Economics and Planning of Short-Haul and Short-Line Railway Intermodal Service

Lessons from Previous and Current Operations

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To develop a more competitive and efficient transportation system, railroads have engaged in intermodal freight transportation of both containers and trailers. Though intermodal rail operations have increased dramatically since the 1950s, traffic trends have also evolved with shipper demands, improved rail infrastructure, and enhanced operational strategy. Many former main railroad lines are now operated by short-line and regional carriers. Industrial centers that were once home to intermodal terminals, both large and small, have lost their intermodal connectivity since short-line and regional railroads typically do not handle intermodal traffic. With local terminals lost, shippers have been forced to increase drayage distances to centralized Class I railroad intermodal terminals. With the economies of scale afforded by recent record levels of intermodal rail traffic, opportunities have arisen to revitalize short-haul intermodal service. In many instances, short-line and regional railroads have taken this opportunity to increase traffic and revenue on their own lines as well as increase traffic on existing intermodal lanes and bring relief to over-capacity centralized intermodal terminals. In most instances, Class I railroads remain involved through operations and marketing of the short-haul service as part of their larger national network. This report summarizes ongoing research that, through examination of current and discontinued short-haul intermodal operations and communication with rail carriers of all sizes, identifies how the strengths of short-line and regional railroads can be leveraged to improve the efficiency of the Class I railroad intermodal network.

Intermodal traffic on Class I railroads in the United States has increased steadily since 2009 and set a record of 13.7 million containers and trailers in 2015 (*1*). To satisfy this primarily long-haul demand, railroads have made capital investments to improve existing intermodal terminals, add new terminals, increase capacity, and increase clearances on routes (*2*). Further expansion of intermodal traffic will require innovative approaches for railroads to become more competitive with trucks for short and medium hauls (*3*). In these markets, short-line and regional railroads have partnered with shippers for intermodal container and trailer service with varying levels of success (*4*). This report summarizes ongoing research that, through examination of current and discontinued short-haul intermodal operations and communication with rail carriers of all sizes, identifies how the strengths of short-line and regional railroads can be leveraged to improve the overall Class I railroad intermodal network.

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SHORT-HAUL INTERMODAL

The term "short-haul intermodal" refers to intermodal trailer or container moves between terminals at a distance of less than 500 mi (*5*). This definition works well for single-line service. However, for service with interchange or handling at intermediate terminals, the term can be interpreted differently. For these movements, the overall transit distance could be well over 500 mi but consist of two or more train runs with at least one run covering a shorter route of less than 500 mi.

For the purpose of this report, short-haul intermodal is defined as a rail operation that optimizes the transportation of containers and trailers by reducing truck drayage and allowing for en route efficiency by establishing strategically planned shorter routes that may or may not connect with other intermodal lanes. Through use of these shorter routes that inject into or lie within the network with smaller intermediate terminals, additional traffic may be generated in both long-haul and short-haul markets.

Short-Haul Intermodal Network Topology

Short- and long-haul intermodal rail are two components of the operationally diverse intermodal transportation network (Figure 1). Although separate operational categories, short- and long-haul intermodal contribute to each other's success and lead to an efficient transportation system. The role of short-haul intermodal in four types of intermodal networks is described in the following subsections.

Hub-and-Spoke Network

A hub-and-spoke operation allows satellite terminals to be linked to one or more centrally located hub terminals by short-haul routes (Figure 2*a*). Truck drayage is still involved between the satellite terminals and local industries, but the over-the-road drayage is significantly reduced by shorter-distance rail lanes that serve as feeder routes for the hub. If the satellite terminals and feeder routes are cost competitive with longer truck drayage to the hub, the short-haul operation can help attract traffic that is more difficult to market or that otherwise may follow an all-truck route.

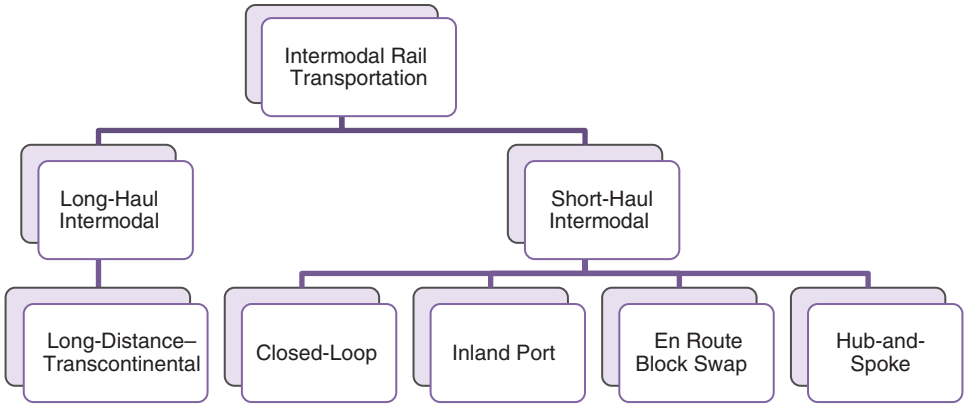

FIGURE 1 Taxonomy of intermodal rail transportation.

En Route Block Swap

En route block swaps involve the set-out and pickup of blocks of intermodal equipment at terminals or interchanges along a longer route (Figure 2*b*). Other short-haul trains then take a block of equipment from the terminal or interchange to a satellite terminal. This model presents an opportunity for short-line and regional railroads that serve industrial centers but do not interchange with a Class I railroad at a centralized intermodal terminal. The smaller satellite terminals allow for additional volume gains by making intermodal terminals more accessible and can lower costs to shippers by reducing drayage. A drawback of this model is a reduction in average train velocity because of additional en route switching.

Inland Port Service

Inland port short-haul intermodal service acts as a rail drayage operation carrying containers from an inland terminal to a seaport for loading onto oceangoing vessels. These services may be part of the national intermodal rail network or isolated routes. This model has been of interest for many east coast and west coast short-line and regional railroads.

Closed-Loop Operations

There may be opportunities for railroads to operate intermodal service for one or more shippers over a single short-haul lane. In a typical situation, two facilities involved in subsequent steps of a production process require routine shipments between them. The facilities are located apart from each other and lack direct rail service but are both relatively close to intermodal terminals (or potential sites for terminals). A short-line or regional railroad could develop these terminals and establish a dedicated short-haul intermodal service between them for the shipper.

Historical Changes in Intermodal Service

Transition from Short-Haul to Long-Haul Intermodal

The streamlined, long-haul operations that are characteristic of modern intermodal rail service have evolved considerably from the earlier era of intermodal rail operations. Originally, to give customers convenient access to the intermodal network, closely spaced, lower-capacity terminals were established and hauls were short. However, growing business at many small terminals did not yield the efficiencies the railroads desired. As long-haul intermodal traffic from larger industrial centers grew, the capital requirements of smaller terminals were seen as a hindrance. Smaller terminals were closed, the remaining primary terminals became more widely spaced and mechanized, and the length of intermodal hauls increased (*6*).

Revival of Short-Haul Intermodal

With existing long-haul intermodal traffic secured, further expansion into short- and medium-haul traffic has been prevalent on eastern carriers (CSX and Norfolk Southern) (*7*). Railroads have increased capacity and decreased transit times on lanes that fall into this short to medium range dominated by trucking. New regulations within the trucking industry, such as maximum driver hours of service, truck size, and weight restrictions, have helped railroads become competitive in these markets (*8*). Both CSX and Norfolk Southern list many short-haul origin–destination pairs in their public intermodal service schedules, available online.

Short-haul intermodal has been promoted by short-line and regional railroads along with states and local municipalities as a way to increase freight on lighter-density rail lines and preserve rail access in regions with a lower density of industrial development (*9–11*). An example of these efforts is the work of the Wisconsin Central Group (WCG), an ad hoc rail freight stakeholder coalition dedicated to increasing economic opportunity and competitiveness throughout Wisconsin and the Great Lakes Forest Region. WCG uses the term "local intermodal" for its approach to reducing drayage miles and providing sustainable rail intermodal access at locations that will not, or are not ready to, sustain a traditional intermodal terminal (*12*). For local intermodal to be successful, WCG found that inbound and outbound traffic flows must be balanced; support 40 to 50 loaded lifts per day, 5 days a week; and have sufficiently short drayage distance that a truck driver can make four to eight loaded trips per shift. WCG found that the approach is most successful when a large anchor customer becomes involved and close communication is maintained with the connecting Class I railroad for efficient connections to manifest and intermodal trains.

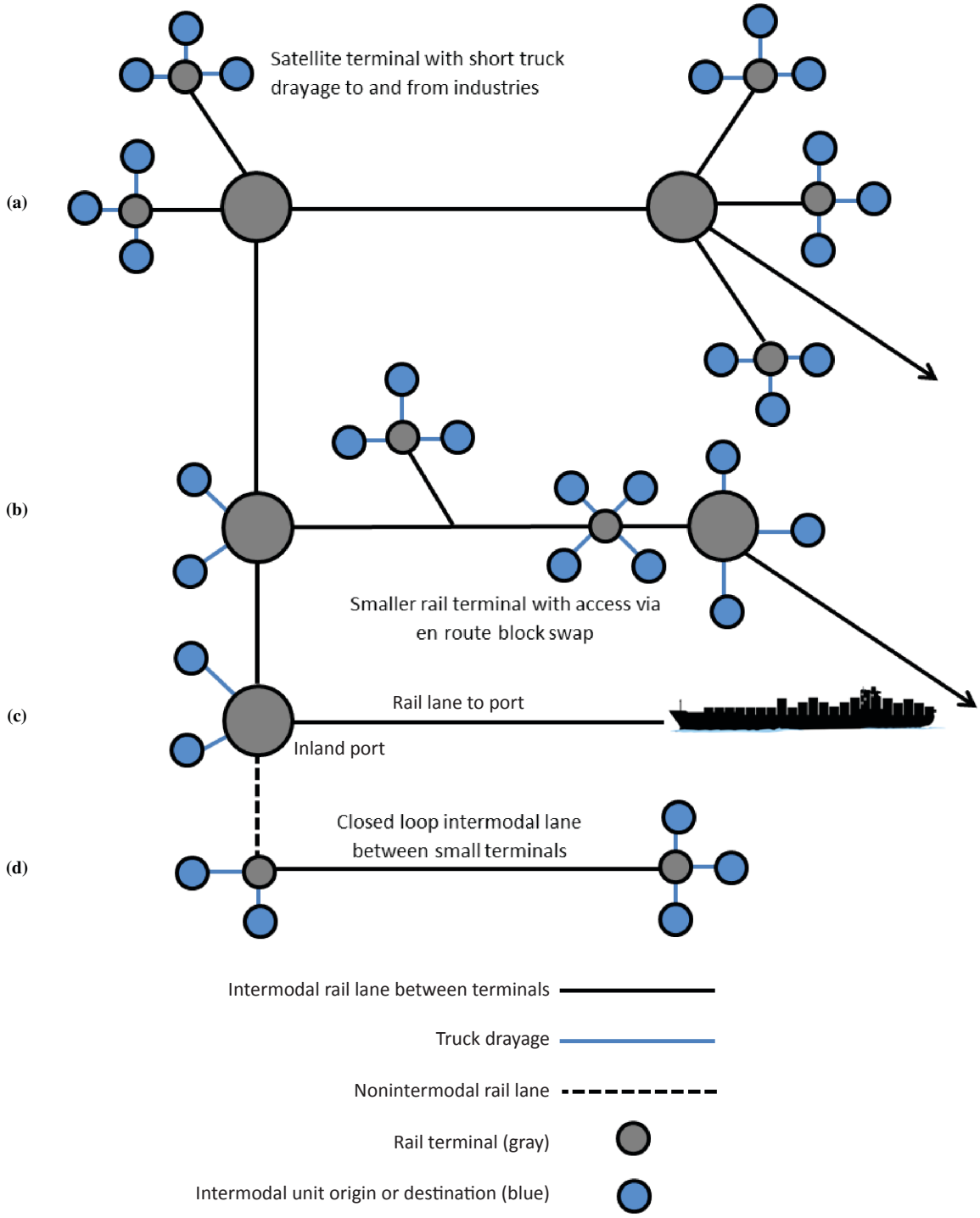

FIGURE 2 Comparison of intermodal network topologies for (*a*) hub-and-spoke intermodal rail system, (*b*) en route block swap intermodal rail system, (*c*) inland port intermodal rail system, and (*d*) closed-loop intermodal.

Intermodal Traffic Metrics

Representation of traffic and revenue data is of major interest for this research, because the success of the service depends on (*a*) the competitive rate per unit that can be charged and (*b*) the annual volume of revenue units. Intermodal traffic statistics can be confused because railroads may report volumes in carloads or in units. Use of double-stack and articulated intermodal rail cars can lead to different interpretations of how many intermodal units make up a carload. For example, a single well car has a capacity ranging from a single trailer (one unit) to a 53-ft container stacked on two 20-ft units (three total units). Association of American Railroads data from 2015 reported that Class I railroads transported approximately 11 million carloads of intermodal freight comprising 13.5 million containers for an average

of 1.23 container or trailer units per carload (*1*). This statistic is used in case studies in this paper to determine revenue per unit.

CASE STUDIES OF SHORT-HAUL INTERMODAL SERVICES

The following sections detail past and current short-haul intermodal operations, often involving short lines (Table 1 and Figure 3). Although only a few of these services are examined in depth in this paper, the research reviewed all the identified services for lessons that can be applied in plans for future corridors.

Norfolk Southern and Pan Am Southern

Service Overview

One of the first modern short-line intermodal efforts began in 1995 as a joint venture between Guilford Rail System (GRS) [now Pan Am Railways (PAR)] and Conrail. Because GRS was a prominent carrier in a region previously devoid of intermodal rail access and because it had considerable drayage distance, GRS and Conrail developed direct intermodal rail service linking Maine to Chicago, Illinois; Kansas City and Saint Louis, Missouri; and Atlanta, Georgia. The GRS terminals were established at Waterville, Maine, and Ayer, Massachusetts. Waterville traffic was consolidated with traffic originating at the Ayer terminal and then interchanged at the Conrail terminal in Mechanicville, New York (Figure 3*c*). Traffic then moved on long-haul intermodal trains within the Conrail and Norfolk Southern network.

Coordination with Class I carriers allowed shippers access to TTX Company intermodal equipment and the national trailer and container pool. Benefits to shippers included value-added services such as a single point of contact for marketing and customer service, electronic availability of shipping orders, transit status reports, and prenotification of arrivals.

When Conrail assets were split between Norfolk Southern and CSX in 1999, Norfolk Southern remained the interchange for GRS, but the intermodal service was retracted to Ayer, and more stringent operating plans to improve equipment availability were implemented.

In 2006, GRS underwent reorganization and became PAR. In 2008, a joint venture between Norfolk Southern and PAR established Pan Am Southern (PAS) with improved rail routes between Albany, New York, and Boston, Massachusetts. Currently, PAS operates westbound intermodal service between Ayer and the Norfolk Southern 47th Street Terminal in Chicago. The eastbound operations originate at 47th Street Terminal as well, but incorporate traffic at Toledo, Ohio.

Additional short-haul intermodal development began in 2015 with containerized bottled water shipped through the newly developed Portland Intermodal Terminal in South Portland, Maine. In 2013, an Icelandic shipping company, Eimskip, began container service from Europe to the new Portland International Marine Terminal (IMT) that included 1,500 ft of port-side track operated by PAR. Executives at Poland Springs, a Maine-based bottled water producer with plants in Poland Springs, Kingfield, and Hollis (the largest bottled water facility in North America), sought to reduce transportation costs through multimodal shipments of bottled water to Massachusetts for distribution. In the established partnership, intermodal containers are leased from Eimskip for a short-haul rail service between the Portland IMT and Ayer. Regular service began in January 2016 with containers drayed 20 mi from the Hollis plant to the Portland IMT. Approximately 45 containers are loaded

TABLE 1 Short-Haul and Short-Line/Regional Railroad Intermodal Service Case Studies

	Service			
Servicing Railroad	Drayage Reduction Using Short Haul (mi)	Intermodal Service Type	Interchange Type	Status
Norfolk Southern–Pan Am Southern	Mechanicville, 150 Portland, 115 Waterville, 190	Hub-and-spoke	Steel-wheel	Active
Chippewa Falls (CN–WC)	100	Hub-and-spoke/block swap	Steel-wheel	Active
Ashley Furniture–Arcadia (CN–WC)	130	Hub-and-spoke	Steel-wheel	Active
Saint Lawrence & Atlantic–Canadian National	250	Hub-and-spoke	Steel-wheel	Inactive
Indiana Rail Road–Canadian National	180	Hub-and-spoke	Steel-wheel	Active
Chicago, Fort Wayne, and Eastern–Norfolk Southern	To be determined	Early stages of development	Early stages of development	Proposed
Indiana & Ohio Railroad	75	Hub-and-spoke	Steel-wheel	Active
Florida East Coast	Between 150 and 750	Hub-and-spoke/inland port	Steel-wheel	Active
Iowa Interstate Railroad	460	Hub-and-spoke	Rubber-tire/steel-wheel	Active
Twin Cities & Western–Canadian Pacific	140	Hub-and-spoke	Steel-wheel	Inactive
Canadian Pacific Expressway Service	360	Closed loop		Active
Wisconsin Central, Ltd.	Green Bay, 200 Neenah, 190 Stevens Point, 240	Hub-and-spoke/block swap	Steel-wheel/rubber-tire	Inactive
Vermont Rail System	460	Hub-and-spoke	Rubber-tire/closed-loop	Inactive
Heart of Georgia–Georgia Central	260	Inland port	Steel-wheel	Active
Escanaba & Lake Superior	210	Closed loop		Inactive

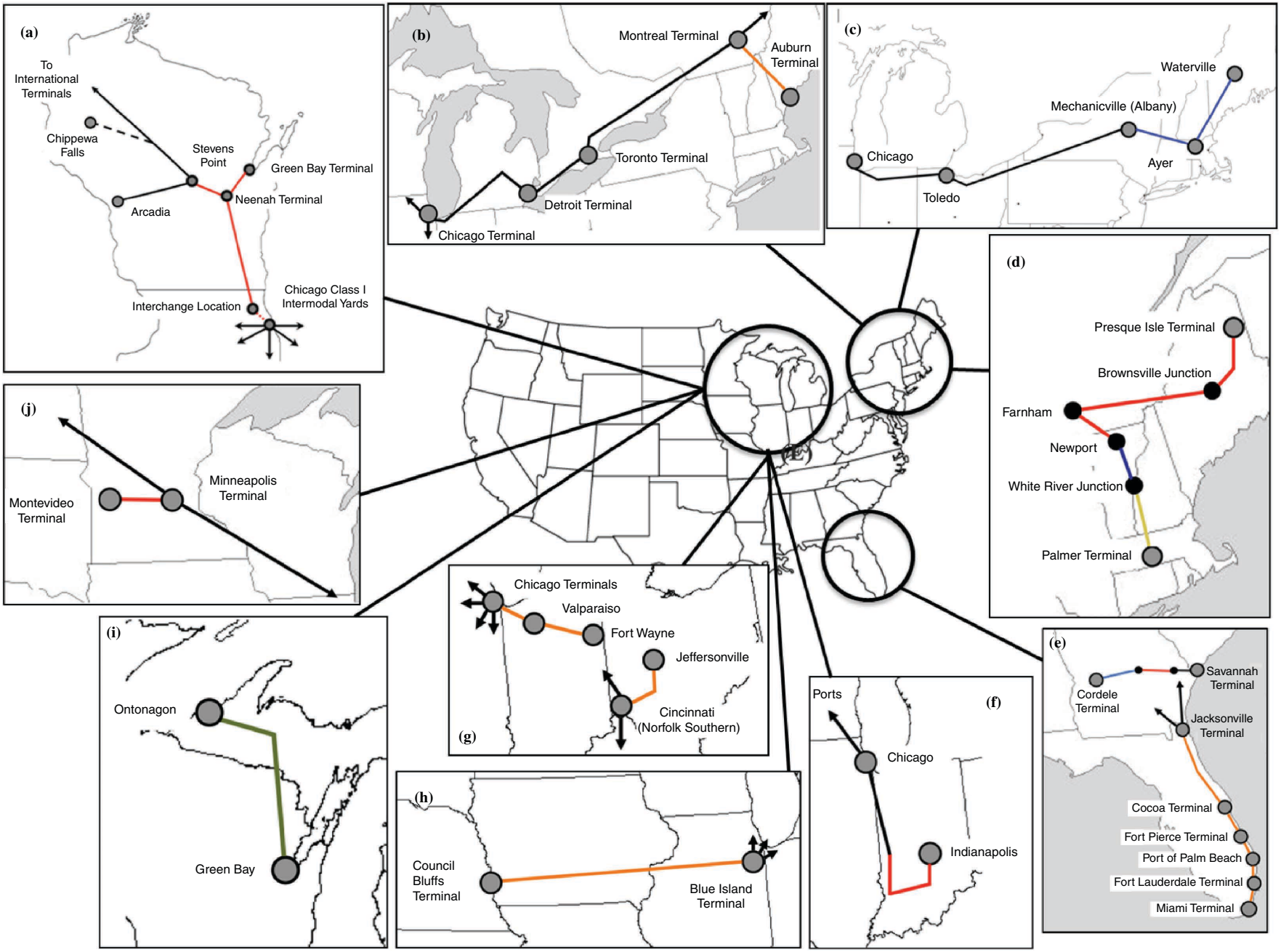

FIGURE 3 Maps of short-haul intermodal lanes, including (*a*) Wisconsin Central and its successor Canadian National; (*b*) Saint Lawrence and Atlantic Railway (SLR); (*c*) PAR and PAS; (*d*) VRS; (*e*) Florida East Coast and Heart of Georgia–Georgia Central Railroad; (*f*) Indiana Rail Road; (*g*) Indiana & Ohio and Chicago, Fort Wayne, and Eastern; (*h*) Iowa Interstate; (*i*) Escanaba & Lake Superior Railroad (ELS); and (*j*) Twin Cities & Western Railway (TCW).

in Portland three times a week (Friday through Sunday). In April 2016, the operation expanded north 75 mi to the reactivated PAR Waterville terminal, where containers are drayed 45 mi from the Kingfield plant. The Waterville–Portland intermodal shuttle train brings an additional 60 containers to Ayer.

Terminal Operation and Equipment

In the creation of PAS, the intermodal terminals at Ayer and Mechanicville were upgraded. The Ayer terminal is listed as a Norfolk Southern terminal, and the terminal is operated by PAS–PAR. The intermodal terminal at Portland was upgraded by the Maine Port Authority and served by PAR, whereas the Waterville terminal is owned and operated by PAR.

The Waterville–Portland–Ayer service is restricted to single stacking because of clearance limitations. Since PAR is a member of TTX, intermodal rail cars are available for the PAR and PAS service. Containers for the Poland Springs intermodal service are rented from Eimskip, and those for the PAS service are from other intermodal marketing companies. This partnership is vital because nearly all revenue traffic is outbound from Waterville and Portland. Containers from the Eimskip marine service allow the rail component to avoid the container repositioning costs normally associated with unbalanced traffic flows.

Business Relations, Marketing, and Profitability

In 2007, 82,476 revenue containers were shipped from Ayer. As built, the Ayer terminal had capacity for 75,000 units per year with the capability for expansion to 175,000. In September 2016, PAS received a $464,172 grant to increase annual container capacity by 29,500 units. The success and continuity of PAS intermodal has led to expansion in even shorter-haul and lower-volume services, such as Waterville–Portland–Ayer.

Canadian National and the Saint Lawrence and Atlantic Railway

Service Overview

The Saint Lawrence and Atlantic Railway (SLR) is a 260-mi short-line railroad operated by the short-line railroad holding company Genesee & Wyoming. The railroad operated between Portland, Maine, and Saint Rosalie, Quebec, Canada, connecting with Canadian National (CN) at Richmond, Quebec. In the 1990s, SLR and CN partnered to provide intermodal service to Auburn, Maine, 35 mi north of Portland and 135 mi north of Boston (Figure 3*b*). International ports served from Auburn included Vancouver and Prince Rupert in British Columbia and Halifax, Nova Scotia, along with various domestic CN terminals.

Terminal Operations and Equipment

The State of Maine partnered with SLR, the Auburn–Lewiston metropolitan area, and FHWA to build the Maine Intermodal Terminal in Auburn. The 35-acre terminal opened in 1994 at a cost of $2 million. The terminal consisted of a double-track, gravel yard facility with parking and container storage, a weighing and freight-control operations center, and a lift provided by the railroad. It was estimated that the facility needed to move between 10,000 and 12,000 containers a year to break even. In its first year of operation, the Maine Intermodal Terminal handled 6,000 containers. In 2001, it handled 15,000 containers. Additional parking capacity was added in 2001, the facility expanded to more than 50 acres, and capacity of the terminal increased to 48,000 lifts per year. Volumes subsequently declined to 4,000 to 5,000 loads per year. In 2009, the volume at Auburn was only 800 containers.

Business Relations, Marketing, and Profitability

SLR leased the intermodal terminal from the city of Auburn and operated it as a terminal in the CN intermodal network. Containers transported to and from Auburn moved on CN authority, waybills, and rates. The intermodal rail cars and containers remained in the CN equipment account. According to the 1997 annual report from then-owner and operator Emons Transportation, SLR intermodal revenue was $1.6 million for 13,000 intermodal units, or revenue per unit of approximately $123.

Despite decreases in traffic, the Auburn terminal remained viable for many years because of its double-stack container service capability, balance of inbound and outbound loads, and connection to the CN transcontinental intermodal system. The primary issues limiting traffic at this terminal were a combination of noncompetitive pricing and lack of direct service to major U.S. destinations. CN is positioned well for international traffic, but connections to CSX and Norfolk Southern would be preferred for domestic service. CN announced it would discontinue intermodal service to Auburn effective November 15, 2014, because of insufficient freight volume and strong competition from other intermodal terminals in Massachusetts, such as Ayer (Norfolk Southern–PAS) and Worcester (CSX).

CN and Indiana Rail Road Company

Eric Powell, manager of economic development at the Indiana Rail Road Company (INRD), provided input for this paper on the INRD intermodal service partnership with CN, in which INRD acts as the operator and carrier for the Indianapolis, Indiana, terminal. The term "short-haul intermodal" is somewhat misleading for the INRD service because INRD is just one 155-mi segment of a 2,600-mi haul from Prince Rupert or Vancouver to Indianapolis. INRD also moves some container traffic to and from Europe through Halifax and Montreal, Quebec, Canada, and to and from Asia and South America through Mobile, Alabama. The bulk of the traffic is imports. No INRD traffic moves the short distance to Chicago except empty containers being repositioned for export loads in Chicago.

To establish the service, the INRD marketing team met with Chicago-based CN marketing personnel in November 2011. INRD presented CN with market data, and in early 2012 the Toronto-based CN intermodal marketing team became involved. INRD made dozens of shipper and freight forwarder visits with CN personnel, and because of the potential volume and shipper support, the idea moved forward. INRD is the primary sales and marketing contact in the area and handles customer service for the intermodal operation; the CN account manager in central Indiana is focused on carload traffic.

INRD established the service as a haulage agreement from Newton, Illinois, to Indianapolis (Figure 3*f*), so that the cars stay

within CN billing and care hire all the way to Indianapolis. CN collects the billing for each container and then pays INRD per box hauled. Customers are billed only once, and CN online tracing tools are available all the way to Indianapolis. Although INRD owns and manages the operations of the Indianapolis terminal, to the customer it is just like any other terminal on the CN system.

Canadian Pacific and Twin Cities & Western Railway

The Twin Cities & Western Railway (TCW) is a short-line railroad in Minnesota that operated an intermodal container service with Canadian Pacific Railway (CP) and North Star Intermodal LLC. North Star (a firm providing containerized transportation and marketing services for grain in the upper Midwest) approached TCW, CP, and steamship lines to move containerized identity-preserved grain from Minnesota by rail. The traffic previously had been moved in bulk rail cars to ports for reloading or by truck to intermodal terminals in the Twin Cities. A short-haul service was devised to shuttle intermodal containers by rail from a terminal on TCW in Montevideo, Minnesota, to the CP Shoreham Yard in Minneapolis for interchange to connecting intermodal trains (Figure 3*j*). TCW–North Star operated seven outbound trains every 2 weeks, or about 182 trains annually. TCW–North Star's traffic mix is a nearly even split between 20-ft and 40-ft containers with an estimated 7,280 loaded containers a year or 14,560 outbound and inbound lifts.

Initially, a unique aspect of this service was the use of bimodal RailRunner equipment. The specially designed RailRunner container chassis with detachable bogies can be easily transformed from over-the-road use to a container-hauling rail car. However, manufacturing issues resulted in use of standard intermodal rail cars allocated from the TTX pool by CP. The service was discontinued for unknown reasons, but it is likely that the reliance on steamship company partnerships led to equipment pooling issues.

A 2008 Minnesota Department of Agriculture report detailed this intermodal operation and quoted rates of $10 per ton for the 130-mi short-haul rail operation (*9*). With the weight of a loaded container estimated at 14 tons, this figure is consistent with traffic statistics of the Wisconsin Central case study discussed below.

Wisconsin Central, Ltd.

Wisconsin Central, Ltd. (WC) was a regional railroad operating approximately 2,850 mi of track in the upper Midwest. Before WC began operating, the predecessor railroad (Soo Line) operated intermodal terminals at Green Bay and Neenah, Wisconsin, but they closed before the change in ownership of the railroad. Because of a lack of terminals in the region, shippers were left with a considerable dray to terminals in the Twin Cities or Chicago for intermodal shipments. The opportunity existed for a short-haul intermodal service that could be competitive with trucks while increasing volume on the railroad and enabling economic development.

While planning the intermodal service, railroad executives were aware of industries in the region that were served by railroad carload traffic but could also use an intermodal service. It was expected that other prospective customers would be attracted to the intermodal service and help it become profitable, but there was risk associated with the capital investments and operational costs.

Service Overview

For its short-haul intermodal operation, WC established terminals at Green Bay, Neenah, and Stevens Point, Wisconsin (Figure 3*a*). Dedicated intermodal trains operated 5 days a week and contained a unique mix of equipment and loading styles as dictated by customer needs. Instead of operating uniform consists of double-stacked containers or trailers on flatcars, WC trains often operated with a mix of loading configurations.

On a given operating day, a train would be dispatched for the Green Bay terminal with a block of cars spotted en route at Neenah for reloading. On arrival at Green Bay in the early morning, the inbound intermodal units would be swapped with the outbound units, and the train would depart for Neenah. At Neenah, a similar loading and unloading process had taken place with the equipment set out earlier. Also at Neenah, a shorter shuttle train would arrive from the Stevens Point terminal. Following the addition of the Neenah and Stevens Point equipment to the train that had originated in Green Bay, the train would depart for Chicago.

Like the other services noted in this paper, Class I railroad partnership was vital to this operation. Since the intermodal traffic was almost exclusively nonlocal interline movements and WC did not have a yard or terminal in the Chicago area, use of a Class I intermodal yard was essential. Although WC had direct connections to various Class I railroads in the Chicago area, the intermodal traffic was not easily decomposed for interchange since containers or trailers sharing the same rail car may be bound for different railroad connections. To alleviate this problem, WC established one primary steel-wheel interchange railroad for which most of the traffic was destined. WC would exchange equipment with the primary connecting carrier, who would then route the cut of rail cars to its own terminal and reload the containers to outgoing trains. To cover this handling cost, the connecting carrier charged WC a fee per lift. This operation was time-consuming and was often delayed, resulting in missed connections.

During the years of WC operations, the primary connecting carrier varied, beginning with BNSF and ultimately involving CSX, Conrail, and Illinois Central. Changes in the primary connecting carrier were prompted by evolving traffic flows to and from the WC network. When traffic was bound not for the connecting carrier but another railroad, the rail cars carrying the containers bound for other railroads would still be interchanged to the terminal of the primary connecting carrier. The traffic would then be lifted to trucks for rubber-tire over-the-road drayage to other railroad terminals.

Terminal Operations and Equipment

At each WC terminal, a one-person crew was responsible for all aspects of the terminal operation, including loading and unloading containers with a reach-stacker, positioning trailers and containers with the shuttle truck, processing associated paperwork, and providing local customer service. The one-person crew kept operating costs low, and capital investment was minimal. At the Green Bay and Neenah terminals, the remnants of the original Soo Line terminals were still intact. At the Stevens Point terminal, compacted gravel and treated soil was used as a staging and lifting area. The largest investment at each terminal was the reach-stackers used to load and unload intermodal equipment.

Because WC was not a member of TTX, intermodal flatcars had to be requested from the primary connecting railroad. The cooperation

between WC and the connecting railroads allowed for a reliable supply of intermodal equipment.

Business Relations, Marketing, and Profitability

Transportation by the WC short-haul intermodal service was significantly slower than by trucking. The time elapsed from loading containers at the northernmost terminals to arrival and repositioning of equipment at the Chicago terminals was typically 12 h, significantly longer than an over-the-road truck haul. However, WC management was skilled in reducing costs and offered truck-competitive rates.

WC found the Class I railroads to be receptive to accepting intermodal traffic. Although larger railroads tend to avoid operating services that have a lower profit margin and require excessive marketing or operational work, the WC intermodal service imposed little work on the Class I carriers. Any Class I efforts were compensated by fees that were absorbed by WC, resulting in lower revenue per container but allowing considerable volume. WC was the primary marketer of the intermodal service, but the primary Class I railroad connection would include the WC terminals within their own intermodal network. Rates were established like ordinary carload service through interline settlement carrier agreements or Rule 11.

WC developed relationships with the trucking firms in the region, notably Schneider National and J.B. Hunt. The trucking firms not only operated the trailers, containers, and tractor trailers but also managed the logistics for shippers. By reducing the costs of long-haul over-the-road transportation, these trucking firms took advantage of the short-haul rail drayage while profitably managing the traffic.

WC took a well-calculated risk in establishing the intermodal service, which proved successful. Although there were anticipated traffic levels at start-up, the "build it and they will come" mentality was a major component of justifying the service on the basis of traffic that had not been guaranteed. Because the service proved to be viable and reliable, more shippers migrated to the WC short-haul operation.

Data from two documents were used to examine the profitability of the short-haul intermodal service: the 1993 Wisconsin Central Transportation annual report and the 1991 Wisconsin Central Transportation prospectus (*13, 14*). Both documents were retrieved from faculty working papers through the Sam Houston State University Center for Business and Economic Development. Important statistics for carload and gross revenue comparison by commodity groups were detailed for 1991 to 1993. From 1988 to 1993, the revenue per intermodal unit gradually decreased from approximately $178 to $113 as traffic increased from 13,013 to 31,710 units per year.

When CN absorbed WC, the serviced was continued for only a brief period. Because of the marginal profitability of intermodal service, CN had little interest in developing business in this territory. Many companies and communities were affected by the discontinuance of intermodal service and the disinvestment of other marginal rail operations in the region.

Northeast Intermodal Rail Development

The Vermont Rail System (VRS) operates 350 mi of track with connections to NS, CP, and CSX along with various other short-line and regional railroads. VRS started operating intermodal trains via trailer on flatcar (TOFC) in 1965 and grew through the early 2000s with the purchase of an extensive fleet of 53-ft trailers. Together with the existing fleet of 45-ft and 48-ft trailers, the VIPZ trailers make up the largest fleet of TOFC trailers nationwide.

In addition to closed-loop TOFC operation on VRS, collaboration was developed with CSX and the Florida East Coast Railway (via CSX) to provide a shared equipment pool. Intermodal TOFC lanes were provided to off-line terminals at Chicago, Saint Louis, and Memphis, Tennessee, via CSX (*15*).

With the existence of several short-line and regional railroads in the region, a short-haul intermodal service (Figure 3*d*) was established through collaboration between VRS; the Montreal, Maine, and Atlantic (MMA; now the Central Maine and Quebec Railway); the New England Central Railroad (NECR); and the Massachusetts Central Railroad (MCER). The intermodal service comprised the following operations:

- Trailers originated on the MMA at Presque Isle, Maine; MMA subsidiary Logistics Management Services arranged drayage to the Presque Isle intermodal facility, where trailers were loaded on VRS TOFC flatcars.
- The MMA manifest train with the addition of the TOFC traffic operated from Presque Isle to Brownville Junction, Maine, where the cars were interchanged to the Brownville Junction–Montreal manifest train. En route, the TOFC equipment was interchanged again at Farnham, Quebec, to yet another MMA manifest train form Farnham to Newport, Quebec.
- The TOFC equipment was interchanged to VRS at Newport and moved in manifest service to White River Junction, Vermont.
- At White River Junction, the equipment was interchanged to NECR and transported to Palmer Yard in manifest train service.
- At Palmer Yard, a MCER switch engine transported the TOFC equipment a short distance to the MCER Palmer intermodal terminal.
- MCER unloaded the trailers and either grounded them or positioned them for truck haul.
- VRS facilitated trucking to final destinations in New York, Connecticut, or Massachusetts. Another truck route option was drayage to the Quaboag Transfer in Bondsville, Massachusetts, for product storage or product transfer for furtherance on over-the-road carriers wanting backhauls.

Beyond this service, the railroad examined interchange to CSX so that trailers could move beyond New England. Any possible container traffic would be restricted to single stack because of the lack of double-stack clearances. VRS assumed marketing of the Palmer ramp and the lane connecting to the Presque Isle terminal with the potential to add other lanes.

Both the VIPZ trailer fleet and the Presque Isle–Palmer short-haul intermodal service have been discontinued.

Escanaba & Lake Superior Railroad

The Escanaba & Lake Superior Railroad (ELS) is a short-line railroad operating in the Upper Peninsula of Michigan and northeastern Wisconsin. Smurfit-Stone is a global producer of paperboard and paper-based packaging materials. The firm had a large plant at the end of the ELS line in Ontonagon, Michigan, that received inbound coal, wood pulp, and binding chemicals and shipped outbound finished paperboard and cardboard products. The plant closed in 2009, leaving no large anchor customers on the already light density line. In September 2010, ELS was given permission to end rail service from Sidnaw, Michigan, to Ontonagon and ultimately was

given permission to abandon the northernmost 16 mi of the corridor between Ontonagon and Rockland, Michigan. The track from Rockland to Sidnaw remained part of the ELS system, primarily for rail car storage and potential low-volume traffic.

Before the closure of the mill and abandonment of the rail segment, ELS experimented with short-haul intermodal rail service for the outbound shipments of finished product, primarily corrugated paperboard, from the plant in Ontonagon to Green Bay, Wisconsin (Figure 3*i*). Several unique conditions existed that led to the development of this service. First, the destination of the finished product in Green Bay was not directly served by rail. To get the product to the warehouse, rail cars would be transloaded near Green Bay and shipments trucked the remaining distance. This carload service option was unacceptable because the short transit distance from the Ontonagon plant to Green Bay did not generate enough revenue to offset the costs of handling material during transloading. Additionally, the weather sensitivity of the product meant an enclosed transloading facility was needed. Because carload service is not considered a favorable option compared with an all-truck route, intermodal options were explored. Because there are no intermodal rail terminals near or within the Upper Peninsula of Michigan, the only option for intermodal service is through ELS. Use of the ELS route, with either carload or intermodal, to Green Bay would avoid costly interchanges with other railroads.

The intermodal service operated by ELS for the cardboard producer required little capital investment. The car shops of ELS, in Wells, Michigan, modified 89-ft flatcars for use in roll-on–roll-off service. At Ontonagon, a circus-style ramp was built on the property of Smurfit-Stone, and an identical ramp was built on a parcel of land owned by ELS at the Howard Industrial Park. The trailers for the service were provided by a local over-the-road trucking firm.

The intermodal rail cars did not leave the ELS system. The service was approximately 240 mi long between the origin and destination, allowing cost-competitive and efficient service. The service did not last long enough for evaluation of the feasibility of such a service in low-traffic-volume regions. However, intermodal service ended because the Smurfit-Stone mill closed, not necessarily because of intermodal service issues.

CONCLUSIONS AND FUTURE WORK

Although the research is ongoing, several conclusions about the strengths of short-line and regional railroads can be used to improve the Class I railroad intermodal network can be drawn from the literature review, presented case studies, communication with railroad officials, and responses from questionnaires distributed to Class I, short-line, and regional railroads involved in the case studies. Specific lessons that can be applied in planning future corridors are summarized below:

- There is no one-size-fits-all approach to short-haul intermodal.
  - If the service is a Class I operation, it must fall within its own profit goals and operational strategy. Collaborative operations between Class I railroads and short-line or regional carriers and closed-loop operations require a case-by-case analysis.
  - Class I railroads are hesitant to partner with small carriers for intermodal service because of operational stability concerns associated with equipment turn times, service reliability, and velocity.
  - Traffic flows can be the largest factor limiting success of the operation. Directional traffic with no loaded revenue backhaul requires costly equipment repositioning. Partnerships with intermodal marketing companies, trucking firms, and steamship lines could address this concern by providing alternate sources of containers and trailers.
- Short lines can partner with Class I railroads to develop a service to
  - Reduce truck drayage to terminals,
  - Increase traffic on existing lanes,
  - Create new traffic by accessing markets where intermodal becomes more economical compared with an over-the-road modal option,
  - Free up capacity at existing terminals, and
  - Penetrate new markets at a lower cost.
- Short lines and regionals can develop a closed-loop intermodal system or short-haul partnership with other local carriers.
  - Intermodal traffic tends to be local and acts as a drayage reduction service between production facilities and distribution centers in a geographic region.
  - Service schedules can be tailored to specific shipper needs.
  - Equipment acquisition can be an issue because railroads will not have access to the TTX pool.
- Important considerations for a Class I partnership with a short-line or regional railroad on short-haul intermodal include the following:
  - Assignment of marketing and customer service. The short-line, regional carrier or an external intermodal marketing company typically acts as the terminal operator with marketing split between the carriers. Customer service responsibilities vary between the local carrier and the connecting Class I.
  - Desired Class I traffic volumes typically are a minimum of 3-days-per-week service carrying a minimum of 100 revenue containers per train. However, consistency in traffic volumes and ease of interchange may lower the required volume for a given service.
  - Interchange location and operating procedures. Class I carriers prefer interchange of intermodal equipment at existing terminals to be added or removed from existing trains, as opposed to en route block swaps. Required switching for en route blocks swaps could lower train velocity between terminals.
- A single anchor customer or a group of two or three high-traffic-volume anchor customers is needed for any short-haul intermodal container service. Additional traffic can be built from smaller customers.
- Marketing a single-line service through partnership with a Class I railroad can be key to securing long-haul traffic that incorporates a short-haul movement at the origin or final destination.
- For terminals on short-line and regional railroads, costs for operation and capital improvement are low and contribute little to the rate. Operators of these types of services note that costs associated with terminal operation and initial investment typically are no more than 20% of the cost. The major costs come from the line-haul operation itself.
- Because intermodal is a premium service, the revenue per ton is higher than for carload service, but it must remain low enough to be truck competitive. For the rates and revenues estimated from the TCW, WC, and SLR case studies, a 40% to 50% higher rate per ton compared with carload traffic was evident. Given similar distances of rail service, the split between terminal and line-haul costs was not easily distinguishable.
- Interaction with trucking firms can be collaborative rather than competitive.

Future work in this field of short-haul and short-line intermodal rail service will finish the full report, featuring detailed traffic data and service plans of existing operations, and summarize full-length correspondence and communication with industry representatives.

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