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DOUBLE-STACK TRAINS: ECONOMIC & INSTITUTIONAL FACTORS

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16. Abstract

The purpose of this study is to examine the economics of double-stack trains and the institutional aspects of container-on-flat-car (COFC) train service. The study focused on service originating in Seattle/Tacoma, Washington, an area chosen because it is the port of entry for a large amount of containerized import cargoes destined for Midwest points.

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PREFACE

This report examines the economic and institutional aspects of "double stack" container-on-flat-car (COFC) train service that is used for the surface portion of joint ocean liner/rail service to and from foreign ports and inland U.S. destinations.

The work was sponsored by the U.S. Department of Transportation, Office of the Secretary, Office of Economics, Washington, D.C. 20590. The study was performed under contract DTRS-57-85-P-82419 to the Department of Transportation's Research and Special Programs Administration, Transportation Systems Center, Cambridge, MA 02142.

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I. EXECUTIVE SUMMARY

The emergence of double-stack railroad trains, operated largely by ocean carriers as proprietary trains with motive power purchased from the railroads under contract, is a relatively sudden and dramatic development in intermodal transportation. The purpose of this research is to provide some insight into the economics of double-stack trains and the institutional aspects of their operation.

The approach was to focus on the Seattle/Tacoma area double-stack operations. The Seattle/Tacoma area was chosen because it is the port of entry for a large amount of containerized import cargo which is destined for points in the Midwest. Interviews were conducted with executives of the ports, railroads, liner companies, terminal operators and others. A list of contacts is included as Appendix A.

Section II of this report presents a brief overview of the introduction of double-stack trains. In Section III, the available evidence on the economics of double-stack operations is reviewed. The cost elements involved in the operation of a double-stack train are identified and well-informed estimates of actual costs are provided. Section IV is a summary of the major institutional perspectives involved in this major export/import transportation innovation and presents the roles and motivations of the Port

Authorities, the railroads and the ocean carriers. The section also contains some observations on the impact of double-stack technology on domestic transportation.

II. OVERVIEW

Double-stack trains are a significant innovation in railroad freight transportation. The trains are composed, typically, of 20 cars, each consisting of five permanently attached platforms. Each platform has a "dropped frame" in which a 40-foot container sits just inches above the rails. Another container is stacked on top. The double-stack train is substantially shorter and lighter than a train composed of conventional flatcars with equivalent capacity.

The first dedicated double-stack service was initiated by American President Lines (APL) in 1984 and had a weekly capacity of 200 forty-foot equivalent units (FEU's). Within two years, double-stack service had increased to 52 weekly trains with a capacity of nearly 5,000 FEU's per week.

Almost all of the double-stack operations have been initiated by ocean liner companies, with the railroads providing only motive power and the right-of-way. There is some controversy within the transportation industry as to the appropriate role for the railroads and the potential impact of double-stack trains on domestic containerization. Some railroads have contracted to provide the actual movement of the train and given the liner companies total control over pricing of westbound movements, whether export or domestic freight. Other railroads have attempted to maintain

control of pricing for westbound domestic freight through provisions in the double-stack contracts. These contracts are confidential and not much is known about the success of the railroads in maintaining control over domestic freight movements.

Double-stack trains have not been a critical issue to rail labor unions. In general, the railroads have been able to price their services to provide adequate returns without seeking substantial concessions from labor in terms of crew size or work rules related specifically to double-stack operations.

There is currently some interest in the potential impact of double-stack trains on domestic transportation. Some estimates of cost savings associated with the new technology range as high as 40 percent of the total cost with conventional equipment, and suggest potential major changes in the competitive position of the railroads and the trucking industry, and even the possibility of a major shift toward containerization of domestic freight. Section III below examines the actual costs involved in double-stack train operations.

III. ECONOMICS

In this section, we will illustrate the cost components of double-stack train operations. The information is drawn from a variety of sources and represents informed approximations. Many of the cost elements are negotiated costs and are regarded as confidential by the parties. Also in this section is a review of available information on charges for double-stack transportation and some observations on the costs and charges of the ocean shipping leg of the marine intermodal transportation movement.

A. Basic Double-Stack Costs

In examining the costs associated with double-stack train operations, we will assume a hypothetical three train per-week operation, running between Seattle and Chicago, with 200 forty-foot container "slots" in each direction. Costs are broken down into the following categories:

- Administrative
- Drayage and terminal operations
- Equipment costs
- Railroad linehaul

1. Administrative Costs

The administrative costs associated with double-stack train operations are extensive. The functions involved include processing of steamship-line cargo manifest data prior to ship arrival, booking of the train, planning and oversight of drayage and terminal operations, documentation of cargo

movement to final destination, tracking of cargo and equipment inland, and marketing of westbound space. Expenses include personnel, office space in Chicago and Seattle, office and communications equipment and computer hardware and software. A reasonable estimate for the administrative function for the hypothetical train operation is an annual cost of $1.4 million, equal to $9,000 per round-trip train ($1.4 million ÷ [3 trains x 52 weeks]) or $45 per round-trip forty-foot container slot. These costs do not include the liner companies administrative costs related solely to ocean carriage.

2. Drayage Operations

Drayage is the movement of containers from the dock or container yard to the rail ramp and from the destination rail ramp to a container yard. The cost is a fairly direct function of distance. In Tacoma, where the rail yards have been built adjacent to the docks, Maersk moves containers directly to the railhead by straddle carrier and Sealand uses a shuttle of "hostlers." In both cases, the cost is minimal, probably under $5 per move. In Seattle the BN double-stack yard is about a 10 minute dray which costs about $1 per minute. Before moving its operations to Tacoma, Sealand incurred drayage costs of $55 per container from its marine terminal to the UP's Willow Street yard.

For the hypothetical train operation an average drayage cost of $20 at each end of the trip in each direction will be assumed. That results in an $80 cost ($20 x 4) per round-trip forty-foot slot or $16,000 per round-trip train.

3. Terminal Operations

Terminal operations are, like drayage, generally contracted out by double-stack train operators. Terminal facility capital costs are high. For example, the CNW spent approximately $30 million to upgrade its Wood Street yard in Chicago into a dedicated double-stack rail terminal. Actual rail yard handling of the container costs $15-$25 per loading or unloading, depending on the design and productivity of the terminal. Terminal operation costs are also affected by the degree to which container freight station services offered such as stuffing and unstuffing of containers are utilized. An informed estimate of the total terminal operations costs of the hypothetical train, assuming full service capabilities at each end, is $250 per round-trip forty-foot slot or $50,000 per round-trip train.

4. Equipment Costs

The major equipment costs associated with double-stack train operations is that of the railcars which cost about $30,000 per platform (two forty-foot container slots) or $3 million per 20-car (100 platform) train set. Recent lease costs for double-stack cars are $10 to $12 per platform per day plus approximately 2¢ per platform-mile for maintenance and repair of the equipment. For a 2,400 mile run each way, and a seven-day total trip time, the hypothetical train would incur railcar costs of about $17,300 per round-trip train or $86.50 per round-trip forty-foot slot. (Per

diem cost = 7 days x $11.00 per day x 100 platforms = $7,700 per train. Mileage cost = 2,400 miles each way x 2 x 2¢ x 100 platforms = $9,600. Total railcar cost = $7,700 + $9,600 = $17,300 per round-trip train. Per slot cost = $17,300 ÷ 200 slots = $86.50 per round-trip forty-foot slot.) Train sets can be purchased outright as well as leased. The total cost of ownership is similar to the lease costs.

5. Rail Linehaul Cost

The largest cost element of a double-stack train operation is the charge by the railroad to provide motive power and the right-of-way. These rates are negotiated together with other contract terms and are regarded as highly confidential by the parties. A realistic estimate of a likely current railroad linehaul charge has been derived from discussions with a variety of authoritative sources. For the hypothetical Seattle-Chicago double-stack train, the line-haul cost would be approximately $225,000 per round-trip train. That works out to be $563 per forty-foot container slot each way, or $1,125 per round-trip slot.

6. Summary

The cost elements discussed above are summarized in Exhibit 1. The total costs per round-trip double-stack train are about $317,000 and the round-trip forty-foot slot cost is approximately $1,600. While not fully comparable to truck costs, because cartage to final destination is not included, it is interesting to note that the per container-mile cost of the double-stack train is $0.33 if the train is

EXHIBIT 1

HYPOTHETICAL DOUBLE-STACK TRAIN COSTS

	Per Round-Trip Train[1]	Per Round-Trip Slot[2]
Administration	$ 9,000.00	$ 45.00
Drayage	16,000.00	80.00
Terminal Operations	50,000.00	250.00
Equipment Costs	17,300.00	86.50
Railroad Linehaul Charge	225,000.00	1,125.00
TOTAL	$317,300.00	$1,586.50

[1] 2,400 miles each way, seven-day round-trip time, 100 platforms.

[2] Forty-foot container slot.

fully loaded in both directions. In the section below, we will examine the effects of other load factors, changes in traffic mix, and container sizes.

B. Load Factor Effects

Most of the ocean-liner operated double-stack trains from the West Coast are 100 percent loaded in the eastbound direction. Westbound load factors, however, are typically 30 to 50 percent loaded with the balance of the slots carrying empty containers.

This has substantial effects on the economics of double-stack operations. If we assume a 40 percent westbound load factor for the hypothetical train, the effect can be seen clearly. The round-trip train carries 200 loaded containers eastbound and 80 loaded containers westbound. The 120 westbound empty containers contribute about $325 of implied revenue each (the cost to haul an empty 40' container by conventional rail) for a total of $39,000. The total round-trip train cost of $317,000 less the implied revenue of $39,000 equals $278,000 of train costs to be allocated among the 280 one-way loaded legs. The resulting cost per one-way loaded leg is approximately $1,000, more than $200 more than the one-way per slot cost ($1,586.50 round-trip slot ÷ 2 = $793.25). This brings the per loaded container-mile cost from $0.33 to $0.42. Exhibit 2 presents detailed double-stack costs and the effect of variations in load factors.

EXHIBIT 2

DOUBLE-STACK COSTS
VARIATION BY PERCENT BACKHAUL

ITEM	No Backhaul	25% Backhaul	50% Backhaul	100% Backhaul
Cont. per train (Ebound)	200	200	200	200
Cont. per train (Wbound)	0	50	100	200
Trains per week	3	3	3	3
Trains per Year	156.00	156.00	156.00	156.00
Cont. per year (Ebound)	31,200	31,200	31,200	31,200
Cont. per year (Wbound)	0	7,800	15,600	31,200
ADMINISTRATIVE				
— Per year	$1,400,000.00	$1,400,000.00	$1,400,000.00	$1,400,000.00
— Per Train	$8,974.36	$8,974.36	$8,974.36	$8,974.36
— Per Round Trip Slot	$44.87	$44.87	$44.87	$44.87
— Per Loaded Container	$44.87	$35.90	$29.91	$22.44
DRAYAGE				
— Per year	$2,496,000.00	$2,496,000.00	$2,496,000.00	$2,496,000.00
— Per Train	$16,000.00	$16,000.00	$16,000.00	$16,000.00
— Per Round Trip Slot	$40.00	$40.00	$40.00	$40.00
— Per Loaded Container	$40.00	$40.00	$40.00	$40.00
TERMINAL				
Per Handling	$125	$125	$125	$125
— Per year	$7,800,000.00	$7,800,000.00	$7,800,000.00	$7,800,000.00
— Per Train	$50,000.00	$50,000.00	$50,000.00	$50,000.00
— Per Round Trip Slot	$250.00	$250.00	$250.00	$250.00
— Per Loaded Container	$250.00	$200.00	$166.67	$125.00
CAR-LEASE COSTS				
Lease per plat.-day	$11.00	$11.00	$11.00	$11.00
M/W per plat.-mile	$0.02	$0.02	$0.02	$0.02
Mileage (r/t)	4800	4800	4800	4800
Platforms per train	100	100	100	100
Trip-days(r/t)	7	7	7	7
Plat. days/trip(r/t)	700.00	700.00	700.00	700.00
Platform-mi/trip(r/t)	480000.00	480000.00	480000.00	480000.00
— Per year	$2,698,800.00	$2,698,800.00	$2,698,800.00	$2,698,800.00
— Per Train	$17,300.00	$17,300.00	$17,300.00	$17,300.00
— Per Round Trip Slot	$86.50	$86.50	$86.50	$86.50
— Per Loaded Container	$86.50	$69.20	$57.67	$43.25
RAIL LINEHAUL COSTS				
— Per year	$35,100,000.00	$35,100,000.00	$35,100,000.00	$35,100,000.00
— Per Train	$225,000.00	$225,000.00	$225,000.00	$225,000.00
— Per Round Trip Slot	$1,125.00	$1,125.00	$1,125.00	$1,125.00
— Per Loaded Container	$1,125.00	$900.00	$750.00	$562.50
TOTAL COSTS				
— Per year	$49,494,800.00	$49,494,800.00	$49,494,800.00	$49,494,800.00
— Per Train	$317,274.36	$317,274.36	$317,274.36	$317,274.36
— Per Round Trip Slot	$1,546.37	$1,546.37	$1,546.37	$1,546.37
— Per Loaded Container	$1,546.37	$1,245.10	$1,044.25	$793.19

C. Traffic Mix Effects

One unknown cost element is the additional charges levied by some railroads on all loaded westbound containers or all loaded westbound containers with domestic freight. These contract terms are confidential, but their effect would be to raise the costs of westbound movements generally, or of domestic hauls in particular.

D. Container Size Effects

The discussion above assumes forty-foot marine containers on the double-stack trains. It has been widely observed that these containers offer less cubic capacity than the typical truck trailer. While beyond the scope of this study, it appears that double-stack train costs would not be greatly affected by the use of 45 and 48 foot containers for intermodal movements or for domestic rail movements only. Equipment costs would probably be higher, but they represent a small portion of total cost. Administrative costs would perhaps increase slightly as load planning is complicated by multiple container configurations. The main question is whether the railroads would allow the use of "domestic containers" at rates comparable to those charged for export/import-oriented double-stack trains.

E. Domestic Double-Stack Rates

1. Eastbound

The only double-stack train service which is not linked with an ocean movement is the Burlington Northern

double-stack from Seattle to Chicago. Charges for this service range from a $1,200 rate for a single container to about $1,050 per container for high-volume shippers. In many respects, however, this train is not typical of ocean-liner operated double-stack trains (see discussion below). Reportedly the breakeven for the BN train is in excess of the current 85 forty-foot equivalent unit (F.E.U.) average load and westbound load factors are poor. Thus the BN train is probably not a money maker.

2. Westbound

Competition for westbound "backhaul" loads has forced double-stack train operators to offer rates close to costs. Rate of $1,000 to $1,050 per container from Chicago to Seattle are reported.

F. Ocean Movement Costs and Rates

While the focus of this study was on double-stack train operations, some observations on the marine leg were recorded.

1. Eastbound

Ocean rates are currently depressed as a result of overcapacity in the Pacific trades. One industry observer estimated the total liner cost of an Orient to Chicago container movement at between $2,500-$3,000 including indirect costs such as marketing, overhead and profit. He suggested that current ocean rates cover only direct costs of about $2,200, but that the intermodal rates do enable double-stack train operators to recover full costs of the rail leg.

2. Westbound

The current imbalance in trade, added to the over-capacity, has severely depressed westbound ocean liner rates. Rates per container from Seattle to the Orient have been reported as low as $250 (vs. $1,500 a few years ago). These low backhaul prices have attracted traffic which would not ordinarily be shipped by container. For example, cargoes of wastepaper and even logs cut to fit the standard marine container have been exported from the Seattle area to the Pacific Rim.

IV. INSTITUTIONAL VIEWPOINTS

A. Introduction

In this section, the perspectives of the railroads, large ocean carriers (with double-stack operations), smaller carriers, the ports, terminal operators and shippers on the major institutional issues which emerged during the course of the research are described.

B. Railroads

The double-stack trains which are currently operating represent a major departure from the traditional role of the railroads. Generally the railroads have provided a broad range of transportation services, including marketing (soliciting freight), scheduling trains, operating terminals, providing rolling stock, tracing shipments, etc. Ocean carriers have taken over most of the functions that were previously provided by the railroads. The role of the railroads in most of the double-stack operations is reduced to providing the right-of-way and the motive power. The change was quite abrupt. The Burlington Northern Railroad, for example, was clearly pursuing a "retail" strategy, controlling the full range of transportation functions and restricting the role of third parties such as brokers, Non-Vessel-Owning Common Carriers (NVOCC's) and the like. Nonetheless, in 1985, BN contracted with Sealand to provide motive power and right-of-way for a double-stack train operating out of the Port of Tacoma.

In examining these changing roles, three aspects of the double-stack and marine intermodal operations come up repeatedly. They are the economics of rail operations, management requirements, and control of freight. Each will be discussed below.

1. Economics

The railroads have complained of inadequate margins on traditional intermodal traffic. Problems of balance, poor equipment utilization, high labor costs, and expensive terminal operations all contribued to an inability to retain intermodal traffic (vs. trucks) at rates that allowed satisfactory margins. With the emergence of double-stack trains, the railroads could rent their right-of-way to ocean carriers and "off-load" all of these problems at margins that are better than those of traditional intermodal operations. The ocean carriers assume reponsibility for balance, paying a basically flat rate for a round-trip train whether the backhaul is full or empty (some exceptions to this will be discussed below). The ocean carriers also design and implement the terminal operations and provide their own labor for both clerical and operating functions. Some observers feel that the shift away from rail labor is a critical element in the success of double-stack trains.

The economics suggest that the limited role of the railroads in double-stack operations is dictated by good business sense, at least in the short run.

2. Management

Another aspect of the double-stack trains that is frequently mentioned regarding the changing role of the railroads relates to the need for highly disciplined and tightly coordinated management of the entire operation. Ocean carrier service is characterized by tight schedules. Containers, ships, and trainsets have to appear when anticipated. Terminal operations must be fast and nearly error-free. Ship stowage in the Far East may have to be planned with regard to train schedules ten days later. Paperwork controls are extensive and critically important.

Many non-railroad observers feel that the ocean carriers bring to the double-stack operation management skills that the railroads do not possess. They assert that the liner companies routinely achieve better terminal productivity than the railroads and even that they negotiate rates with a better understanding of railroad costs than the railroads themselves have.

Whether or not these assertions have any merit, it is certainly true that successful double-stack intermodal systems require tightly coordinated and disciplined management from Pacific Rim to inland U.S. destinations and origins, and that this is easier to achieve with a single entity than with responsibility split between an ocean carrier and a railroad.

3. Control of Freight

Probably the single most important factor in the emerging role of ocean carriers in the inland transportation

of import/export cargo is their control of large freight volume. While a double-stack car, in itself, may offer significant economies relative to conventional equipment, the benefits of a double-stack "system" go far beyond that. High equipment utilization, ultra-efficient terminal operations, and continuous movement of containers from dock to destination are what really bring out the economic potential of the double-stack. The most dramatic illustration of the kind of freight which delivers these efficiencies is a containership arriving at a dock with 200 F.E.U. containers bound for a single inland destination area, available to be loaded onto the double-stack train scheduled to leave the port within hours of the ships arrival. Control of this kind of freight is a major factor in the changing role of the railroads. The railroads do not control this freight--the ocean carriers do. They can route it through any of the major West Coast ports, to achieve inland transportation economics, almost at will. The ocean carriers are in the driver's seat with regard to controlling the movement of this freight vis-a-vis the railroads, and their role in double-stack operations reflects this.

The railroads have conceded this role for intermodal export/import cargo, but they are not unaware of the potential competition from the ocean carriers for domestic freight. It is not clear to what extent they will be able to control this aspect of double-stack operations. There is already some domestic freight moving eastbound as well as

westbound on West Coast double-stacks, as will be discussed below. The main avenue of control open to the railroads is restrictive terms of the contracts with the liner companies. Details of these contracts are confidential, but it appears that some railroads have imposed no conditions aimed at limiting domestic freight on double-stack trains, some have simply imposed an arbitrary charge for all loaded containers on the backhaul (westbound), and others are said to have included in the contracts penalties and disclosure provisions aimed directly at limiting ocean carrier encroachment on domestic freight markets.

4. A Railroad-Operated Double-Stack Train

One Pacific Northwest double-stack intermodal train is unusual in that it is operated by a railroad rather than an ocean carrier. In 1985, the Port of Seattle considered operating a double-stack train to Chicago, with the port responsible for marketing, terminal operations, scheduling and leasing of the train sets. The purpose was to offer smaller ocean carriers, without the cargo volume to justify a dedicated train, the same economies available to the larger carriers and thus to attract traffic to the Port of Seattle.

When the Port decided not to take such a high-risk and direct role in inland transportation, the Burlington Northern effectively adopted the plan and offered a similar service to the smaller ocean carriers. The BN purchased 100 cars (each of five platformsm 10 F.E.U.

containers) and offered daily (except Sunday) fifteen car trains with a seven day turnaround time. (Three cars were held as spares.) This was a better schedule than the Port of Seattle Plan of 2 1/2 trans per week.

BN needed virtually full trains eastbound in order to break even on the operation. Currently they are loading about 85 F.E.U. per train, or 8 1/2 cars, and consolidate these cars with conventional equipment from Tacoma to make up the daily train to Chicago.

In many respects, this service is not directly comparable to the West Coast double-stack trains operated by the Ocean carriers:

- The target market is freight from many smaller carriers, precluding the integrated planning and scheduling characteristics of the individual liner company trains.
- Equipment utilization is low. Nine cars per train vs. fifteen cars available suggests a utilization of no better than 60 percent even if backhauls were full.
- The service is priced at the same level as conventional COFC, with only a $75 per container decrease from the TOFC spot rate. (Volume discounts are offered, however.)
- The BN is not aggressively marketing the westbound backhaul so that most westbound double-stack cars are carrying empty containers.

- Consolidation of double-stack cars with conventional TOFC equipment moving out of Tacoma means that some of the economies of true "unit train" operations are missed.
- Although 30-35 percent of the eastbound import cargo is destined for the U.S. East Coast, there is no direct service. East Coast containers are transloaded at Chicago onto conventional equipment due to tunnel clearance problems with BN's eastern connecting railroads.

5. Summary

Overall, the railroads seem to be pleased with the double-stack trains. They are achieving equal or better returns than on their conventional intermodal traffic, with substantially less risk of empty backhauls, poor equipment utilization and high marketing. They expect to see growth in double-stack operations and consequently a growing role for ocean carriers in the inland transportation of export/import freight.

C. Large Ocean Carriers

1. General

The dominant fact of life for the large ocean liner companies in the Pacific trades is over capacity. One estimate of 1986 load factors for North America-Asia containership trades has indicated average loads of 76 percent of capacity (89 percent eastbound, 59 percent westbound), Traffic World, March 24, 1986, p. 34.

The overcapacity and associated load factors have produced fierce competition with commodity-type pricing. The larger carriers that have initiated double-stack trains for intermodal movements have some higher costs (e.g., crew costs) than their smaller competitors. Double-stack trains offer a competitive edge on inland destination/origin traffic, however, in terms of cost, total time, and reliability. Evidence that the double-stack is a competitive tool is provided by American President Line's (APL) opposition to the Port of Seattle's plan to offer double-stack services to the smaller carriers without the freight volume which would justify a dedicated double-stack train. APL was concerned about losing some of the competitive edge provided by its own double-stack train, and also concerned about more competition for westbound double-stack backhauls.

2. The Marine Intermodal Leg

It is anticipated that on the ocean side of the intermodal freight movement, overcapacity and associated depressed rate levels will continue for at least several years. Worldwide capacity is high in relation to demand and capacity is not expected to exit the Pacific containership trades. In fact, new capacity is entering the trades as existing carriers purchase new and larger ships with lower per-container operating costs. Only five to ten years ago, Pacific containerships had a 900 container (F.E.U.) capacity. Many of

those have been modified in recent years to a capacity of some 1,200 F.E.U. capacity. Sealand, Maersk and other major carriers are looking now at new 1,600-1,800 F.E.U. containerships for the Pacific. While these are not large in comparison to the giant ships being introduced into Asia-U.S. East Coast and Asia-Europe trades, they will have a significant impact on Pacific trades capacity. (One 1,800 F.E.U. ship, if filled with Midwest-bound containers, would require nine of the typical 200 F.E.U. double-stack trains.) Many observers expect failures among the less competitive ocean carriers.

3. The Inland Intermodal Leg

In addition to control of large blocks of container traffic which are optimal for double-stack train operations, ocean carriers apply intensive management to make the double-stack a smooth and efficient element in the total transportation movement. The trains are booked in advance, like a ship. While the containerships are still at sea the liner companies can determine which containers are bound for an inland destination and "reserve" space on the train scheduled to depart following the arrival and unloading of the ship.

A more extreme example of coordination is that some carriers actually "load the ship to fit the train." That is, the ship is loaded in the Pacific rim ports with containers booked for a specific double-stack train segregated on board to facilitate the most efficient terminal

operations at the U.S. West Coast port of entry. While not always 100 percent successful, this intensive management is illustrative of the coordination that a railroad or a smaller carrier, dependent on conventional intermodal transportation, would find difficult to match.

4. All-Water Competition

Some transportation analysts feel that the new large containerships (4,200 F.E.U.'s) offering the lowest cost marine transportation in all-water service will successfully compete against double-stack trains and limit their use. Currently much of the double-stack freight is micro-land-bridge traffic, where the destination (or origin) is an inland point. There is, of course, no all-water competition for this traffic. The two types of movements for which there is all-water competition have to be looked at separately:

a. Landbridge

This is freight moving from one foreign port to another foreign port via a transcontinental movement across the U.S. An example is a container originating in Japan and bound for Rotterdam. This is a 12,000 mile haul, about the same westbound through the Suez Canal or eastbound via the Panama Canal. While a landbridge movement (Japan-Seattle-rail to New York-Rotterdam) would offer a few days of time savings, most observers assert that the saving is not worth the costs of double handling involved in the landbridge movement.

Thus all-water containerships will continue to dominate these cargos.

b. Mini-Landbridge

This traffic originates in a foreign port and is destined for a U.S. port. A container from Japan to New York could be shipped via a West Coast port of entry with a rail movement to New York or could move via all-water service through the Panama Canal. Although there is potential competition for this traffic, most observers feel that there are basically two markets. One is the higher value, lower density freight which will tend to move intermodally. The other is the lower value, higher density freight which will tend to move in all-water service. The role of value is simply that the higher carrying costs of owning high value goods justifies the quicker, but more expensive, landbridge movement. Density plays a role as well because double-stack trains are limited in terms of weight. Penalties are applied for over-weight trains due to the need for extra motive power or breaking trains to move them over higher grades.

There is no doubt that in the middle range of value and density there is cargo that could shift from double-stack mini-landbridge to an all-water route in response to cost savings related to the new large containerships in all-water service. Most observers felt, however, that the amount of diversion to all-water routes would not be large enough to seriously affect double-stack train operations.

D. Smaller Ocean Carriers

As noted above, the current overcapacity in the Pacific containership trades had produced an environment of fierce competition. It is described as a fight for survival and many observers expect failures among the smaller, mostly foreign-flag, carriers serving the Pacific trades. The double-stack trains give the larger carriers a competitive edge for import and export traffic with inland destinations and origins.

It is expected that many of the smaller carriers will join with competitors in consortia, sharing ships and terminals, in an effort to compete on a more equal basis with the large carriers. Evergreen Lines and Japan Lines have already announced such a combination for service to the U.S. West Coast. It is possible that some of the smaller carriers, through consortia, will establish new double-stack trains. It is illegal for ocean carriers to jointly negotiate railroad rates, but a single carrier or its intermodal subsidiary can negotiate a rate, set up a double-stack operation and offer space on the train to other ocean carriers. Some observers have said that Orient Overseas Container Line's (OOCL) new double-stack train from Long Beach to inland and East Coast points will serve other ocean carriers as well as OOCL cargos.

The nature of double-stack train operations, as implemented by the large carriers which control sufficient

traffic to justify a dedicated train, suggest that it will be difficult for smaller carriers to achieve the full economies associated with the double-stack technology. The intensive and coordinated management of "the system" is not likely to be attained by multiple entities sharing a double-stack train.

E. Ports

The Ports of Seattle and Tacoma have been active participants in the development of intermodal transportation of import and export traffic. They are competing for this traffic against each other and against the other West Coast ports. Their basic motivation is that port activities mean jobs. The Port of Seattle alone estimates that more than 60,000 local jobs are derived from port operations.

All of the major West Coast ports provide facilities for container operations such as piers, cranes, land and rail terminals. Some go beyond physical facilities and offer a wide range of services to shippers and ocean carriers. Seattle, which has been perhaps the most aggressive West Coast port offers the following services:

- It acts as shippers' agent, providing decision making and management services such as freight routing.

- It owns and operates warehouse facilities and processes warehouse cargo receipt, storage and shipment transactions. This involves direct computer-to-computer communication with shippers.
- It provides a computerized inventory and control system for containers and chassis.
- It offers a consolidation service for smaller shipments by truck, rail and air.
- It negotiates freight rates with truckers and railroads, prepays freight charges and bills the shippers.
- It provides a container tracing service via computer links with major railroads.

In 1985 the Port of Seattle explored the feasibility of operating its own double-stack container train to provide the economies of double-stack operations to shippers and to those ocean carriers which did not have the cargo volume, the resources nor the technical skills to institute their own inland transportation system. The port's plan included leasing the double-stack railcars, providing 10 acres of port-owned land for an inbound/outbound container storage area, and purchasing data processing equipment. They planned to develop software to process booking, dispatching, loading, stability calculations, unloading, tracing, status monitoring and performance measurement. In

Chicago, the Port planned to lease 13 acres of terminal space, 400 chassis, and office space for port marketing offices and U.S. Customs. Operating labor and trucking services were to be provided through contracts.

The port ultimately decided not to pursue the plan. Opposition from a major port customer, American President Lines, was one factor in the decision. APL regarded the plan as subsidized competition for its own double-stack operation, both for import traffic and for backhaul freight from Chicago to Seattle. The Burlington Northern Railroad decided to implement a similar plan in cooperation with the Port of Seattle. Operation of that train is discussed above.

One railroad noted that it had been contacted by "4 or 5" ports interested in establishing double-stack trains. Most observers feel, however, that the role of the ports will be one of management, as the ports are not well equipped to cope with the higher risk aspects of train operations such as railcar ownership.

Services offered by most ports involve some level of subsidy, although it is difficult to measure or compare. Seattle and Tacoma ports receive direct tax subsidies of $26 million and $5 million, respectively. California ports received free land. Tax-free bonds are sold by many Port Authorities to build cargo container facilities. Many ports receive police and fire protection free or below cost.

Seattle and Tacoma have been very successful at attracting export/import traffic to their ports. Their major competitors are the Bay area ports of Oakland and San Francisco and the Southern California ports of Long Beach and Los Angeles. Seattle and Tacoma handle over 20 million tons of cargo, about 30 percent of the West Coast total tonnage. Their operating revenues are also about 30 percent of the total.

They have been successful despite the major disadvantage that they are not as large in terms of local export/import container freight. L.A.-Long Beach, for example, has an area population of about 12 million vs. 2 million in the Puget Sound area. The difference is reflected in the fact that 70 percent of L.A.-Long Beach cargos originate or terminate in the local area. The corresponding percentage for Seattle/Tacoma is 20 percent.

In addition to aggressive marketing and development of shipper/carrier services, Seattle and Tacoma have several advantages in the fight for container cargos:

- Geography. Assuming a 20 knot average cruising speed, Seattle/Tacoma have a 15 hour advantage over the Bay area ports and a 30 hour advantage over the Southern California Ports in terms of ship transit time.
- Rail Connections. Seattle/Tacoma rail connections are more convenient to the ports than those of their competitors.

- Truck Access. Seattle and Tacoma ports have good freeway access and relatively uncongested highways.

The fight for cargos among the West Coast Ports is accelerating. All the major ports are adding facilities and services to attract ocean carriers and shippers. Seattle and Tacoma port executives are optimistic. They expect that with the introduction of the new larger containerships, there will be an increase in "load-centering" (concentration by the ocean carriers on fewer calls at fewer ports) and that they will fare well at the expense, primarily, of the Bay area ports.

F. Domestic Shipping

One question raised by the introduction of double-stack trains is the extent to which they will have an impact on domestic transportation. At one extreme, it is possible to visualize the double-stacks and their associated economies as a "trigger" for a dramatic shift to containers for domestic shipping. The other extreme would involve double-stacks as a key element in export/import intermodal transportation, with no impact on domestic shipping other than as backhaul traffic to remedy export/import imbalance.

Currently all of the West Coast double-stack trains are carrying a significant proportion of empty containers in the westbound direction. Fifty percent loaded is regarded

as a successful effort to balance traffic flows. Trains with only 20 percent loaded containers are not unusual.

Some of the ocean carriers do not solicit domestic traffic even for the westbound backhaul. That is perhaps because of restrictions or penalties in the terms of their contracts with the railroads. Most operators do, however, solicit westbound domestic freight.

American President Lines has perhaps been the most aggressive in terms of domestic freight. It is reportedly soliciting domestic traffic for the eastbound leg of its L.A.-New York double-stack train as well as the westbound backhaul. The Maritime Administration has estimated that 40 percent of cargo moving on APL's double-stack trains is domestic freight (Traffic World, April 15, 1985). The APL L.A.-New York train is direct eastbound, but stops in Chicago on the westbound run to drop off domestic freight. Similarly, APL's Seattle-Chicago double-stack is direct eastbound but stops in Portland to drop off domestic freight originating in the Midwest.

The future impact of double-stack trains on domestic freight transportation is uncertain. The key determinants are container dimensions and institutional relationships.

1. Container Dimensions

The cubic capacity of the standard 40-foot marine container is roughly 70 percent of that of the largest 48' by 102" road trailer or domestic container. A double-stack

train operating with standard marine containers thus sacrifices a large percentage of the economies that might be achieved vis-a-vis domestic trailers or containers on flat cars. There are significant barriers to adapting larger cube containers to the existing double-stack operations:

- Current double-stack railcars can handle only a small number of larger containers.
- Current containerships are designed around the standard 40-foot container (they can carry larger containers on deck).
- Many rail lines do not have the clearances necessary to haul the larger containers in double-stack configuration (e.g., main lines from Seattle/Tacoma east can handle one 9 1/2' high container stacked on a 8 1/2' box but not two 9 1/2' containers).
- Availability and control problems intensify with the introduction of a variety of container sizes.

It would seem that the deterrents to double-stacking of larger containers are overwhelming but most observers do not agree. They point out that APL is currently using 45' and 48' containers in its operations; that new double-stack railcar designs incorporate 48' wells; that new containerships can be designed to accept the higher cube boxes; that management systems can be created to resolve problems of control

and availability; and that even clearance problems can be circumvented with mixed container loads and solved with bridge and tunnel modifications. The consensus is clearly that double-stack trains will evolve with the capability of handling large domestic containers.

2. Institutional Aspects

The other key factor in evaluating the impact of double-stack trains on domestic transportation is an institutional one. What institutions will take the lead?

The railroads show little interest in initiating retail double-stack services. Burlington Northern is operating a double-stack train from Seattle to Chicago (see discussion above). Conrail did establish double-stack service between New York and Chicago, primarily for import/export traffic, but cancelled the service after a short trial. There is not much evidence that the railroads will be innovators in this area.

American President Lines, however, has already indicated its ability and intention to embrace domestic traffic in its double-stack plans. Its close working relationship with Transway International, a large freight forwarder, and its acquisition of National Piggyback Services, the largest shippers' agent in the U.S., make it a clear presence in the domestic transportation business. As APL and the other proprietary train operators successfully demonstrate that the problems of incorporating domestic freight within

export/import oriented double-stack train operations, pressure will mount on the railroads to make those economies available to large shippers, forwarders, and agents. The railroads will have to initiate double-stacks in those high volume corridors where economies are achievable or act as wholesalers and allow shippers, forwarders or various partnerships to operate the trains, as they have the ocean carriers.

APPENDIX A

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