SHORT HAUL RAIL INTERMODAL: CAN IT COMPETE WITH TRUCK?

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TRANSPORTATION RESEARCH BOARD 2004 ABSTRACT

Intermodal traffic (truck trailers or ocean containers handled on special rail equipment) is the fastest-growing segment of rail traffic. Between 1990 and 2000, rail intermodal grew at an annual rate of 4.6% -- much faster than rail carload freight, which grew at an annual rate of only 1.4%. However, during the same period, truck tonnage grew at an annual rate of 6.9%, and air cargo at a rate of 17.9%. So rail intermodal is growing, and in 2004 is expected to overtake coal as the single largest source of revenue for freight railroads. But railroad intermodal tonnage is not growing as fast as truck traffic, and market share is consequently falling. This is a problem, since with total freight traffic projected to grow 57% by 2020, all the increased traffic will have to be accommodated on the highway network.

The introduction of double stack rail cars in the 1980s dramatically reduced rail haul costs, and made intermodal traffic competitive at distances of 500 miles or so, while previously rail could only compete with truck at distances of about 750 miles or more. Still, most rail intermodal traffic remains long haul. Three quarters of all truck tonnage moves distances of less than 500 miles, and rail does not compete in this market.

Rail haul costs are developed for a number of short corridors, and it is demonstrated that, while double-stack has lowered line haul costs, terminal and drayage costs remain high. If these costs can be reduced, rail intermodal can be competitive even in short-distance corridors.

This paper proposes a number of ways in which these costs might be lowered, both by industry initiatives and by public investment. The paper concludes that, without some action by the public sector, short haul rail intermodal will continue to be non-competitive, and highway truck traffic will continue to grow.

COMMENTARY on this paper offered independently after a review by Dr. Edward K. Morlok, UPS Foundation Professor of Transportation, University of Pennsylvania

“In this paper Messrs. Resor and Blaze provide a valuable addition to the literature on intermodal containerized rail-truck transportation. It highlights important features of the costs of intermodal service and thereby identifies challenges to improving the intermodal system.” For Professor Morlock’s full comments see the end of the paper.
INTRODUCTION

Intermodal traffic (truck trailers or ocean containers handled on special rail equipment) is the fastest-growing segment of rail traffic. Between 1990 and 2000, rail intermodal grew at an annual rate of 4.6% — much faster than rail carload freight, which grew at an annual rate of only 1.4%. However, during the same period, truck tonnage grew at an annual rate of 6.9%, and air cargo at a rate of 17.9% (1). So rail intermodal is growing, and in 2004 is expected to overtake coal as the single largest source of revenue for freight railroads (2). But the reality is that railroads are continuing to lose market share to trucks.

Railroads are failing to keep up in part because the intermodal markets in which they have been so successful are mature. Because of high terminal costs, rail intermodal has been most competitive on the longest hauls. A decade ago, before double-stack rail equipment became common, the received wisdom in the railroad industry was that rail could compete only for hauls of more than 700 or 800 miles. Double stack technology changed that, reducing direct movement costs by about 50% and making rail competitive at distances of 500 miles or more (1,3).

This change in technology has been the source of the growth in rail intermodal, since by 1992 rail had reached its maximum penetration in many long haul markets. A study by KPMG in that year found that rail intermodal accounted for 80% of the eastbound container/trailer traffic from California (3). Clearly, there was not much room for growth in that market, even a decade ago.

Where has rail intermodal traffic growth occurred? Figure 1 is a map of rail intermodal flows, in terms of numbers of TEU (twenty-foot equivalent units, a standard measure of intermodal volumes), over the rail system in 1999. As can be easily seen in Figure 1, by far the heaviest rail intermodal volume is between Los Angeles, the Midwest, and the East. Much of this is “land bridge” traffic, containers from the Far East moving by ship to the Ports of Long Beach and Los Angeles, then east by rail. The second and third largest flows are from Oakland, CA and Seattle and Tacoma, WA east to Chicago and beyond. These, too, are land bridge movements. The reasons for the success of land bridge will be discussed in a later section of this paper. The point here is that despite the cost reductions made possible by double stack technology, the rail intermodal market is primarily a long distance market.

Figure 1: Rail Intermodal Flows (Source: FHWA)

To continue to grow, rail intermodal must be able to penetrate shorter-haul markets. Only one successful short-haul intermodal market appears on Figure 1, however: the heavy line connecting Jacksonville, FL

2
with Miami. Here, regional railroad Florida East Coast has partnered successfully with trucking companies to become competitive in a 400-mile lane. In fact, FEC is so competitive that some trucking companies use FEC from Miami to Jacksonville, then continue to the Northeast United States via highway. So intermodal clearly can compete for the short haul, if the conditions are right.

More important are the constraints on the competitiveness of rail intermodal. There have been few other corridors similar to the FEC one. What constrains intermodal growth? Is it the cost of the rail haul itself, a lack of rail capacity, or the cost of terminals and drayage? The remainder of this paper will address these issues.

THE DOUBLE STACK REVOLUTION

In 1977, the Southern Pacific Railroad and American Car & Foundry constructed the first true “double stack” car. It was a single unit car and was capable of handling two 40’ containers. It has been preserved at the California State Railroad Museum in Sacramento.

This prototype was followed by a three-unit articulated car in 1979, and in the early 1980s the SP and shipping lines began ordering the now standard five-unit cars (five articulated “well” flat cars, sharing a total of six trucks). By use of the wells, two containers could be stacked one on top of the other. Thus, within a total length of about 265 feet, the car could carry 10 40-foot containers. On conventional 89-foot flat cars, each of which can carry two containers, a total length of more than 450 feet would have been required. In addition, even though the prototype SP car used tall bulkheads to secure the containers in the top positions, the “tare weight” (empty car weight) per container was much less than for conventional rail equipment. It was a genuine technical advance.4

Further development over the ensuing decade produced the “IBC” car. Rather than heavy end-of-car bulkheads, this car used “inter-box connectors” (IBCs) to secure the top containers. IBCs are standard equipment on container ships. They are flat pads with “bayonets” sticking out of both sides. These are spring-loaded to lock into the corner castings on containers, and they hold the container stacks together on the ship. They serve equally well on double-stack cars.

Figure 2 shows a train of IBC double stack cars. Cars of three manufacturers are visible in the photo; note that all are five-unit articulated cars (five platforms sharing six trucks), and all use IBCs to secure the containers.
Obviously, double stack cars require more overhead clearance than conventional rail equipment, usually a clearance of 22 feet above top of rail (ATOR). The American Railway Engineering and Maintenance Association (AREMA) now recommends 23 feet of overhead clearance for double stacks. Railroads have spent significant sums clearing major routes for these cars. This has involved lowering track, raising bridges, and cutting notches in the curved crowns of tunnels to increase clearance. Some of this work has been funded by states and port authorities, since these organizations perceive a competitive advantage in lowering rail costs.

How much did double-stack lower rail costs? The direct cost of movement fell by 40 to 50% (3). A confidential study for Burlington Northern Railroad by ZETA-TECH Associates in 1990 came up with a savings of 45% on the route from Seattle to Chicago, a number confirmed by the 1992 KPMG study. That savings was also confirmed in a Conrail study during the early nineties. The sources of these savings generally included:

- Greatly improved net to tare ratio (a single IBC double stack well weighs only 17 tons, versus 35 tons for a conventional flatcar carrying the same two containers)
- More containers per foot of train length (avoiding the need to lengthen sidings as this traffic grew)
- Reduced terminal size (terminal tracks can be shorter since more containers per foot of train can be loaded)

The single disadvantage of these cars was that they could move only containers, not trailers. At first, this limited their market to ocean containers owned by the liner shipping industry, moving in “landbridge” (coast to coast) or “mini-bridge” (port to inland destination) service. But the advantages of the cars were so compelling that railroads soon began purchasing containers specially designed for domestic service. These domestic containers were lighter than ocean containers, since they were not designed to be stacked six high (as they often are on ships), and had a higher cubic capacity. In 1990, Burlington Northern Railroad purchased its first order of domestic containers: 25,000. In 2003, the Intermodal Association of North America reported that 25% of total container movements by rail involved domestic containers. This occurred despite the need to manage (and find space for) fleets of chassis needed to allow the boxes to be moved over the road to and from customers.

The scope of the revolution brought about by double stack can be seen in Figure 3, which shows the trend...
from 1990 to 2002 (5, 6). Note that by 2001 the number of domestic containers alone exceeded the number of truck trailers handled by railroads. Railroads have essentially ceased investing in trailers for “piggyback” service and instead are buying domestic containers for double stack movement. Probably the largest remaining user of railroad piggyback service is United Parcel Service. UPS remains the largest single railroad customer.

The dramatic reduction in cost achieved by double stack technology also reduced the distance at which rail intermodal becomes competitive with truck. For traditional trailer on flat car (TOFC) service, the minimum truck-competitive haul was thought to be around 750 miles. Recent evidence, including the costs presented in the next section of this paper, suggest that rail can now be competitive at distances of 500 miles or possibly even less.

The next section of this paper will develop rail line haul costs for container movements from the Port of New York and New Jersey to various nearby destinations.

**DETERMINING RAIL INTERMODAL COSTS**

In 2000, the Port of New York and New Jersey undertook to determine how the non-highway movement of containers to and from the ExpressRail intermodal terminal in Elizabeth, NJ might be increased. The Port Authority intended to develop the Port Intermodal Distribution Network (PIDN), which would include various non-highway modes:

- Rail intermodal
- Container barge
- Short-sea container transport

ZETA-TECH Associates, Inc. was asked to develop costs for container movement by rail from ExpressRail to a total of ten “centroids” (regional markets but not specific cities) of high traffic flow to and from the Port of New York and New Jersey. These inland points were:

<table>
<thead>
<tr>
<th>Destination</th>
<th>Distance in Miles (Short Route)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albany/Mechanicville</td>
<td>150</td>
</tr>
<tr>
<td>Camden/Pennsauken, NJ</td>
<td>100</td>
</tr>
<tr>
<td>Syracuse</td>
<td>284</td>
</tr>
<tr>
<td>Rochester</td>
<td>362</td>
</tr>
<tr>
<td>Buffalo</td>
<td>437</td>
</tr>
<tr>
<td>Hagerstown</td>
<td>210</td>
</tr>
<tr>
<td>Pittsburgh</td>
<td>427</td>
</tr>
<tr>
<td>Hanover, PA</td>
<td>180</td>
</tr>
<tr>
<td>Framingham, MA</td>
<td>309</td>
</tr>
<tr>
<td>Springfield, MA</td>
<td>242</td>
</tr>
</tbody>
</table>

For each of these, a routing was determined using trackage of both Norfolk Southern Corporation and CSX Transportation, the two large competitive railroads in the northeast U.S (the Port Authority preferred competitive routings wherever feasible). For routings to Springfield and Framingham, NS traffic was routed from Mechanicville, NY via the tracks of Guilford Rail System, a small New England carrier. The NS routing to Syracuse, NY made use of trackage of short line New York, Susquehanna and Western Railroad from Binghamton, NY to Syracuse.

For Rochester, NY and Framingham, MA, no competitive route to CSX was available. For some other locations, such as Springfield, the competitive routings via NS had excessive circuity, leading to uncompetitive costs.

With the exception of Pittsburgh and Buffalo, distances between ExpressRail and the selected centroids are less than the minimum usually considered rail-competitive.
Cost and Operational Assumptions

Operating Costs

ZETA-TECH developed costs for movement over each route between each centroid and ExpressRail by use of standard railroad industry cost factors, outputs of Zeta-Tech costing and simulation models, and other sources. Feasible routes were selected through use of employee timetables, track charts, and Zeta-Tech knowledge of rail operations in the northeastern U.S. No route analyzed in this report involved interchange between competitors CSXT and NS (this is what ruled out Framingham as a destination for NS – it cannot be reached except over CSXT trackage).

The number of crews required for a one-way move was estimated based on knowledge of crew districts and an assumption that a change of railroad (e.g. from NS to CP) requires an additional crew.

All movements used five-unit articulated stack cars, of the IBC (inter-box connector) type. Where clearances existed for double-stacking of containers, costs were based on a total of eighty platforms (sixteen five-unit cars) per train, fully loaded (320 TEU). Where double stack clearances did not exist, trains were “filleted” to half the fully loaded capacity (160 TEU).

The following is a summary table of values used in the analysis:

<table>
<thead>
<tr>
<th>Cost Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locomotive ownership</td>
<td>$200 per day, typical for a high-horsepower loco, 2003</td>
</tr>
<tr>
<td>Locomotive maintenance</td>
<td>$1.25 per mile (typical Class I average)</td>
</tr>
<tr>
<td>Car ownership</td>
<td>$2.09 per hour, standard rental rate for DTTX type stack cars</td>
</tr>
<tr>
<td>Car maintenance</td>
<td>$0.07 per mile, cost from TTX Corp. records</td>
</tr>
<tr>
<td>Crew cost</td>
<td>$450 per shift (average wage plus fringe, current Class I labor contracts)</td>
</tr>
<tr>
<td>Fuel cost</td>
<td>$0.0013 per gross ton mile, based on 2003 prices and typical consumption figures for intermodal trains</td>
</tr>
<tr>
<td>Track maintenance cost</td>
<td>$0.0018 per gross ton mile, based on average spending by Conrail 1995 – 1998</td>
</tr>
</tbody>
</table>

Operational Assumptions

A typical power assignment for intermodal service is 2.5 horsepower per trailing ton (HPTT) or more. For a sixteen car stack train, with all wells loaded to maximum capacity, about 12,000 HP is required. This equates to three SD60 or SD70 type locos (3,800 to 4,000 HP each), or three Dash-9 or AC44 locos (4,400 HP each). Both of these are common types of units on CSX and NS.

Train length was limited to 4,500 feet because a critical link on the network (the CSX River Line between Elizabeth and Selkirk) is single track, with some relatively short passing sidings. Other routes, such as west through Allentown to Harrisburg, are largely double track and it is possible that longer trains might be operated. To the extent that additional locomotives are not required, this may reduce cost per TEU somewhat.

To permit unrestricted double-stack operation (stacked 9’ 6” boxes in a well car), a clearance of 20 feet 6 inches above top of rail (ATOR) is required. While several of the routes studied had sufficient clearance for tri-level auto racks (19’ 6”), and this would permit stacking of 8’ or 8’ 6” containers, there was insufficient information available to determine how many containers moving to each destination were “high cube” and how many were standard. Without this detail, a “worst case” assumption of single-stack operation was made.
The following routes have unrestricted double stack clearance, and train capacity was set at 320 TEU for this analysis:

- Port Newark – Albany/Mechanicville
- Port Newark – Syracuse
- Port Newark – Rochester
- Port Newark – Buffalo
- Port Newark – Hagerstown
- Port Newark – Pittsburgh

The following routes do not have unrestricted stack train clearance; however, capacity was set at 320 TEU since “hi-cube” boxes are still relatively uncommon:

- Port Newark – Springfield, MA
- Port Newark – Framingham
- Port Newark – Camden/Pavonia

Specific clearance impediments were as follows (there may be other, more minor, clearance impediments):

1. On the NS/CP/Guilford route to New England: Hoosac Tunnel, Adams, MA, 19’ 3”
2. On the CSX route to New England: State Line Tunnel, NY/MA, 19’ 3”
3. On the route to Camden, overhead catenary on Amtrak limits height to 18 feet

Costs per TEU

Costs per twenty-foot equivalent (TEU) and forty-foot equivalent (FEU) were calculated for movements in each direction: export (outbound) and import (inbound), with the number of annual train trips sized to handle the larger of the flows of loaded containers. Thus the higher cost per loaded box on each line of the table reflects the movement of fewer loaded and more empty containers in the lighter-volume direction. The closer to balanced the flows are, the less the differential between costs. A reasonable adjustment would be to simply take the arithmetic mean of the two costs as an average.

While the capacity of the stack trains is listed as 320 TEU, the trains cannot in fact handle 320 20-foot boxes. Most stack cars can handle two 20-foot containers in the lower position in any well (some older cars are limited to only the two end wells in each five-unit articulated set). In no case can a container of less than 40 feet be handled in the top position. Therefore the actual maximum capacity of an 80-platform train is 160 twenty-foot containers plus 80 40-foot (or longer) containers. In practice, 20-foot containers comprise much less than 50% of the boxes moved through ports, so this restriction is not a practical problem.

In each case, costs assume operation of a dedicated train. Again, using forecast volumes this assumption may be relaxed in subsequent analysis for certain lower-volume moves, which might result in some cost reduction.

All costs assume a 12-hour dwell for the rail equipment at each end of the movement. Drayage and lift costs are not included in the totals. A 10% management fee has been added to total costs. Running time for each consist is based on an average speed of 20 MPH over the length of the route. Running times are rounded up to the next full day.
**Unit Cost Inputs**

<table>
<thead>
<tr>
<th>1. Stack Car</th>
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<tbody>
<tr>
<td>Stack car length</td>
</tr>
<tr>
<td>Capacity</td>
</tr>
<tr>
<td>Lease cost</td>
</tr>
<tr>
<td>Maint. Cost</td>
</tr>
<tr>
<td>Tare weight</td>
</tr>
<tr>
<td>Max gross wt.</td>
</tr>
</tbody>
</table>

Note 1: Length, weight, and capacity from TTX Corp.
Note 2: Car ownership and maintenance are TTX Corp. lease rates

<table>
<thead>
<tr>
<th>2. Locomotive, Crew, Fuel, and Track Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
</tr>
<tr>
<td>Power/weight</td>
</tr>
<tr>
<td>Lease Cost</td>
</tr>
<tr>
<td>Maintenance cost</td>
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<tr>
<td>Fuel</td>
</tr>
<tr>
<td>Crew</td>
</tr>
<tr>
<td>Track</td>
</tr>
</tbody>
</table>

Note 3: Length from EMD drawings
Note 4: This is a typical power assignment for intermodal trains
Note 5: Locomotive ownership cost is based on a typical lease rate. Loco maintenance is a typical Class I value.
Note 6: Fuel at $1 per gallon; consumption based on computer simulation of stack train operations.
Note 7: Crew cost reflects current wage and fringe rates for a two-person crew
Note 8: Track cost based on typical trackage rights fee of $0.30 per car mile that railroads pay to each other. This includes overhead and administration, and apportionment of other fixed costs

**Train Length/Weight**

<table>
<thead>
<tr>
<th>3. Train Length/Weight Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum length 4500 feet</td>
</tr>
<tr>
<td>4500/273 = 16.48; thus max. length is 16 cars</td>
</tr>
<tr>
<td>Max. trailing tonnage: 6200 tons, 100% loaded to max net per well</td>
</tr>
<tr>
<td>@ 2.5 HP/TT, requires 15500 HP</td>
</tr>
<tr>
<td>Motive power: 4 SD60/SD70 units @ 3,800 – 4,000 HP</td>
</tr>
</tbody>
</table>
Quantifying the Costs

Using the above factors and costs, it is possible to develop a cost of movement per TEU for each of the specified routes. In the original analysis, a cost was developed for each of two competing routes. Here, for the sake of brevity, costs are provided only for the most economical route between the port and each city listed above.

Table 2: Calculated Cost of Rail Line Haul, Selected Cities

<table>
<thead>
<tr>
<th>Line Haul Cost per FEU</th>
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<tbody>
<tr>
<td>From</td>
</tr>
<tr>
<td>Portside</td>
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<tr>
<td>Portside</td>
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<tr>
<td>Portside</td>
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<td>Portside</td>
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<td>Portside</td>
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</tbody>
</table>

These costs were calculated based on the volume of containers moving between the port and each city. Costs are distance-dependent in part, but are also heavily influenced by the balance between inbound and outbound flows. Other factors, such as the high track access charges levied by Amtrak for use of the Northeast Corridor (which does not have clearance for double stack cars), influence costs as well. For example, the Portside – Camden move costs $40.03 over Norfolk Southern; using CSX trackage rights over Amtrak, the cost would be more than $200.

Figure 4 illustrates the relative share of railroad costs for a one-way haul on the 145 mile run to Albany. The total cost per train for this short haul lane example is about $4,523, which calculates to the $28.27 shown in table 2 above.
The costs in Table 2 compare very favorably with truck. Using a loaded cost of $1.41 per mile, an empty cost of $1.04 per mile (typical over the road costs, not drayage costs), and a cost per hour of dwell of $63.30, a truck round trip from Portside to Albany, with an empty return, would cost an estimated $578.50 – and this to move one 40-foot (or longer) container. That is more than 20 times the calculated rail haul cost. But that’s not the whole story; otherwise, rail traffic would be growing even faster and trucks would be losing market share.

First, the rail cost is a direct movement cost. It does not include any overheads, profit, or – most importantly – terminal and drayage charges. These are estimated below.

Second, the entire round-trip truck cost has been assigned to one movement of a 40-foot box. Given the flexible nature of the trucking industry, the over-the-road trucker will try to obtain a backhaul even if he only covers his out-of-pocket costs. So the proper number for comparison with rail is not the round-trip truck cost, but a one way cost. This happens to be $289.25 (half the cost of a round-trip road haul plus three hours of dwell time at terminals in this case).

So, the true comparison between truck and rail must include drayage charges and the cost of two lifts (moves onto and off rail cars) for the rail movement, while the truck cost includes ownership, maintenance, and operation of the truck, plus the driver’s time. Also, the proper truck comparison is with a one-way cost (or half the round trip), since it can be presumed that the trucker will find a backhaul cargo to cover his costs.

Even for the over-the-road trucker, the cost of a three-hour dwell time (added to a ten-hour round trip) is substantial. But the terminal and drayage costs (using typical industry numbers of $30 per lift and $150 per dray) overwhelm the rail portion of the intermodal haul. So there is good news and bad news about rail competitiveness. Double stack equipment has made the rail line haul very cheap. The remaining problems are with the pickup and delivery operations in mostly urbanized terminal areas.
MAKING RAIL INTERMODAL COMPETITIVE FOR SHORT HAULS

The PIDN study did confirm truck competitive rail hauls from Portside to Buffalo and Pittsburgh. These hauls are close to 500 miles, a distance at which it is agreed that rail can compete, even today. However, about three quarters of all merchandise traffic in the United States moves less than 500 miles (6), so unless the burden of drayage and terminal costs can be reduced, rail cannot compete in this market. However, any public investments that might reduce dray and terminal costs will potentially increase rail intermodal’s market share. So what can be done?

Factors Affecting Rail Costs

Rail costs can be lowered by clearing rail routes for double stack cars. This has already been discussed. However, since the rail line haul cost is such a small part of the dock-to-dock cost, opening additional double stack routes alone as a public/private investment will likely have only a minor effect on rail competitiveness. Other strategies will be required if rail is to be competitive for shorter hauls.

Drayage

Draymen are paid by the trip, rather than by the hour, and thus one way of lowering costs is to offer draymen the opportunity to make more trips during their working day. Drayage costs may be reduced, at the margin, by improving “intermodal connectors”, the roads that connect ports and rail yards to the highway network. The Federal Highway Administration has a program in place to do this (8). Technology can play a role, as well. An effective method for quickly matching available drivers with loads is another way to increase dray productivity. A number of researchers have addressed this issue, most notably Morlok and Spasovic (7). They found that a centrally managed drayage operation at one Conrail intermodal terminal could potentially decrease drayage costs by 43% to 62% -- the equivalent of reducing the $150 dray in the previous example to between $57 and $85. A look at Figure 5 will show that reducing the dray cost to $170 ($85 * 2) would render rail competitive even in the 150 mile corridor from Portside to Albany. Although much work has been done by researchers in this area, the authors are unaware of any implementation of such a scheme.

On Dock Rail

“One dock” rail is not literally on the stringers (the pier) at a port, but within the fenced port area. Longshoremen can move containers directly from ship to rail yard, greatly reducing handling costs as compared to a dray movement through public streets. Of course, any import or export move must move through a port, so on dock rail can essentially eliminate one dray charge.

Unfortunately, some port operators view their rail intermodal terminals as profit centers. This results in relatively high prices for container movement, and of course works against the competitiveness of rail. Further, the advantages of on dock rail apply only to import and export cargo, a small part of total national freight movement.

Given the concerns expressed about a lack of future highway capacity by government and private planners (1), public agencies would seem to have some incentive to reduce terminal costs to the maximum extent possible. In fact, the public benefits of fewer trucks on the highways might in fact justify public subsidies for the construction and even the operation of container terminals. “Dry ports”, such as the one in Front Royal, VA, are another of reducing congestion in already busy urban areas. The dry port is an inland location to which containers are moved by rail once off-loaded from a ship. Since containers remain in the possession of the steamship line throughout, the cost of drayage is avoided. Perhaps more important, so is gate congestion and the queuing of tractors on city streets as they wait to pick up boxes.

Terminal Locations

In recent years, there has been an unfortunate trend in rail intermodal terminal location. When railroads first entered the intermodal business, they typically located the new intermodal terminals at existing yard sites (often at the locations of freight houses no longer needed for less-than-carload freight). These sites were often in the middle of congested urban areas, and equally often had no direct access to highways.
As railroads have rationalized their facilities, many of these yards have closed and the land has been made available for redevelopment. But the alternate locations developed by the railroads, while optimal from their point of view, can result in additional truck traffic on the already-most congested highway links.

Three examples will illustrate the trend:

- Norfolk Southern’s new intermodal terminal for New York and northern New Jersey is located in Bethlehem, PA, a 65-mile dray over crowded Interstate 78 to customers in the New York region.
- Union Pacific recently constructed a terminal in Rochelle, IL, about 50 miles west of Chicago. Once again, trailers and containers must be drayed long distances to consignees.
- Norfolk Southern recently opened an Atlanta-area terminal in Austell, GA, about 20 miles west of downtown Atlanta.

To be sure, the original in-city locations chosen by railroads were often less than perfect, and the new terminals do enjoy good access to high-speed highways. And the reasons the railroads give for their location decisions -- high land prices, traffic congestion, rail network congestion – are economically valid. Add to all this the fact that many rail intermodal customers are moving out of cities.

Nevertheless, the suburbanization of rail intermodal terminals has the effect, not just of worsening truck traffic on already congested highways, but also of lengthening the time (and cost) of dray movements. This of course makes rail intermodal even less competitive. There is evidence that public sector planners have recognized the negative results of this trend. Some metropolitan planning organizations (MPOs) have attempted to work with railroads to find mutually satisfactory terminal locations. However, most of these initiatives have failed due to MPO lack of familiarity with the rail mode or a lack of interest on the part of railroads.

\[\text{Capacity}\]

Public/private partnerships that reduce terminal and dray cost will certainly bring more intermodal traffic to the railroads, but is there capacity to run this traffic on the existing network? In too many locations, the answer may be no. More specifically, the capacity may exist but not the ability to operate trains to strict schedules.

The AASHTO Freight Rail Bottom-Line Report (1) finds that a public investment of at least $2.5 billion per year for the next 20 years will be required if rail is even to maintain its current market share. An investment of less than that amount will mean that rail traffic will grow more slowly than truck traffic. All of the projected growth in freight traffic over the next 20 years would consequently have to be accommodated on the highway network.

However, with a public investment of about $4 billion in railroads, rail market share will actually grow slightly. AASHTO finds this investment is easily justified by the public policy benefits of reduced investment in the highway network, a reduction in accidents and congestion, and an improvement in the environment.

\[\text{CONCLUSIONS}\]

Rail intermodal has proved it can compete with trucks. The double stack revolution has produced tremendous growth, and it appears that intermodal will supplant coal as the railroad industry’s largest producer of revenue as early as 2004.

However, as spectacular as the growth has been, rail intermodal has grown more slowly than truck traffic. Of equal concern, rail is thought to be competitive only in corridors of 500 miles or longer, and three
quarters of the truck traffic in America moves shorter distances than that. The railroads do not even compete for this business in most corridors.

The result is that the railroad industry grosses about $35 billion per year, while the estimated size of the trucking industry is $400 billion. Railroads are capital-constrained, and as the AASHTO report notes, cannot themselves invest enough in the rail network to maintain their current traffic share. This means that, absent government action, the entire 57% increase in domestic freight tonnage projected to occur by 2020 will have to be handled on the highway network.

There is a clear role for public/private partnerships to reduce terminal costs, add rail network capacity, and bring some order to the fragmented drayage industry. Rail line haul costs are far below those of truckers; if the terminal problems can be addressed, rail can be competitive even in 150-mile markets. But this will not happen absent a change in public policy investment strategy.

REFERENCES


Written Discussion of paper 04-3140, authored by Resor R. R. and Blaze, J. R

**Short Haul Rail Intermodal : Can It Compete with Truck?**

**Presented at the TRB January 2004 Annual Meeting.**

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**DISCUSSION**

by Professor Edward K. Morlok, University of Pennsylvania

In this paper Messrs. Resor and Blaze provide a valuable addition to the literature on intermodal containerized rail-truck transportation. It highlights important features of the costs of intermodal service and thereby identifies challenges to improving the intermodal system. Below I will try to present the results of the cost analysis in a form that emphasizes these features and from that make the case for efforts to address cost problems.

Figure 1 graphs the costs developed in the paper for intermodal service via rail and over-the-road trucking, as a function of length of haul. The trucking cost is very straightforward: $189 plus $0.876/km ($1.41/mile). For the rail line haul, a regression line was fitted to the costs presented there vs the length of haul (distances from 241.5 km to 703.6 km [150 to 437 miles], the short haul of 161 km (100 miles) was omitted as a high-cost outlier). The resulting equation fit the data very well and had an R-squared value of 0.99: a negligible intercept and a distance-based cost per container of $0.122/km ($0.196/mile). To this was added the terminal cost of $30 per lift (two lifts) and two drayage movements at $150 each. Each of these costs is identified in the figure.

The drayage cost clearly dominates.

At a haul distance of 322 km (200 miles), it is 75 % of the total cost. At 805 km (500 miles), 66 %. With these input costs, it declines in percentage to 50% only at about 1970 km (1224 miles)!

And the costs for drayage used by Resor and Blaze are lower than those often cited. For example, a recent discussion in an industry newsletter of the impact of new driver hours-off-service regulations on drayage costs gave a range of $303 to $455 per dray movement as “typical” (3). These are two to three times the values used here, but the same point is made with even the lower values from the paper being discussed.

Such a result on the importance of drayage cost is not new. As Resor and Blaze point out, we at Penn (initially in cooperation with Conrail, later others) have undertaken research on the cost of drayage and, equally importantly, on ways to reduce it.
This research is covered with a blending of research and industrial perspectives in papers by John Sammon, Vice President-Intermodal at Conrail at the time of the research, and Morlok—references (1) and (2).

The means to reduce drayage costs are clear—reducing idle time and especially reducing mileage driven with empty containers (or trailers) and bob-tailing (tractor only). But getting the cooperation of the various parties involved to actually achieve results is difficult.

One reason is that usually there are many players involved for one shipment: the railroad, the terminal operator, the drayage company, the shipper, and often an intermodal retailer.

Another is that the scheduling of pick up and delivery at various shippers or consignee locations will have to be coordinated—much like what is now commonplace in the over-the-road trucking industry.

Yet another is that to achieve economies the business of two or more drayage firms and/or retailers may have to be coordinated. Alternatively, any one drayage operation would most likely have to pick and choose the loads to haul based on each load fitting into its overall operation—a possible but probably difficult arrangement given industry structure.

In principle, this should be a “win-win” situation, for the railroads, drayage firms, shippers, and others. Reducing costs would leave more money on the table for all—to the benefit of everyone’s ROI—and would also reduce the breakeven distance so that intermodal could compete with trucking where the bulk of trucking business and revenue lies.

What does this mean? Getting to “go” is difficult but the potential for gain is great. This situation is a natural for demonstration projects, perhaps with participation from a third party—government or other entity that will benefit from better intermodal service.

The list of beneficiaries is long, as Resor and Blaze indicate, and both the public interest and the private interest (of the players) should be well served by making intermodal more competitive with trucking. It is time for action by forward-looking firms in the industry.

REFERENCES

