the results are positive but barely so. The same analysis shows that current operation of carload service does not return enough to sustain the required investments.

This analysis was done on the basis of numbers for all Class-I railroads; results for individual railroads would certainly vary. Further, the analysis was done at a relatively gross level of detail. No one could claim that our simple model is a precise predictor of railroad financial performance. The model results do tell us that, if the improvement results reported by the railroads are genuine and can be sustained, carload service could pay for its capital requirements.

We believe the likelihood is that rail managers will find a way to reduce cost to the point that carload at least carries itself financially. Given that this traffic generates over 40 percent of industry revenue, business logic would dictate a serious and sustained effort to make it profitable before deciding to give it up. We also need to bear in mind that scheduled operation is not the only available approach to reducing carload costs. Expert opinion holds that there are significant inefficiencies in local service. Further, the large railroads need to examine their networks to see whether they could provide carload service with fewer yards than they now use. It is not clear that they have all made a rigorous effort to do this. If a yard is truly excess, its elimination both reduces cost, and improves the quality, of carload service. Rail managers do not embark on a fool's errand when they set themselves to make carload service viable. They have every reason to try and reasonable prospects for success.

Revenue Enhancement

We considered the following hypothesis: Scheduled operation will lead to more reliable delivery of carload shipments; more reliable service will allow higher rates on existing traffic; and more reliable service will attract new carload traffic. This hypothesis has some validity.

Total output of commodities that move in carload shipments is growing slowly—at rates well below GDP growth. Weighted by rail-shipped tonnage, annual growth of physical output for principal carload commodities (except scrap) was 1.5 percent over 1987-2000. Further, the potential market is limited to firms that already have sidings or are close enough to a rail line for installation of a siding to be feasible.

High levels of delivery reliability are difficult to achieve. A carload movement from origin to destination is not a single event as is a truckload movement. It is a series of independent events: local pick-up, movement through two or more terminals, and local drop-off at destination. In order to attain reliability of better than 0.80, it is necessary that a car have an on-time probability of better than 0.95 for *each* of its scheduled connections. To get at, or near, 0.90 reliability, on-time probability for each connection has to be 0.98 at least. Achievement of these higher levels is, perhaps, not impossible but would require a level of discipline in execution for road trains, yard operations, and local service that is far beyond railroads' present standards. Experts who have studied the matter closely think that a goal much above 0.80 is unrealistic in current conditions.

We noted that goods that now move by carload are largely low-value commodities; for the most part, carload shippers that put much premium on reliability abandoned railroad service long ago. Some, e.g., chemical, shippers would place some value on increased reliability.

Among people that we spoke with, there was a range of opinion on the future market for carload service. The preponderance of opinion was on the side of slow growth. One senior rail executive thought improved reliability would bring more business from existing customers, but he doubted that many new customers would be attracted. Some shippers offered the following view: If carload customers perceive that railroads will consistently achieve 0.80 reliability, some, not all, shippers would increase carload tonnage by ten to 15.0 percent. This would be a one-time step-up after which rail tonnage growth would continue at historical rates (1.0 percent annual growth, 1987-2000) or perhaps a little above historical rates.

There are those with a more expansive outlook. An executive with another big railroad thought carload growth close to GDP growth was possible in some lanes. A short-line manager believed that reliability could be improved to the point that reservations could be sold on a day-of-delivery basis and that this would be a strong selling point.

Short lines have a role in developing carload markets. Some short-line executives report high rates of traffic growth. With more personal attention and more follow-up on service problems, short lines may succeed in attracting new customers, where a big railroad, a remote and impersonal entity from the viewpoint of many small shippers, would have little chance of doing so. But successes in these small, niche markets may not have a strong effect on national trends.

For these reasons, we take a somewhat restrained view of the prospects for carload revenue growth. We believe railroads would do well to achieve modest carload revenue growth on the basis of more traffic from existing customers and some possibility for higher rates in some markets for enhanced reliability. In real terms, carload revenue fell 1.2 percent per year from 1987 to 2000. Given this history, any noticeable growth in real revenue would be a remarkable turnaround; an annual growth rate of 1.0 percent would be a real achievement.

Conclusion for Viability

Scheduled railroading, other improvements, and sustained management focus on carload operation, taken together, have a real potential to make carload service more than cover its cost of capital. Most of this would be due to cost reduction. In terms of "winning back" traffic lost to trucking, the effects would be modest. But railroads will stay in the carload business with some growth in tonnage, rates, and revenue. The growth in revenue could be enough to improve significantly railroads' earnings.

Policy Implications

The findings of this study do not lead to significant policy implications in the sense that the findings do not indicate that any special Federal action is required by the outlook for carload service. The question of what, if anything, the government should do would certainly arise if we found the railroads were likely to withdraw from, or severely curtail, carload service.

If railroads did give up carload service, it would be a gradual process, one of not replacing or refurbishing assets as they reached the ends of their useful lives. And total abandonment of carload traffic would not occur under any foreseeable circumstances. It would make no sense, for one thing, for the railroads to give up chemical traffic. We should note, though, that a major reduction in rail carload movement could have significant negative implications for highway capacity.

One way to look at this is terms of additional truck-miles. We estimated that carload traffic in 2000 (not including chemicals) was the equivalent of 21 billion truck-miles. Actual intercity truck-miles in 2000 were approximately 73 billion. Adding 21 billion additional truck-miles on top of this would have a noticeable effect in a number of corridors. Almost certainly, however, most of these 21 billion additional truck-miles would not appear on highways. Most of this traffic would shift to intermodal service; some might be handled with transloaders. Regardless, the traffic shifted to trucks would be at the ends of trips where highways are most likely to be congested. We can get some notion of what this impact would be by expressing it in terms of truck trips. We convert carload tonnage to truck trips by dividing 530 million by 15, obtaining approximately 35 million new truck trips at each end of what were all-rail trips. A major withdrawal of railroads from carload service would raise questions about whether the government should act and how.

We also need to take note of the impact on short lines and regional railroads in the event of a major withdrawal from carload service by the large railroads. Most of these firms would be forced out of business. One could argue that that is the Darwinian nature of the marketplace in action, the source of the strength of a free economy. Others, however, might argue that the demise of several hundred companies would merit at least some consideration by Federal policy makers as to whether some action would be desirable.

Our basic finding, however, is that due to scheduled operation and other improvements in efficiency, carload service will continue with relatively slow growth in tonnage but as a profitable operation for the railroads. This will not have a significant effect on the traffic share between rail and highway; but neither will the railroads dump huge volumes of freight traffic on to the highway network. And the short lines will continue to grow.

This page intentionally left blank

I. Introduction

This paper, commissioned by the Office of Policy in the Federal Railroad Administration, addresses several questions around the topic of scheduled railroading. The central issue is the likely effect of scheduled operation on the financial performance of carload-merchandise service and whether carload service is likely to be financially viable over the next few decades.

FRA is interested in this question, because of the possible consequences if carload service proves to be not viable. The carload market comprises a large number of shippers that load one or a few cars at a time; they use rail service because of the low cost relative to trucking. Railroad withdrawal from this market would necessarily mean higher transport costs for these shippers and a significant increase in the volume of freight moving on highways for at least part of its journey. Further, not all, but most, of the 500-odd short lines and regional carriers are wholly dependent on carload service for their business. Disappearance of, or even a major reduction in, carload service would mean the end of commercial life for these firms.

Scheduled railroading has emerged in the last few years as a way of dealing with inefficiencies in carload-merchandise service as it is now operated. In a very real sense, carload service is the remnant of what, 50 years ago or so, was all railroading. While carload service is a remnant of "old" railroading, it is a big remnant—over 40 percent of Class-I revenue. For most short lines, it is the only source of revenue.

More than half of rail revenue now comes from services that have developed, in their present forms, over the last three or four decades and especially since the passage of the Staggers Act in 1980. These are: unit trains for bulk traffic, especially coal and grain; intermodal service; and highly specialized services for the automobile industry. The talent and energy of railroad management, as well as railroad capital, have been largely focused on development of these "new" rail services while carload service has continued to function much as it always has.

Innovation has tended to occur in markets where a small number of customers—trans-Pacific container lines, automobile makers, for example—tender very large amounts of traffic. There are some large carload shippers, e.g., chemical companies, but carload is mostly a market of relatively small shippers; and it is entirely a market of firms that will never load a whole train and, typically, load no more than a few cars at a time. While few individual shippers are significant sources of revenue, they are, collectively, a very large source of revenue. Carload is also a market where rail traffic growth is slow and where railroads have been losing market share to trucks for years. Service is slow and not highly reliable.

As well as a large source of revenue, carload operation is a large source of cost; a big share of a railroad's assets is required to support this service. Many in the industry believe that carload is not currently earning enough to justify the investment required to support it. Given the reality of slow traffic growth and significant cost, rail management has begun to focus on "old" railroading, to consider whether its cost can be reduced and whether service reliability can be improved.

Scheduled operation is the principal, but not the only, approach to the carload problem now under consideration. In varying degrees, it is being planned or is being implemented at each of the U.S. mega-carriers: Union Pacific (UP), Burlington Northern Santa Fe (BNSF), CSX, and Norfolk Southern (NS). It is also being implemented at the two large Canadian carriers: Canadian National (CN) and Canadian Pacific (CP). Against this background, it is the purpose of this paper to place scheduled railroading in the context of current carload operation, to consider its potential for improving both the financial and service performance of carload railroading, and to assess the prospects for the future financial viability of carload service.

More specifically, we will:

- Define and describe scheduled railroading;
- Assess its potential for reducing cost;
- Analyze the significance of potential cost saving for railroad financial performance;
- Assess the potential for improving service quality and increasing carload revenue; and
- Consider whether there are any implications here for public policy.

This material will be set forth in the following sections:

II. Definition and Overview of Scheduled Operation
III. Cost Reduction and Effect on Railroad Earnings
IV. The Carload Market: Traffic, Trends, and Future Prospects
V. Summary Assessment of Financial Viability of Carload Service
VI. Consideration of Policy Implications.

Much of the information for this paper was gathered in interviews with railroads, large railroads and short lines, shippers, and some observers of the industry. It was fortunate that the International Railway Planning Conference, Calgary, September 21-24, 2003, took place while this study was being conducted. The conference brought consultants and carriers together for three days of discussion of virtually nothing but scheduled railroading. We are grateful to Canadian Pacific Railway and MultiModal Applied Systems, the principal sponsors of the conference. The occasion made our task considerably easier and surely improved the product of our work.

Most of the people we interviewed were more comfortable, and more willing to engage in open discussion, on assurance that they would not be quoted directly. In Appendix B, we list all individuals interviewed together with their companies.

II. Definition and Overview of Scheduled Operation

Preliminary Note

The focus of this study is on the application of scheduling to the unique problems of carload service. Scheduling, as such, is relevant to all forms of rail service, not just carload service. But the distinctive operational feature of a carload shipment is that it must be moved through a series of intermediate terminals to get from origin dock to destination dock. This is what distinguishes it from trainload service—bulk and intermodal unit trains that move direct from origin to destination with little or no requirement for intermediate handling.

Definition

Carload traffic typically comes from shippers who can load only one or a few cars at a time; in any event they are shippers who never load enough cars to make a whole train. Such shipments can only be moved if they are brought into yards where they can be consolidated with other small shipments into full trains. The cars in a train leaving that yard will not all be going to the same destination terminal; that train must be broken up in another terminal where its cars, along with cars arriving in other trains, will be assigned to new trains for the next legs of their journeys. In this way, a carload shipment will move through two or more intermediate terminals before it reaches its final terminal whence local service will move it to the receiver's siding.

We do not need to develop a full, technical definition of scheduled railroading or to get far into the details of different ways of carrying it out. Our concern is with the results that can be attained in terms of service and financial performance. We need to define scheduled railroading with sufficient clarity that it can be clearly understood in the context of rail operations and rail business strategy.

Business-strategy Context

The future profitability of carload service is a central business-strategy question for the railroad industry. Railroads are in close competition with truckload trucking for this traffic and have been losing market share, more or less gradually, for decades (although the absolute level of carload tonnage has been rising, albeit slowly). It is a widely held view that unreliable service is a major reason for the decline in rail share of merchandise traffic. Carload service is far cheaper than truckload (TL) service, but it is much slower, much less reliable, and railroads cannot offer the flexibility of TL service. Shippers that continue to ship carload do so because of the low rates and because they can tolerate slow and unreliable service.

A TL firm will bring an empty trailer to a customer's dock on one or two days' notice, and the cargo will move as soon as the truck is loaded. A big railroad may need close to a week's notice, and the crew of a local train will not wait while the car is loaded. And it might be a few days before they could get back. (Note: this would be different on a short line; empties could be spotted on fairly short notice. A crew and power might not wait while the car was loaded, but they could be back the next day.) A TL company can move a load 500 miles a day under most conditions and will be on time. Because of time spent in terminals, a 700-mile run that a truck can make in less than two days will likely take a rail car three or four days, at the least. And, for reasons discussed later in this paper, the movement of a car in several different trains makes reliable delivery times hard to achieve. There is some number of shippers who can live with long transit times but have problems if a car does not arrive on the promised day.

As noted earlier, carload service, for all its defects, remains a major source of revenue. We received the following reports on carload revenue share: UP, 47 percent; NS, 44 percent; BNSF 25 percent[1]. Reflecting, in part, higher costs, revenue per car is higher than for other traffic. On the UP, for example, carload service accounts for 35 percent of total cars moved against 47 percent of revenue.[2]

Along with a disproportionate share of revenue, carload service requires a disproportionate share of assets. It is clear that classification yards and many other yards and terminals could be dispensed with if railroads did not provide carload service. Rail managers believe the carload share of assets exceeds the carload share of revenue. Further, the operating cost of carload service is high. Handling in yards and pick-up and drop-off by local trains are labor intensive relative to unit-train operations.

The degree of carload's contribution to required investment in road and equipment is discussed later in this paper. We do note here that our discussions with carriers indicate that revenue does exceed variable cost, so there is some contribution. Nonetheless, it appears to be an open question within the industry as to whether the earnings from carload service justify its costs. Whether carload service should be continued or gradually abandoned as assets require replacement or rehabilitation is a legitimate question. It is also a difficult question. Such a large fraction of revenue cannot be lightly given up. Once that revenue went away, it might appear that carload traffic had been making a greater contribution than recognized by railroad accounting systems. And, once given up, that revenue could not easily be regained.

This is the business context in which we look at scheduled railroading in this paper. It is a method by which management might reduce cost of carload operation and possibly increase revenue. It is not, however, the only means at hand for increasing carload earnings. Some railroads, for example, may have more terminals than required for optimal carload operation; they might find that they can reduce infrastructure while maintaining and improving carload service.

Further, some observers of the industry believe local service is overly costly on a per-car basis and that increased efficiency in local operations could lead to substantial cost reduction for carload service. It has been noted, for example, that 65 to 70 percent of crew starts may be in local service on some railroads.[3] Some observers also believe that there are significant work-rule issues in local service, the resolution of which could yield efficiency gains. (Again, this is an area where short lines are likely to be more efficient than mega-carriers.) The real point here is that, as rail managers focus their attention and energy on carload service for the first time in a long time, they may find a number of ways to squeeze cost out of the system and otherwise

[1] Figures for UP and NS from their presentations at the International Railway Planning Conference, Calgary, September 21-24, 2003; presentations were by, respectively, John Gray and Daniel Mazur. For BNSF, the number is from a conversation with BNSF staff member on December 9, 2003.
[2] From John Gray's Calgary presentation.
[3] Jason Kuehn, MultiModal Applied Systems, Calgary presentation, September 21, 2003.

improve it. We should not presume that gains from scheduled operation represent the limit on what can be done to make carload service more efficient.

Operational and Management Context

The following description of scheduled railroading is based on interviews with Carl Van Dyke, President of MultiModal Applied Systems, and discussions with people at several carriers where scheduled operation is being implemented. There are variations in method among these carriers, and certainly not all of them are implementing scheduled operation in precise conformity with what MultiModal would recommend. But we believe this description captures the essential nature of scheduled railroading.

As a management concept, scheduled railroading may be described as follows. Carload operations are to be planned according to market conditions expected in the next three to six months. Once a satisfactory plan has been established, it is to be adhered to for the next three to six months when the market forecast and the operating plan are revisited. Lower-level management, i.e., the field, does *not* have authority to interfere with the plan. A yardmaster, acting on his own, may not annul or add a train. The doctrine is: The plan rules unless a senior executive finds a contingency that requires a short-term adjustment. And the plan is designed so that it can accommodate occasional adjustment without disrupting the scheduled operation. The MultiModal concept, shared by some rail managers, is that the plan should use about 80 percent of capacity, leaving room for unexpected incidents and traffic spikes; some think this percentage should be higher.

In operational terms, scheduled railroading entails the following steps. (Not every railroad will do it exactly this way, but this is a good general description.)

<u>Traffic data and market forecast</u>. Making a good short-term forecast of demand for rail movement usually requires some enhancement and reorganization of a carrier's historical traffic data. It is thought that a market forecast is acceptable if it comes within 20 percent of actual traffic.

<u>Block plan</u>. A complete block plan consists of the routing (through terminals) from each terminal of every possible movement to other terminals. Assume a network with terminals A, B, C, D, E, F; the block plan would specify the intermediate terminals through which a block of cars from A would move to get to each of the other five terminals. The move from A to C could be ABC or AC; the move from A to F could be ACF, ABDF, or some other combination. Planning the blocks involves a trade-off among block size, transit time, and car handling cost. Formal analytical devices such as computer models may be used in this process.

<u>Train schedule</u>. A complete train schedule is developed that is consistent with the block plan. Every road train has specific blocks assigned to it. The schedule includes all local trains as well as road trains between terminals. Computer models may also be used in the train scheduling process. Field managers do not have authority to change the train schedule; annulment or addition of trains must be done at a high level in the carrier's central office. (UP does this on a corridor basis, decisions being made by corridor managers.)

Yard operating plan. A yard-operating plan specifies the order of trains in the hump queue at every classification yard. As well as specifying the order of trains, the yard-operating plan also provides open slots in the queue. This allows for accommodation of non-plan train movements without disrupting the planned operation.

With these plans and schedules in place, all cars, as well as trains, are scheduled. Every car is assigned to a block, and each block is assigned to a series of trains. In effect, each car has a complete trip plan from origin dock to destination dock. The time of arrival of a car at its last terminal and its placement on the receiver's siding can be predicted with reasonable accuracy as long as the plan is followed and all trains reach destinations by the scheduled time and all cars are processed through yards so that they make their scheduled connections to their next trains. (This is difficult to achieve for reasons set out below. Some observers suggest that 80 percent on-time reliability is a sensible goal.)

Perhaps more than anything else, it is strict discipline in execution of the plan that distinguishes scheduled railroading from non-scheduled railroading. Non-scheduled railroading is often referred to as "tonnage railroading"; it could as well be called anarchic railroading. With tonnage railroading, railroads have schedules, but yardmasters have authority to override schedules, especially if they believe a train has insufficient tonnage. This business model is focused on the gains from running heavier trains. Costs incurred when individual nodes in the network make schedule decisions without considering effects on other nodes and the rest of the network are either ignored or presumed to be minimal. More likely, the utilization inefficiencies inherent in cars and power units not being where they were scheduled to be has been accepted as an inevitable cost of doing business on a railroad. Further, this strategy implicitly assigns reliability of delivery a lower value than presumed labor-cost reductions from heavier trains.

Overview

Early Experience with Scheduled Operation

All four U.S. mega-carriers are, by their own accounts, in some stage of implementing scheduled railroading. Varying degrees of progress have been achieved, but it is safe to say it is an on-going task at all of them. No two carriers are planning or carrying out scheduled operation in the same way. UP, for example, is scheduling by corridor, not the whole system as a single entity: specifically, the I-5, Gulf Coast, and Mid-America corridors. Some carriers are using the software and algorithms developed by MultiModal, some are not.

A lack of uniformity in initial development of car scheduling is not surprising; one would expect different sets of managers in differing circumstances to adopt different approaches. The lack of harmony may, however, be a source of future problems. A great deal of carload traffic is interline traffic. How does RR A plan for the use of its cars when it does not know when they are coming back from RRs B and C? Gains in car utilization that one can achieve with cars on one's own territory may be quite difficult to match when one's cars are on another railroad's territory. And improvement in service reliability on one's own railroad may do little for reliability of delivery when the destination dock is on another carrier's territory.

Though it remains a work in progress, there has been enough experience with scheduled railroading to allow us to draw some inferences. From looking at the four large American carriers, and also at CN and CP, we can state that scheduled operation is feasible, albeit with some reservations about the level of reliability that can be achieved (discussed further below). We can also state that the cost of actually doing it is not very high. Putting scheduled operation in place comes in two parts: planning and implementation. Cost of planning and initial implementation has been estimated at two to five million dollars, including both consultants' time and time of own staff.[4]

Implementation requires sustained management effort to change the basic operating method of the railroad and consistently adhere to the new discipline. In the initial stages, the switch to scheduled operation needs unswerving support from the highest level of management. The shift in decision making on canceling or adding trains from the field to a higher level means a profound change in corporate culture on most railroads. The management focus and energy to see a big company through a transition like this could be a large component of the cost of implementing scheduled operation. The process is not over, but, on the evidence so far, most railroads seem to be getting through this transition successfully.

Capacity Issue

To some degree, effective scheduled operation depends on adequate mainline capacity. If there are any bottlenecks in a system where congestion can occur under surge conditions, scheduled operation will break down. Further, traffic density affects a system's ability to recover from an incident such as a derailment or equipment failure. None of the railway staff we spoke with reported capacity as a concern in converting to scheduled operation, but it is clearly a factor that managers have to keep in mind. A senior manager at NS told us that they had eliminated system bottlenecks, but it was an ongoing process and essential to the success of scheduled operation.[5]

Reservations

Some railroad executives believe that car-reservation systems will develop as an adjunct to car scheduling. Advance reservation systems are of value to shippers who know their future requirements by assuring them that empties will be placed on their sidings when wanted. Reservations would provide information on near-future demand that would enhance the accuracy of the demand forecasts that underlie schedule planning. In particular, it would seem that precise, advance information on when customers are going to ship would enhance the reliability of local service, both pick-up and drop-off. Reservations should also be a useful marketing tool for carriers. Advance information on demand would be useful in pricing carload service. It would give carriers the opportunity to engage in yield management analogous to what airlines are able to do.

BNSF has perceived advantages in a reservation system and has acted on that perception. That carrier's loading origin guarantees (LOGs) are similar to the certificates of transportation (COTs) it initiated in the 1980s for advance guarantees of grain-car placement. Shippers submit bids for

[4] Conversation with Carl Van Dyke, President, MultiModal Applied Systems, September 4, 2003.
[5] Conversation with James McClellan, then Senior VP/Strategic Planning for NS, October 20, 2003.

stated numbers of cars available in a specified time period (a week) and at a specified place. A discount from the published rate for the move in question comes with the LOG. A one-car-per-week minimum is required to submit a bid in the primary market; the program is available for shippers of metal, pulp board, perishables, and steel products. BNSF claims reliability of better than 99.9 percent for placement of LOG empties.

BNSF recently held an auction in which LOGs were offered over a 52-week period; all the equipment BNSF allocated to LOGs for that period was taken. It is clear that carload shippers place some value on certainty of equipment availability. Aside from advance commitments from customers, a sale like this gives BNSF an excellent basis for a market forecast for planning scheduled operation. As with COTs, secondary trading of LOGs is allowed; this permits shippers to get out of commitments to load when they find circumstances changing. By providing an exit from their commitments, a secondary market encourages shippers to make advance reservations. The movement of prices in the secondary market is also a valuable source of information to BNSF on future demand for cars.

The COTs program for grain cars was eventually adopted by other carriers; it would be surprising if other rail firms did not also offer an auction for guaranteed placement of empties for carload shippers.

There are some in the industry, especially some short-line managers, who argue that reservations should be sold on a day-of-arrival basis. This would certainly appear to be a good marketing approach; the question is whether the railroads could achieve the degree of reliability needed to sell service on this basis.

Role of Short Lines

Any analysis of carload merchandise service is incomplete unless we give some attention to the role of short lines. Two statements about short lines in this context are certainly true. (A) If carload service were to disappear, most short lines would disappear along with it. It is the only market most of them have. (B) Generally, short lines do a better job with local service and with selling than the mega-carriers do. They provide pick-up and drop-off service at lower cost and do it in a more flexible, customer-responsive manner than do the big railroads. Part of this is because of the absence of labor agreements with restrictive work rules. Part of it is also because short-line managers are totally focused on running customer-responsive local service; that is their whole task.

For the same reason, short lines expend more sales effort per dollar of carload revenue than do big railroads. Retail selling is usually not a strength of mega-carriers, but short-lines are good at it, because they have to be. With flexible service and personal attention, a short line can often increase business, even from shippers with little or no prior experience of shipping by rail. Individual short lines are, thus, sometimes able to show revenue gains far greater, in percentage terms, than average national growth in carload business. A short-line manager at the Calgary conference reported regular carload growth of five to ten percent per year.[6]

[6] Presentation of Thomas Hoback, CEO, The Indiana Railroad, Calgary, September 23, 2003

When managers of large carriers consider ways of improving local service, selling more of their branch systems to short lines is always one of the options on the table.

The Mathematics of Reliability

It is not easy for a rail carrier to achieve a high level of on-time delivery in carload service, even with a good plan and a feasible schedule to which management conscientiously adheres. It is a challenge much different from running an intermodal train or a truck on time. A truckload firm, for example, will know average speed over a given stretch of highway at given times of day. It can calculate the time required to drive from A to B, add a buffer to allow for unexpected incidents, and make sure that the driver departs on time with the load. If the firm does this consistently, it will achieve on-time performance in the high 90s. A railroad can do much the same for an intermodal train from Intermodal Terminal A to Intermodal Terminal B. The railroad may have problems with trains that have to meet or pass each other on single-track line, but good plans and schedules will take care of those problems.

When we consider the probability of the truck or intermodal train arriving on time, we are looking at the probability of a single event. If the train or truck makes its run on schedule for 95 percent of those events, then on-time probability is 0.95. But the movement of the car in carload operation is a series of independent events. Local service picks the car up and takes it to a terminal whence it moves through a series of terminals until local service places it on the receiver's siding. It will not arrive at the destination on time, unless every connection along the way, including final delivery, is made on time.

Table 1 shows the effect of key variables on on-time performance. "On time" requires definition. Under the schedule, each car has a trip plan, a series of trains each scheduled to arrive at the next terminal in time for the car to be processed through that yard and make its next scheduled connection. An analogy can be drawn with an air traveler with connecting flights. The traveler is on time only if he gets to an airport, and gets through it, in time to catch his flight for each leg of this journey. A pick-up is on time if the car gets to Terminal A in time and is placed in its scheduled train for the move to Terminal B. The A-to-B move is on time if the car makes its scheduled connection in Terminal B for the B-to-C move and so on.[7] The drop-off is on time if the local train drops the car on the receiver's siding on the promised day.

[7] This emphasizes the point that discipline in yard operation is as important as on-time performance of road trains.

Table 1. Probability of On-time Delivery

Pick-up	Drop-off	Case A			
0.98	0.98				
		Number of Road Moves (terminals minus one)			
Road Reliability	5	4	3	2	1
0.99	0.91	0.92	0.93	0.94	0.95
0.98	0.87	0.89	0.90	0.92	0.94
0.97	0.82	0.85	0.88	0.90	0.93
0.96	0.78	0.82	0.85	0.89	0.92
0.95	0.74	0.78	0.82	0.87	0.91
0.94	0.70	0.75	0.80	0.85	0.90
0.93	0.67	0.72	0.77	0.83	0.89
0.92	0.63	0.69	0.75	0.81	0.88
0.91	0.60	0.66	0.72	0.80	0.87
0.90	0.57	0.63	0.70	0.78	0.86

Pick-up	Drop-off	Case B			
0.95	0.95				
		Number of Road Moves (terminals minus one)			
Road Reliability	5	4	3	2	1
0.99	0.86	0.87	0.88	0.88	0.89
0.98	0.82	0.83	0.85	0.87	0.88
0.97	0.78	0.80	0.82	0.85	0.88
0.96	0.74	0.77	0.80	0.83	0.87
0.95	0.70	0.74	0.77	0.81	0.86
0.94	0.66	0.70	0.75	0.80	0.85
0.93	0.63	0.68	0.73	0.78	0.84
0.92	0.59	0.65	0.70	0.76	0.83
0.91	0.56	0.62	0.68	0.75	0.82
0.90	0.53	0.59	0.66	0.73	0.81

Pick-up	Drop-off	Case C			
0.90	0.90				
		Number of Road Moves (terminals minus one)			
Road Reliability	5	4	3	2	1
0.99	0.77	0.78	0.79	0.79	0.80
0.98	0.73	0.75	0.76	0.78	0.79
0.97	0.70	0.72	0.74	0.76	0.79
0.96	0.66	0.69	0.72	0.75	0.78
0.95	0.63	0.66	0.69	0.73	0.77
0.94	0.59	0.63	0.67	0.72	0.76
0.93	0.56	0.61	0.65	0.70	0.75
0.92	0.53	0.58	0.63	0.69	0.75
0.91	0.51	0.56	0.61	0.67	0.74
0.90	0.48	0.53	0.59	0.66	0.73

If there is a failure on any of these links, the car cannot keep to its trip plan and cannot be on time at the receiver's siding. When we speak of on-time probability on any link, we mean the probability that the car will make its next connection, *given that it made the previous connection*. Once there is a failure on any link, the on-time probabilities for all the remaining links drop to zero. Success on the previous links is essential for success on any given link, *but does not ensure success on that link.* The fact that a car is placed in its scheduled B-to-C train does not ensure that it will make its scheduled C-to-D train. In that sense, probability of success on any link is independent of performance on the previous links. Thus, on-time delivery depends on a series of independent events. The probability that a car makes all connections on time is the *product* of the probabilities of success on each connection.

Table 1 shows the effect on reliability of three variables: probability that local moves will be on time; probability that road moves will be on time: and number of road moves. Local-service reliability is treated as a separate variable, because local service is a different operating environment from road service. Three different matrices are shown with different pick-up and drop-off reliabilities. In each case, pick-up and drop-off reliabilities are assumed to be same; this assumption is made for the sake of simplicity. The three cases are: Case A, 0.98; Case B, 0.95; and Case C, 0.90.

Road reliability is the probability that a car will make its planned connection at the next terminal. For simplicity, reliability is assumed to be the same for all road moves. Each row in a matrix is a different level of road reliability, rising from 0.90 in the bottom row to 0.99 in the top row.

Each column in a matrix is a different number of road moves, dropping from five to one as we move to the right. The number of road moves is the number of terminals minus one. Thus, the case with the most car handlings has six terminals and five road moves. Any move requires at least three events: pick-up, one road move, and drop-off.[8] The three-event moves are in the far-right column in the table.

The numbers in the cells are the probabilities that a shipment will be placed on the receiver's siding on the promised day. On-time reliability rises as we move up and to the right. Consider an example from Case B (local-service reliability of 0.95): road reliability of 0.96 and four road moves (five terminals). In this example, on-time reliability is 0.77;[9] eliminate one terminal, and it rises to 0.80; take out another terminal, and it rises to 0.83. Consider an example from Case C (local-service reliability of 0.90): road reliability of 0.90 and four moves; on-time reliability is 0.53.

The dark shading in the matrices indicates on-time reliability of 0.90 or better. The light shading shows reliability of 0.80 to 0.89. We see that the effect of the number of terminals is very strong, especially at the lower levels of road reliability. For example, the bottom row of Case B shows reliability rising from 0.53 to 0.81 as the number of road moves falls.

[8] Instances in which a car would not make a move over the road between at least one pair of terminals would be so rare that they are not worth considering here.
[9] The calculation: $0.95^2 \times 0.96^4 = 0.77$.

Without good reliability on the local moves, it is virtually impossible to attain reliable deliveries. With Case C (local reliability of 0.90), delivery reliability of 0.80 is all but out of reach. When local reliability is 0.95, delivery reliability of greater than 0.80 requires road reliability of 0.96 or higher for most cases. Both local and road reliability of 0.98 would be required to get delivery reliability in the high 80s or low 90s. Most experts think reliability much above 0.80 would be an unrealistic goal in current conditions.

Questions to Be Answered

In this brief review, we see that car scheduling is feasible, and railroads, mega-carriers, are working to implement it. We also see that high levels of on-time performance are very difficult to achieve. In the following sections we try to see what benefits the railroads can get from scheduled operation. We will try to answer the following questions:

What degree of cost reduction can be realized?

Will scheduled operation bring increased revenue, whether from higher prices or more traffic?

Between them, what can cost reductions and revenue increases do for railroad earnings and what does that imply about the long-run viability of carload service?

III. Cost Reduction and Effect on Railroad Earnings

There is a general consensus that effective car scheduling will reduce costs. In our discussions, most major carriers reported that they had experienced operating-cost reductions because of scheduled operation. The theory behind tonnage (anarchic) railroading was that savings in crew costs from canceling light trains would outweigh any costs incurred by not running on schedule. The opposite has proved to be the case. Scheduling improves equipment utilization and, with good planning, heavy trains are the norm anyway.[10]

Equipment utilization is improved, because cars and locomotives turn up in places and at times where, according to the plan, they are wanted. Under tonnage railroading nobody really knows where equipment is going to turn up, because no one really knows the network impact of train cancellations made by individual yardmasters. With effective execution of a good plan, car miles are reduced because of less circuitry, car velocity is increased, dwell time in yards is reduced, there are fewer deadhead miles for power and crews, and so forth.

Some of the crew savings of tonnage railroading may well have been illusory in any event, because costs of deadheading crews or putting them up overnight away from home to wait for a return train may not have been fully taken into account. An additional, though not easily quantified, benefit of scheduling is vastly improved working conditions for road crews as a result of predictable work schedules. Living with the "on-call" regime has negative effects on family life and train crews' morale. This is surely a significant factor in crew-retention problems.

Estimates of efficiency gains cover a wide range. For car utilization, we heard estimates of improvement ranging from ten to 30.0 percent, for locomotives, ten to 20.0 percent.[11] Even though on-time reliability much higher than 0.80 is nearly impossible under current operating conditions, achievement of these gains is still feasible. Scheduled operation significantly increases the level of predictability in car and locomotive location even while on-time reliability is still something short of ideal.[12]

We accept these estimates from railroads as valid. We need to convert them into gains in railroad earnings and analyze the effect of those gains on the financial viability of carload service. To do this, we developed a simple model on an industry-wide basis (all Class-I carriers). We used the STB 2000 cost of capital, 11.0 percent. (There are industry observers who argue that the STB cost of capital is too high. They point out that the railroads stay in business despite their failure to recover the STB cost. This is an interesting argument, but it is not part of our task to make an independent estimate of cost of capital to railroads. We defer to the STB on this point and do not believe the analysis is thereby damaged.)

The analysis entailed the following steps.

---

[10] Some industry observers note that crew costs are in the budgets of railroad operating departments but equipment ownership or leasing costs are not. This could account for suboptimal decision-making.
[11] Calgary presentations from Multimodal, CP, UP, and NS and follow-up discussions with these firms. Of these railroads, only CP has come close to full implementation of scheduled operation.
[12] Conversation with Jason Kuehn, Multimodal, February 12, 2004.

1. Estimate annual saving from reduction in equipment requirements.
2. Estimate current contribution from carload service; add equipment savings to get new contribution.
3. Allocate percentages of road and equipment investment to carload service.
4. Express required carload investment as an annualized investment cost.
5. Compare annualized investment cost with new contribution from carload.

We need to trace through these steps in some detail. Equipment saving was calculated by treating the utilization improvement as a reduction in equipment requirements. A ten-percent improvement in car utilization was expressed as a ten-percent reduction in the annualized cost of owning the cars required for carload service. The value of the carload fleet (all railroads) was estimated and annualized with a capital recovery factor for a 40-year life at 11.0 percent. Number of cars was number of boxcars[13], gondolas, reefers, and tank cars listed in *Railroad Facts 2001*[14] plus an adjusted number for flat cars. Acquisition costs for car types were also taken from *Railroad Facts 2001.*

The number for flat cars was adjusted, because most flat cars are either carrying auto racks or in intermodal service. For Class-I railroads, we used the AAR Analysis of Class I Railroads 2000[15] and took the sum of general-service flat cars and "all others"; this gave us 20,389. For non-Class-I railroads, we used *Railroad Facts* and took half the number shown there; this gave us 8,142 non-Class-I flats in carload service. For the private fleet, *Railroad Facts* shows about 43,000 flats, we arbitrarily reduced this to 2,000 for the carload fleet. This gave a total of just over 30,000 flats in carload service against the total of about 157,000 flats, all owners, in *Railroad Facts*. (About 110,000 of these belong to Trailer Train (TTX)).[16] A table with our complete numbers on cars is in Appendix A.

A critical question here was how to treat the private fleet in regard to utilization improvement. To limit the savings estimate to railroad-owned or leased cars clearly understates the gain. If fewer private cars are needed to move the same traffic, it seems a virtual certainty that some of that saving is going to come back to the railroads. One way or the other, railroads pay for the use of shippers' cars, and market pressures will push those implicit prices down as utilization of private cars improves. It seems likely, though, that this would be a slow and imperfect process. Some part of the large tank-car fleet, for example, is used primarily for storage, so a ten-percent utilization improvement would not turn into a ten-percent reduction in tank-car requirements. For a rough approximation, we assumed the railroads would realize half the utilization benefit from private cars. For sensitivity, we dropped this fraction to one-fourth.

[13] This somewhat overstates the number of boxcars in the carload service fleet, because it includes boxcars used for auto parts, but we do not think this makes a significant difference. Motor-vehicle traffic accounted for just under seven percent of total carloads in 2000, and a good part of that was racks for finished vehicles.
[14] Association of American Railroads (AAR), *Railroad Facts 2001*. *Railroad Facts* is an annual publication of AAR.
[15] The AAR Analysis of Class I Railroads is an annual compilation of railroad financial and operating data prepared by AAR from the data in the Form R-1s that the railroads file with the STB.
[16] Conversation with David Deboer, January 7, 2004. TTX is a car pool owned by Class-I railroads. It includes some boxcars, but most of its equipment is either intermodal or auto racks.

For locomotives, we applied the improvement percentage to the entire Class-I fleet on the ground that all of a carrier's fleet would be affected by reduced requirements for power for carload service. We assumed a purchase price of $2,000,000 per copy and a 30-year life for the annualization.

In order to estimate the current contribution from carload service we used a revenue/variable-cost ratio of 1.2, i.e., a margin of 0.167. We discussed this with staff at three of the four mega-carriers and with former Conrail personnel. These talks yielded a range for carload R/VC from 1.2 to 1.6 with a consensus that 1.2 was a valid lower bound. We applied the margin to 2000 carload revenue of $15.9 billion[17] and obtained a current contribution of about $2.7 billion. For the new contribution, we simply added the savings from improved utilization to current contribution.

We used several methods for allocating road and equipment investment to carload operation. The 2000 AAR Analysis of Class I Railroads shows investment for road, locomotives, cars, and other equipment. For road, there are numbers for miles of several types of main track and for way switching and yard switching track. We assigned all of the switching track to carload and considered the remainder as the core. To allocate core, we used data on carload traffic from the 2000 Carload Waybill Sample[18]. A special run (courtesy of FRA) showed 691.3 billion ton-miles of traffic that was neither intermodal nor unit train. (Since this includes automotive traffic, it is an exaggeration of carload ton-miles, but it is a minor exaggeration.) The AAR data show a total of 1,466 billion revenue ton-miles; the resulting ratio of carload to total ton-miles is 47.2 percent. We apply this to the core, add the switching track back in, and the result is 61 percent of road investment allocated to carload service.

We discussed allocation of power with a senior planning executive at a major carrier who suggested 70 percent as a good approximation of the carload share. This seemed reasonable to us, and we accepted it. For cars, we used the *Railroad Facts* numbers for the car types referred to above for Class-I railroads.[19] On this basis, we allocated 44 percent of car investment to carload service. We treated other equipment on the assumption that all of it is for maintenance of road and related work. Accordingly, we used the same percentage as for core track: 47.2 percent. We applied the percentages so developed to Class-I investment figures, averaged over 1996-2000, for road, power, cars, and other equipment. The following table summarizes the cost-allocation findings.

[17] Carload revenue was estimated from AAR Analysis of Class I Railroads, 2000. We subtracted revenue from grain, coal, automotive, forwarders and shippers, and "all other." These last two would cover intermodal.

[18] The Carload Waybill Sample is based on a sample of waybills submitted annually by all rail carriers to the STB. It covers all rail traffic; it is not restricted to carload service as defined in this paper.

[19] When estimating the savings from improved utilization, we used cars for all railroads on the ground that savings to non-Class-I carriers would come back to Class-I carriers in the form of reductions in car rent or similar payments. When allocating investment, we use Class-I cars, because we are using the Class-I investment figure.

Table 2. Investment Allocation to Carload Service				
Investment Type	**Road**	**Locomotives**	**Cars**	**Other Equipment**
Percent Share	61	70	44	47
Annual Investment	$2,657 million	$855 million	$260 million	$122 million

We took the present value of a 20-year investment stream at these levels for each category. Present values were annualized on the basis of an 80-year life for track, 30 years for locomotives, 40 years for cars, and 30 years for other equipment; the annualized numbers were summed, and the result is the annual investment cost that carload service must support. As noted above, 11.0 percent was used for interest in all cases. This works out to an annual investment cost of about $3.5 billion. The last step was to compare the new carload contribution to the required investment cost. For carload to be viable, its contribution must at least cover the annual investment cost.

The result of this analysis is shown in Table 3 for a range of utilization improvements from zero to 20 percent. The third row of the table reflects the sensitivity test referred to above regarding the degree of benefit from the private fleet that would accrue to railroads. The base case assumes one-half of that benefit for Class-I carriers; the sensitivity test assumes one-fourth.

Table 3. Carload Contribution minus Annual Cost of Investment				
Utilization Gain (%)	0	10	15	20
Contribution minus Cost (with ½ gain from private fleet)	-$804 million	$26 million	$441 million	$856 million
(with ¼ gain from private fleet)	-$804 million	-$27 million	$361 million	$750 million

The results show financial viability, in the base case, for carload service with utilization improvements from ten percent up. The result at ten-percent improvement is marginal. It goes from slightly positive to slightly negative when the gain to railroads from the private fleet is based on one-fourth of that fleet instead of one-half of it. The positive numbers indicate recovery of investment with an 11.0 percent cost of capital (STB 2000) with money left over: a return of greater than 11.0 percent.

At the present level of contribution, our analysis shows that carload does not cover its required investment. This supports a view we heard from various sources in the industry—that carload service as now operated does not justify replacement or rehabilitation of the assets that it requires.

This is a simple analysis and also a crude one. The cost-allocation scheme is certainly open to challenge. Detailed analysis on an individual railroad could obviously give different results. But the scheme is suitable for a rough approximation, and that is all that is required for this study.

The estimated level of investment could be questioned on the ground that it is based on the railroads' actual level of investment—maybe that level is too low. This is a fair point, but we note that our hypothetical investment level is not based on actual investment in carload service. It is based on the application of our cost allocation to total investment in road and equipment. Again, we think this sufficient for a rough approximation.

Clearly, this analysis does not yield an accurate prediction, nor is it intended to do so. We interpret these numbers to mean that there is a reasonable prospect scheduled operation could improve equipment utilization to the point that carload service could bring a return sufficient to recover the investment required to sustain it.

This page intentionally left blank

IV. Carload Market Traffic, Trends, and Future Prospects

Traffic and Trends

We have defined carload by exception: rail traffic except bulk unit trains, intermodal, and automotive (motor vehicles and parts). For looking at trends in this market, it is useful to identify the commodity groups it comprises. A simple way to do this is to take the commodity groups listed in the AAR Analysis of Class I Railroads and remove grain, coal, motor vehicles and parts, forwarder and shipper associations, and "all other." (The last two are intermodal.) This gives us the following list.

Farm products other than grain
Metallic ores
Crushed stone, sand, and gravel
Non-metallic minerals
Grain-mill products
Food and kindred products
Primary forest products
Lumber and wood products
Pulp and paper
Chemicals and allied products
Petroleum products
Stone, clay, and glass products
Coke
Metals and products
Waste and scrap.

Nine of these groups make up 95 percent of carload traffic (by carload). These are listed in Table 4 in descending order of volume with their percentage shares of all carload traffic in the period 1996-2002. None of this is high-value traffic compared to intermodal or motor vehicles and parts. Chemicals and lumber and wood products have the highest values, enough for shippers to have some interest in reliability.

Table 4. Principal Carload Commodities 1996-2002

STCC	Commodity Group	Percentage
28	Chemicals and Allied Products	18.1
26	Pulp and Paper Products	15.5
33	Primary Metal Products	14.5
24	Lumber and Wood Products	13.9
40	Waste and Scrap	8.7
20	Food Products	8.4
29	Petroleum Products	7.9
14	Nonmetallic Minerals	5.1
32	Stone, Clay, and Glass	2.9

Source: Carload Waybill Sample

Carload traffic has not been growing fast. Table 5 summarizes recent trends in both tonnage and real revenue. To provide context, the same numbers are shown for all rail traffic. The year 2000 was chosen as an endpoint, because 2001 and 2002 are both affected by the recent recession. The years 1978 and 1987 seemed convenient as starting points because they match with other relevant data series.

Table 5. Annual Growth Rates: Tonnage and Real Revenue

	1978-2000	1987-2000
Carload Tons	-0.7%	1.0%
Carload Revenue	-2.3%	-1.2%
Total Tons	1.0%	1.8%
Total Revenue	-1.4%	-0.6%

Source: AAR Analysis of Class I Railroads 1978-2000

Reflecting some turnaround in railroad performance after the enactment of Staggers, both tonnage and revenue trends are better for 1987-2000 than for 1978-2000. It is plain that rail tonnage grows slowly and real revenue falls slowly; but carload tonnage grows even more slowly, and its revenue falls faster. The revenue trend reflects competitive conditions. This is traffic that moves by rail only because of the low price; rail rates have to stay well below truck rates to hold this business for the railroads.

The slow growth in tonnage is due, in part, to slow growth of output in these sectors. In Table 6, we see growth, from 1987 to 2000, in physical output of the industry sectors that produce the principal carload commodities, listed in order of carload volume. (Scrap is not included, because it is not treated as an output by BEA. Otherwise, these sectors include all the carload commodity groups that account for the top 95.0 percent of carloadings, as listed in Table 4.) For comparison, we have included the rail tonnage growth for these sectors for the period.

Table 6. Industry Growth Rates: Physical Quantity Index

Industry Sector	1987	2000	Growth Rate, % p.a.	
			Index	RR Tons
Chemicals	79.08	105.99	2.3	2.3
Pulp and Paper	91.87	95.07	0.3	0.1
Primary Metal Prods.	83.49	110.37	2.2	4.5
Lumber and Wood	126.6	104.73	-1.5	-0.5
Food	87.78	93.67	0.5	1.1
Petroleum Prods.	96.21	99.16	0.2	1.3
Nonmetallic Minerals	90.90	123.42	2.4	1.1
Stone, Clay, Glass	80.24	112.10	2.6	0.7

Source: BEA Quantity Indexes for GDP by Industry. http://www.bea.doc.gov/bea/dn2/gpocwi.htm
AAR Analysis of Class I Railroads 1978-2000

The average growth rate for these sectors, weighted by rail-shipped tonnage in 2000, is 1.5 percent—in the same period in which carload tonnage was growing at 1.0 percent. We are not in a position to give a complete explanation of carload traffic's lag behind the overall growth rate. One part of the explanation must be, however, that an increasing share of the production of these goods is taking place at sites that are not rail served, and the same is true for facilities receiving these goods. Sixty years ago, almost all production or warehouse facilities of any size would have been located on rail sidings. This is no longer the case, and this must be a significant factor restraining carload growth, now and in the future.

The differences between output growth and tonnage growth in the individual sectors doubtless have many explanations. The relatively rapid growth of rail carriage of primary metal products reflects a steep drop in this tonnage in the 1980s followed by recovery in the 1990s. The fact that chemical tonnage has been rising at the same rate as output of chemicals likely stems from the fact most chemical shippers and receivers are on rail sidings and are not leaving them. It could also be related to an increase in transloading of chemicals at the receiving end. The same factor might be present in movement of petroleum products.

It may be noteworthy that, in five of these eight sectors, railroads are holding their share of output (chemicals) or increasing their share: primary metal products, lumber, food, and petroleum products. (In the case of lumber, carload tonnage is falling more slowly than output is.) This suggests that railroads do have some opportunity to increase the growth rate of carload tonnage.

Future Prospects

Today's demand for carload movement comes from shippers who are not concerned about transit times and can tolerate unreliable deliveries; more precisely, they can tolerate the current level of reliability. For such customers, the speed and dependability of truck service offer little value, and they make their mode choice almost entirely on price. Unless the service deteriorates noticeably from its current levels, the railroads should not lose those customers. If the traffic-growth trends of the last 15 years persist, carload tonnage will continue its slow growth.

Our inspection of growth of industrial output and carload tonnage shows there may be some scope for faster growth of carload traffic. Whether this could be achieved depends, in part, on whether customers continue to maintain their production facilities on rail sidings and build their new facilities on sidings. To the extent that customers, for whatever reason, shift production away from rail-accessible sites, that share of future production is closed to railroads. Overall, industry-location decisions of the last 40 years or so have not been favorable to railroads. The importance of this factor cannot be emphasized enough.

A large rail carrier surveyed plant and warehouse locations in one of its major corridors and found that only 16 percent of potential shippers' sites were within 500 feet of a railroad track. That 16 percent of sites still offers considerable potential for traffic growth from the railroad's perspective. But constraints like this must be kept in mind when considering estimates that carload traffic could grow somewhere near the GDP growth rate. An increase in growth rate of a few tenths of a percentage point could be of major financial benefit to a railroad with carload traffic still growing quite slowly compared to the economy or total manufacturing.

For this study, a central question is whether significantly increased reliability of carload delivery dates would affect traffic growth. Railroad executives express a wide range of opinions on this point. The most restrained view we heard was that improved service would bring some traffic growth from existing customers but would not attract new shippers in any significant amount. The most optimistic view was from an executive who thought improved service would be achieved and it would bring his company carload growth at near-GDP rates in some of its lanes.

The key issue here is how much value carload customers place on reliability; the answer is that it matters more for some than it does for others. Some current users ship all they can by carload rail; a low level of reliability is not a problem for them. Others use carload heavily but move some traffic by truck in cases where reliability is an issue. These shippers would increase their use of carload if on-time reliability rose to 0.80. We heard estimates of tonnage increases of ten to 15.0 percent for some types of shippers.

A related question is whether shippers for whom reliability matters would pay more for increased reliability. Last year, BNSF offered many of its carload shippers a money-back guarantee: placement of the car on the receiver's siding on the promised day or the move would be free—this for a premium of about ten percent over the regular rate. There were no takers. This does not say that a railroad would get no rate increase with better service; it does say that a railroad would face a marketing challenge in trying to get higher rates in return for greater reliability. Well-informed observers of the market told us that, when and if railroads achieve 0.80 reliability and their customers come to believe they can depend on it, they will get some increase in rates on some of their traffic. Many chemical shippers, for example, are happy to use tank cars as slowly moving warehouses, but it is worth something to them and their customers to know when they are going to arrive.

To close this discussion, we think the following is a reasonable statement. Greater reliability of delivery dates would attract some additional traffic to carload service, and it would allow somewhat higher rates on some of this traffic. This could be enough additional revenue to have a significant effect on railroad earnings. Compared to the total economy or to truck traffic, the additional traffic would be small. There would be a one-time step up to higher tonnage, likely not more than ten percent of all carload traffic; after that, growth would continue at a low rate, possibly somewhat higher than past growth rates.

V. Assessment of Future Viability of Carload Service

Recapitulation

Scheduled railroading offers potential for reducing cost of carload service and improving its attractiveness to shippers. In the preceding pages, we have examined scheduled operation both as a means to reduce costs and as a means to increase revenue. The prospects for cost reduction appear significant, for revenue enhancement markedly less so.

Cost Reduction

On the basis of current experience with scheduled operation, most big railroads have reported, or expect, significant improvements in equipment utilization: ten to 30 percent for cars, ten to 20 percent for locomotives. We have used a fairly simple financial model to analyze the impact on carload viability of improvements on this order. The apparent result, with cost of capital at 11.0 percent, is that the contribution from carload could cover the cost of the investment stream required to support carload operation. This is particularly true at improvement levels of 15.0 percent or better; at ten percent, the results are positive but barely so.

This analysis was done on the basis of numbers for all Class-I railroads; results for individual railroads would certainly vary. Further, the analysis was done at a relatively gross level of detail. No one could claim that our simple model is a precise predictor of railroad financial performance. The model results do tell us that, if the improvement results reported by the railroads are genuine and can be sustained, carload service could pay for its capital requirements.

We need to remember, however, that the central question in the policy context is not just the question of whether carload service can become financially viable through scheduled railroading. The question is whether carload service can be made financially viable by any means. Scheduled operation is not the only avenue to improvement available to railroad management. There is good reason to believe that railroad managers will find other ways to increase carload efficiency as they focus on the problem.

An important point here is that rail management has only recently begun to give serious attention to the efficiency of carload service. We noted earlier that carload railroading was once all railroading; it has changed little over the past few decades. As railroads developed new services, they left the "old" railroad operation largely untouched. Bulk unit-train, intermodal, and automotive services were designed to operate around, as it were, the old railroad operation. Rail managers developed special services while leaving the old system intact along with all its inefficiencies. This made sense as the fastest and cheapest way to develop new services and markets.

It may well be the case, however, that the industry is approaching the limits of the productivity gains it can easily achieve in new railroading. This is not to say that there will be no more efficiency increases in intermodal or unit-train operation; it is to say that the gains are likely to come more slowly and with more effort and cost. Put another way, much of the low-hanging fruit has been picked, and rail managers must now look to the middle-or-higher-hanging fruit. The railroad industry has come to a place where it must confront the inefficiency of old railroading. Management must either wring costs out of carload service until it pays its way or gradually abandon it.

If railroads did back out of carload service, it seems the most likely result would be that the traffic would be switched to intermodal. Customers now shipping carload because of the low price would seek the cheapest available alternative; that would rarely, if ever, be an all-truck move. Transloading at the ends of the trip would be a limited option. Transloading eliminates the need for local service but does not eliminate the economic requirement to consolidate small shipments into trainloads and move them through a series of terminals.

Transloading would have relevance for chemical traffic. The likelihood that the railroads would give up carload chemical traffic must be near zero. In the absence of classification yards, one way to move chemicals would be with less frequent shipments to attain heavier trains with transloading at the receiving end of the trip.

We believe the likelihood is that rail managers will find a way to reduce cost to the point that carload at least carries itself financially. This is based, in part, on railroad reports on improvements from scheduled operation and on the findings from the financial model. These results are not conclusive; they do not demonstrate that scheduled operation will necessarily lead to viable carload service. They do demonstrate that this is a plausible outcome, one well within the limits of the possible. However, our view is also based on the belief that rail managers will make a sustained effort to achieve viable carload service and are likely to succeed. Given that this traffic generates over 40 percent of industry revenue, business logic would dictate a serious and sustained effort to make it profitable before deciding to give it up.

Here we need to repeat that scheduled operation is not the only available approach to reducing carload costs. Expert opinion holds that there are significant inefficiencies in local service. The large railroads need to examine their networks to see whether they could provide carload service with fewer yards than they now use. It is not clear that they have all made a rigorous effort to do this. If a yard is truly excess, its elimination both reduces cost and improves service. Rail managers do not embark on a fool's errand when they set themselves to make carload service viable. They have every reason to try and reasonable prospects for success.

Revenue Enhancement

We considered the following hypothesis: Scheduled operation will lead to more reliable delivery of carload shipments; more reliable service will allow higher rates on existing traffic; and more reliable service will attract new carload traffic. This hypothesis has some validity.

Many carload shippers are not willing to pay much for increased reliability. Total output of commodities that move in carload shipments is growing slowly—at rates well below GDP growth. Weighted by rail-shipped tonnage, annual growth of physical output for principal carload commodities (except scrap) was 1.5 percent over 1987-2000. Finally, the potential market is limited to firms that already have sidings or are close enough to a rail line for installation of a siding to be feasible.

For reasons set out earlier, high levels of delivery reliability are difficult to achieve. In order to attain reliability of better than 0.80, it is necessary that a car have an on-time probability of better than 0.95 for *each* of its scheduled connections. To get at, or near, 0.90 reliability, on-time probability for each connection has to be 0.98 at least. Achievement of these higher levels is, perhaps, not impossible but would require a level of discipline in execution for road trains, yard operations, and local service that is far beyond railroads' present standards. Experts who have studied the matter closely think that a goal much above 0.80 is unrealistic in current conditions.

We noted that goods that now move by carload are largely low-value commodities; for the most part, carload shippers that put much premium on reliability abandoned railroad service long ago. Some, e.g., chemical, shippers would place some value on increased reliability.

Among people that we spoke with, there was a range of opinion on the future market for carload service. The preponderance of opinion was on the side of slow growth. One senior rail executive thought improved reliability would bring more business from existing customers, but he doubted that many new customers would be attracted. Some shippers offered the following view: If carload customers perceive that railroads will consistently achieve 0.80 reliability, some, not all, shippers would increase carload tonnage by ten to 15.0 percent. This would be a one-time step-up after which tonnage growth would continue at historical rates (1.0 percent annual growth, 1987-2000) or perhaps a little above historical rates.

There are those with a more expansive outlook. An executive with another big railroad thought carload growth close to GDP growth was possible in some lanes. A short-line manager believed that reliability could be improved to the point that reservations could be sold on a day-of-delivery basis and that this would be a strong selling point.

We have to give some attention to the role of short lines in developing carload markets. At the Calgary conference, short-line executives reported high rates of traffic growth. Obviously, high growth rates in small niche markets will not turn around the national trends. On the other hand, we do have to recognize that short lines do spend more sales effort per dollar of revenue than do large railroads and do a better job selling to small customers. With more personal attention and more follow-up on service problems, short lines may succeed in persuading shippers to install sidings where a big railroad, a remote and impersonal entity from the viewpoint of many small shippers, would have little chance of doing so.

For the reasons stated, however, we take a restrained view of the prospects for carload growth. We believe railroads would, given 0.80 reliability, achieve some carload revenue growth on the basis of more traffic from existing customers and higher rates in some markets for enhanced reliability. In real terms, carload revenue fell 1.2 percent per year from 1987 to 2000. Given this history, any noticeable growth in real revenue would be a remarkable turnaround.

Conclusion

Scheduled railroading, other improvements, and sustained management focus on carload operation, taken together, have a real potential to make carload service more than cover its cost of capital. Most of this would be due to cost reduction. In terms of "winning back" traffic lost to trucking, the effects would be modest but positive. Railroads will stay in the carload business with some growth in tonnage, rates, and revenue. The growth in revenue could be enough to improve significantly railroads' earnings.

VI. Policy Implications

The findings of this study do not lead to significant policy implications in the sense that the findings do not indicate that any special Federal action is required by the outlook for carload service. The question of what, if anything, the government should do would certainly arise if we found the railroads were likely to withdraw from, or severely curtail, carload service.

If railroads did give up carload service, it would be a gradual process, one of not replacing or refurbishing assets as they reached the ends of their useful lives. And total abandonment of carload traffic would not occur under any foreseeable circumstances. It would make no sense, for one thing, for the railroads to give up chemical traffic. We should note, though, that a major reduction in rail carload movement could have significant implications for highway capacity.

One way to look at this is in terms of additional truck-miles. Our data from the AAR Analysis of Class I railroads show approximately 690 million carload tons in 2000, of which about 160 million tons are chemicals. Take out the chemicals, and this leaves 530 million tons. Average rail length of haul in 2000 was 843 miles; that is too long for our purposes, because it reflects the heavy volume of intermodal traffic from the Pacific Coast to the Mid-west and the coal movements out of the Powder River Basin. If we go back to 1978 when these influences were less strong, we find a length of haul of 617 miles. On this basis, we use an approximate length of haul for carload service of 600 miles. Multiplying by 600 turns 530 million tons into 318 billion ton-miles. If we divide by 15 (a good rough estimate of the average inter-city truckload[20]), we obtain 21 billion truck miles.

In 2000, total intercity truck miles were approximately 73 billion.[21] Adding 21 billion additional truck-miles on top of this would have a noticeable effect in a number of corridors. Almost certainly, however, most of these 21 billion additional truck-miles would not appear on highways. Most of this traffic would shift to intermodal service; some might be handled with transloaders. Regardless, the traffic shifted to trucks would be at the ends of trips where highways are most likely to be congested. We can get some notion of what this impact would be by expressing it in terms of truck trips. We convert carload tonnage to truck trips by dividing 530 million by 15, obtaining approximately 35 million new truck trips at each end of what were all-rail trips. A major withdrawal of railroads from carload service would raise questions about whether the government should act and how.

We also need to take note of the impact on short lines and regional railroads in the event of a major withdrawal from carload service by the large railroads. Most of these firms would be forced out of business. One could argue that that is the Darwinian nature of the marketplace in action, the source of the strength of a free economy. Others, however, might argue that the demise of several hundred companies would merit at least some consideration by Federal policy makers as to whether some action would be desirable.

Our basic finding, however, is that due to scheduled operation and other improvements in efficiency, carload service will continue with relatively slow growth in tonnage but as a

[20] Transportation Technical Services, *Blue Book of Trucking Companies 2001-2002*, pp. S-1, S-3, S-4.
[21] *Railroad Facts 2002*. The number for intercity ton-miles was converted to truck-miles by dividing by 15.

profitable operation for the railroads. This will not have a significant effect on the mode split between rails and highway; but neither will the railroads dump huge volumes of freight traffic on to the highway network. And short lines should continue to grow.

Appendix A
Cars in Carload Service 20004

These are the figures that were used to allocate car investment to carload service.

	All owners	All RRs	Class I	Private
Equipped box	132,582	129,653	89,430	2,929
Unequipped box	23,209	9,469	360	13,740
Flat	30,531	28,531	20,389	2,000
Gondola	210,004	134,576	114,609	75,428
Refrigerator	26,848	24,654	20,654	2,194
Tank	247,600	863	828	246,737
Total	670,774	327,746	246,270	343,028

Sources: *Railroad Facts 2001*
AAR Analysis of Class I Railroads
ICF Consulting/ZetaTech adjustment of flatcar numbers.

Appendix B
Persons Interviewed for Study

Alfred, Ray
Washington State DOT

Anderson, Stephen
Washington State DOT

Ahuja, Ravindra K.
University of Florida

Beaulieu, Peter
Puget Sound Regional Council
Freight Mobility/Corridor Strategies

Bell, John
New York State DOT

Bell, W. P.
Canadian Pacific Railway

Bobb, Stephen
BNSF

Bredenberg, Rollin
BNSF

Byers, Wayne
Byers Transportation Consulting

Case, Rod
Canadian Pacific Railway

Daly, Pat J.
CSX

Davis, Llew
Multimodal Applied Systems

Ditmeyer, Steven
National Defense University

Erickson Jr., Thomas
Rail Cents Enterprises

Farra, Gabe
CSX

Flagello, John
TTX Company

Foy, Kevin
Multimodal Applied Systems

Glaser, Ted
Owens Corning

Gray, John
Union Pacific Railroad

Harrison, Rob
Center for Transportation Research
University of Texas

Hoback, Thomas
Indiana Railroad

Hummer, John
New Jersey Transportation Planning Authority

Hunt, David
Cambridge Systematics

Ireland, Phil
Canadian Pacific Railway

Kornhauser, Alain
ALK Associates Inc. and Princeton University Engineering School

Kuehn, Jason
Multimodal Applied Systems

Lambert, Bruce
Federal Highway Administration

Margl, Rick
BNSF

Marlino, Philip
Conoco Phillips
Chairman, NITLeague Rail Committee

Marshall, Charles
Genesee & Wyoming

Mazur, Daniel
Norfolk Southern

Medina, Mario
Texas State DOT

McCarren, Reilly
Arkansas & Missouri Railway

McClellan, James
Formerly with Norfolk Southern

Onimus, Frank
CSX

Pursley, Frank
Formerly with CSX

Ratcliffe, Lawrence
CSX

Rawling, Gerald
Chicago Area Transportation Study

Sammon, John
Formerly with Conrail

Smith, Michael
Wilbur Smith

Staniford, Mac
BNSF

John Titterton
Novolog
Formerly with Conrail

Van Dyke, Carl
Multimodal Applied Systems

Watts, Douglas
BNSF