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MANALYTICS, INC.

DOUBLE-STACK STUDY PRESENTATION

TO

ASSOCIATION OF AMERICAN RAILROADS

June 1990

FRA/MARAD DOUBLE-STACK STUDY:
PURPOSE

The study answers six major questions:

- Where is double-stack service now?
- Where can domestic double-stack service compete with trucks?
- What could a truck-competitive double-stack network look like?
- What implications would such a network have for railroads?
- What implications would such a network have for ocean carriers and ports?
- Will existing market forces bring about an efficient double-stack network?

CURRENT DOUBLE-STACK SERVICES

- Double-stack services are no longer dominated by unit trains owned by, and operated for, ocean carriers.

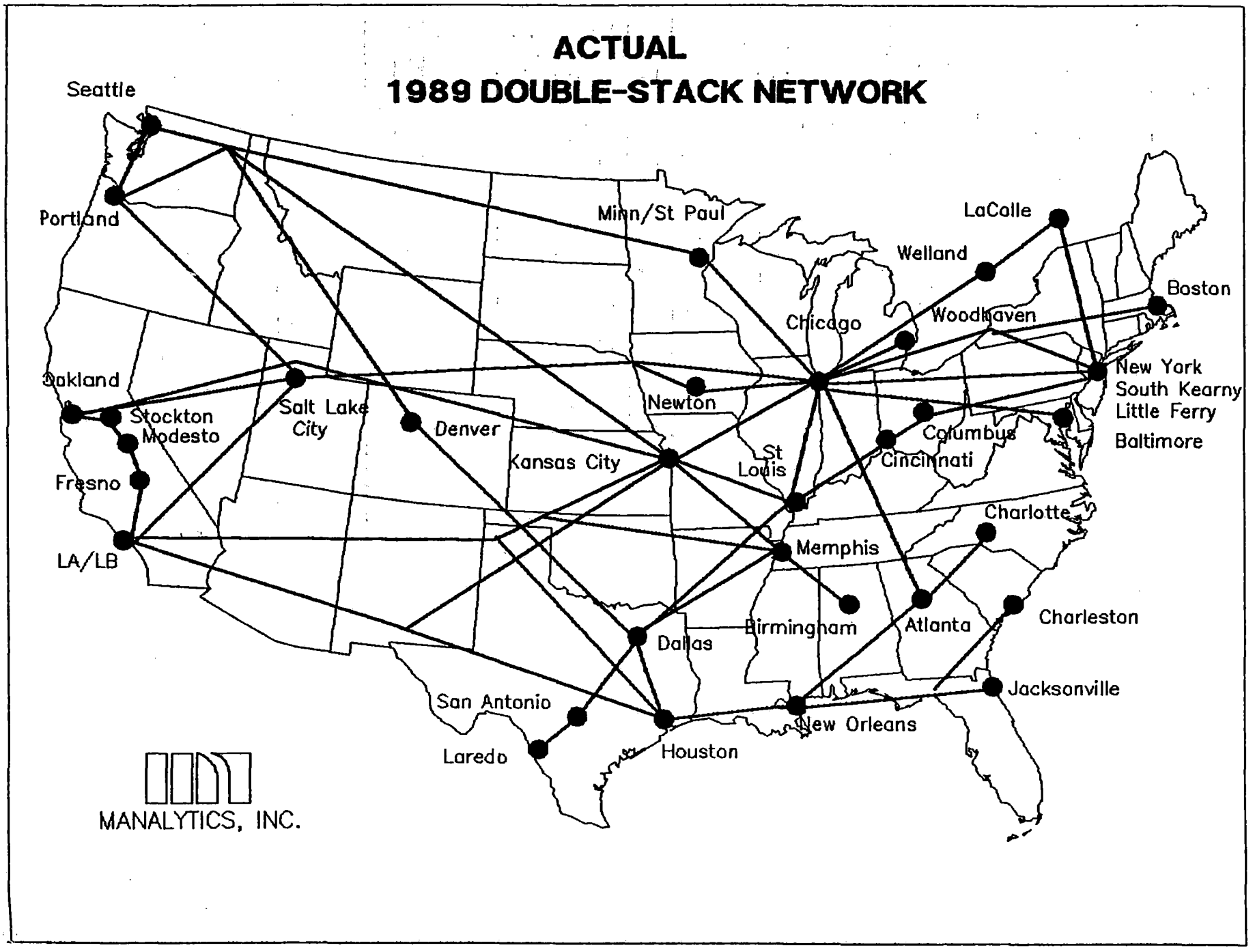
- International double-stack services are provided by the railroads under a variety of contractual arrangements with North American affiliates of ocean carriers.

- Domestic double-stack services are provided by railroads, ocean carrier affiliates, and third parties.

- Double-stack services of all kinds are increasingly integrated into overall rail intermodal operations.

- Double-stack service can be, and is, provided with or without dedicated double-stack trains.

ACTUAL
1989 DOUBLE-STACK NETWORK



DOMESTIC DOUBLE-STACK COMPETITION WITH TRUCKS: VOLUME AND SERVICE FREQUENCY

MAJOR HUBS

- Minimum of 46,800 annual loads: 15-car trains, 6 days per week.
- 28,080 annual loads (60 percent) needed for start-up.

INTERMEDIATE POINTS

- Minimum of 2,600 annual loads: one car, 5 days per week.
- 1,560 annual loads (60 percent) needed for start-up.

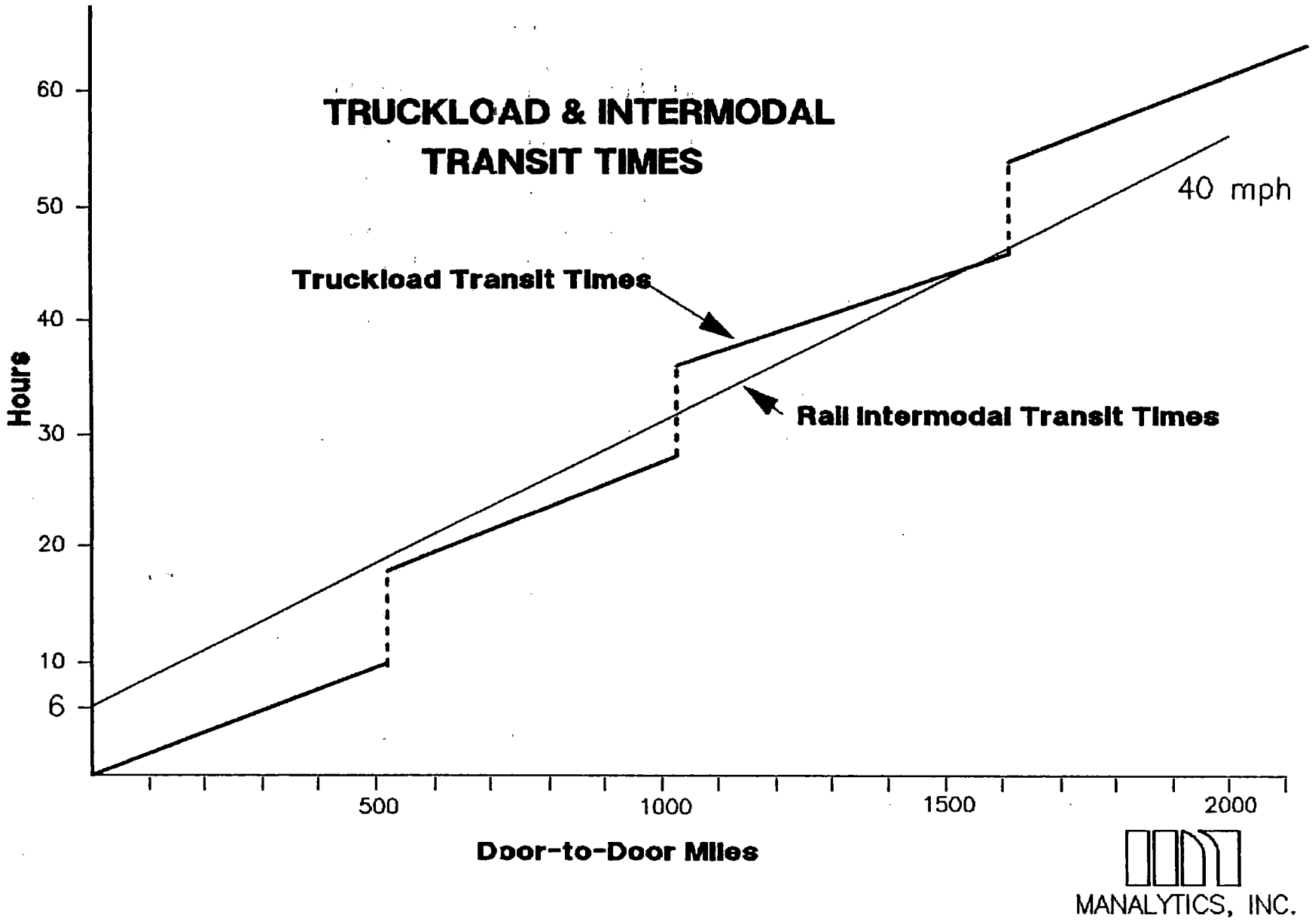
DOMESTIC DOUBLE-STACK COMPETITION WITH TRUCKS: TRANSIT TIME

TRUCK TRANSIT TIME

- Truckload carriers average 54 mph, driving 10 hours on and 8 hours off.
- Truckload carriers move directly from door to door: no stem or dwell time for terminal operations.

RAIL TRANSIT TIME

- Priority double-stack trains average about 40 mph over the road, including necessary stops.
- Double-stack service, however, moves from hub to hub, and must allow a minimum of about 3 hours stem and dwell time at each end.
- With a 6-hour handicap, a double-stack service cannot usually provide competitive transit times on trips of less than 540 miles.
- On trips of 540 to 1,620 miles, a double-stack service becomes increasingly competitive with trucks.
- On trips of over 1,620 miles, double-stack service has a transit time advantage over trucks.
- Double-stack services <u>might</u> compete with truck transit times on "overnight" trips under 540 miles, but the cost may not be competitive.


TRUCKLOAD & INTERMODAL
TRANSIT TIMES
40 mph
Truckload Transit Times
Rail Intermodal Transit Times
Hours
60
50
40
30
20
10
6
500
1000
1500
2000
Door-to-Door Miles
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DOMESTIC DOUBLE-STACK COMPETITION WITH TRUCKS: TRUCK LINE-HAUL COSTS

- Line-haul truck operating costs, exclusive of any overhead, are about $.71 per mile:

Equipment ownership and maintenance	$.31
Fuel at $1.05/gal and 5.22 mpg	.20
Labor wages and benefits at $11.00/hr	.20
	$.71

- The leading truckload times average about 80 percent utilization, yielding an operating cost of about $.89 per laden mile.

- Rail routes are generally about 8 percent circuitous, so the truck haul is about 92.6 percent of the rail haul.

- Currently, double-stack customers expect a discount, from truck rates, averaging about 15 percent.

- Given roughly equal overhead and profitability, and current service perceptions, domestic double-stack costs must be at least 15 percent below truck costs to be considered fully competitive.

DOMESTIC DOUBLE-STACK COMPETITION WITH TRUCKS
RAIL LINE-HAUL COSTS

- Rail-line haul costs for several operating scenarios and two routes (Los Angeles-Oakland and Los Angeles-New Orleans) were estimated using Manalytics' Rail Cost Model.

- Favorable assumptions were used to simulate the best attainable performance: 100 percent loaded movement, no train delays, no switching costs, etc.

- With 3-person crews, 20-car trains, and extended crew districts, line-haul costs averaged $.124 per container mile between Los Angeles and New Orleans (2,010 miles) and $.144 between Los Angeles and Oakland (559 miles).

- Trailer Train equipment costs added $.014 per container mile, giving costs of $.138 per container mile between Los Angeles and New Orleans and $.158 per container mile between Los Angeles and Oakland.

RAIL LINE-HAUL COST ESTIMATES

Case	Los Angeles-New Orleans 2010.2 Miles $/Unit Mile*	% Change	Los Angeles-Oakland 559.4 Miles $/Unit Mile*	% Change
1. Base Case: 20-car train, 2-person crews, extended districts	0.118	-	0.138	-
2. 15-car Train, 2-person crews, extended districts.	0.136	+15	0.142	+3
3. 28-Car train, 2-person crews extended districts.	0.113	-4	0.130	-6
4. 20-car train, 3-person crew, extended districts.	0.124	+5	0.144	+4
5. 20-car train, 4-person crew, extended districts.	0.129	+9	0.150	+9
6. 20-car train, 2-person crew, short districts.	0.121	+3	0.143	+4
7. 20-car train, 4-person crew, short districts.	0.133	+13	0.157	+14
8. 15-car train, 4-person crew, short districts.	0.156	+32	0.185	+34

* Not including cars or containers.

Source: Manalytics Rail Cost Model.

DOMESTIC DOUBLE-STACK COMPETITION WITH TRUCKS: TERMINAL AND DRAYAGE COSTS

TERMINAL COSTS

- Lift costs were estimated at $34 per lift: $26 per lift for a "turnkey" contract operator, and $8 per lift for facility costs.
- Terminal time for cars was estimated at $3.49 per unit.
- Chassis cost for one day at each end was estimated at $16.00.

DRAYAGE COSTS

- Drayage rates are about $35 per hour, and the drayage bill depends on time rather than distance.
- The cost analysis allowed for a 30-mile drayage range to cover a typical commercial zone or metropolitan area.
- The estimated drayage rate (cost to the double-stack customer) was $140 for a 4-hour, 30-mile round trip on each end, or $280 door-to-door:
- Drayage beyond the 30-mile metropolitan radius was estimated at $.70 per mile ($35 per hour at 50 mph).

DOMESTIC DOUBLE-STACK COMPETITION WITH TRUCKS: TOTAL DOUBLE-STACK OPERATING COSTS

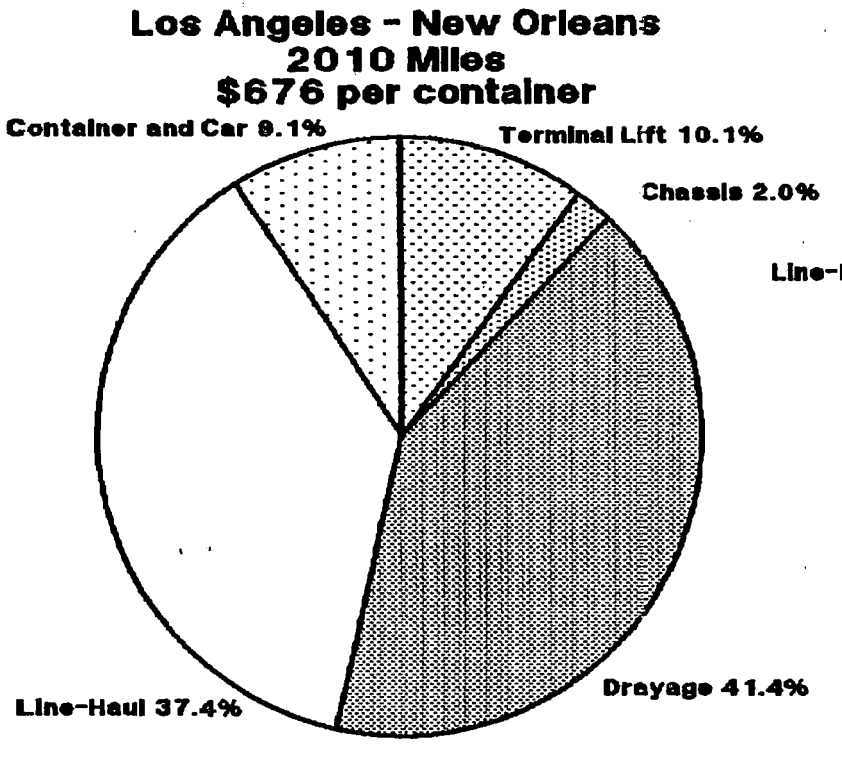
- Total door-to-door double-stack operating costs included line-haul, terminal, equipment, and drayage costs.
- Between Los Angeles and New Orleans (2,010 miles), total costs were estimated to be $676.28 per container, or $.336 per container mile.
- Between Los Angeles and Oakland (559 miles), total costs were estimated to be $478.16 per container, or $.855 per container mile.
- Terminal and drayage costs accounted for more than half the total on both routes.

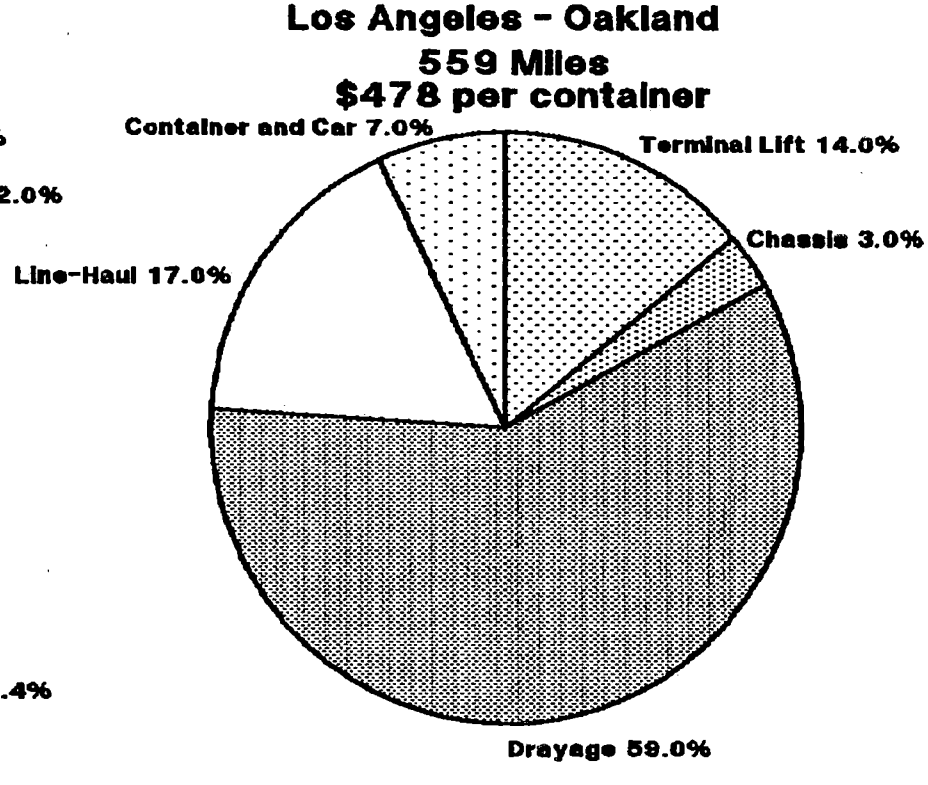
TOTAL DOUBLE-STACK OPERATING COSTS
$/Unit-Mile

Route	Line Haul $/unit mile	Line Haul Cost*	Line Haul Car Cost	Terminal Car Cost	Container Cost	Terminal Lift	Chassis Cost	Drayage	Total	Total $/unit mile
L.A.-New Orleans										
2010.2 Miles 48 Hours	0.124	249.26	27.03	3.49	32.50	68.00	16.00	280.00	676.28	0.336
L.A.-Oakland										
559.4 Miles 15 Hours	0.144	80.55	10.62	3.49	19.50	68.00	16.00	280.00	478.16	0.855

* 3-person crews, 20-car trains, extended crew districts

DOUBLE-STACK DOOR-TO-DOOR OPERATING COSTS





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DOMESTIC DOUBLE-STACK COMPETITION WITH TRUCKS: MINIMUM LENGTH OF HAUL

- Double-stacks have lower line-hual costs, but the line-haul must be long enough to overcome the terminal and drayage handicap.

- Door-to-door double-stack costs are:

  $\$393.49 + .158\ M_R + (2).70\ D$
  where M_R = Rail miles
  D = Drayage over 30 miles on each end

- Customers currently expect a discount from truckload rates, typically about 15 percent.

- In order to compete with trucks, double-stack cost must be no more than 85 percent of truck costs:

  $$.85\ (.89)\ .926\ M_R$$

- The minimum length of haul is where:

  $$393.49 + .158\ M_R + (2).70\ D = .85\ (.89).926\ M_R$$

  or:

  $$725.3 + .258\ D = M_R$$

- The minimum length of haul is <u>725 miles</u> (with drayage of 30 miles on each end).

DOMESTIC DOUBLE-STACK COMPETITION WITH TRUCKS: DRAYAGE REACH

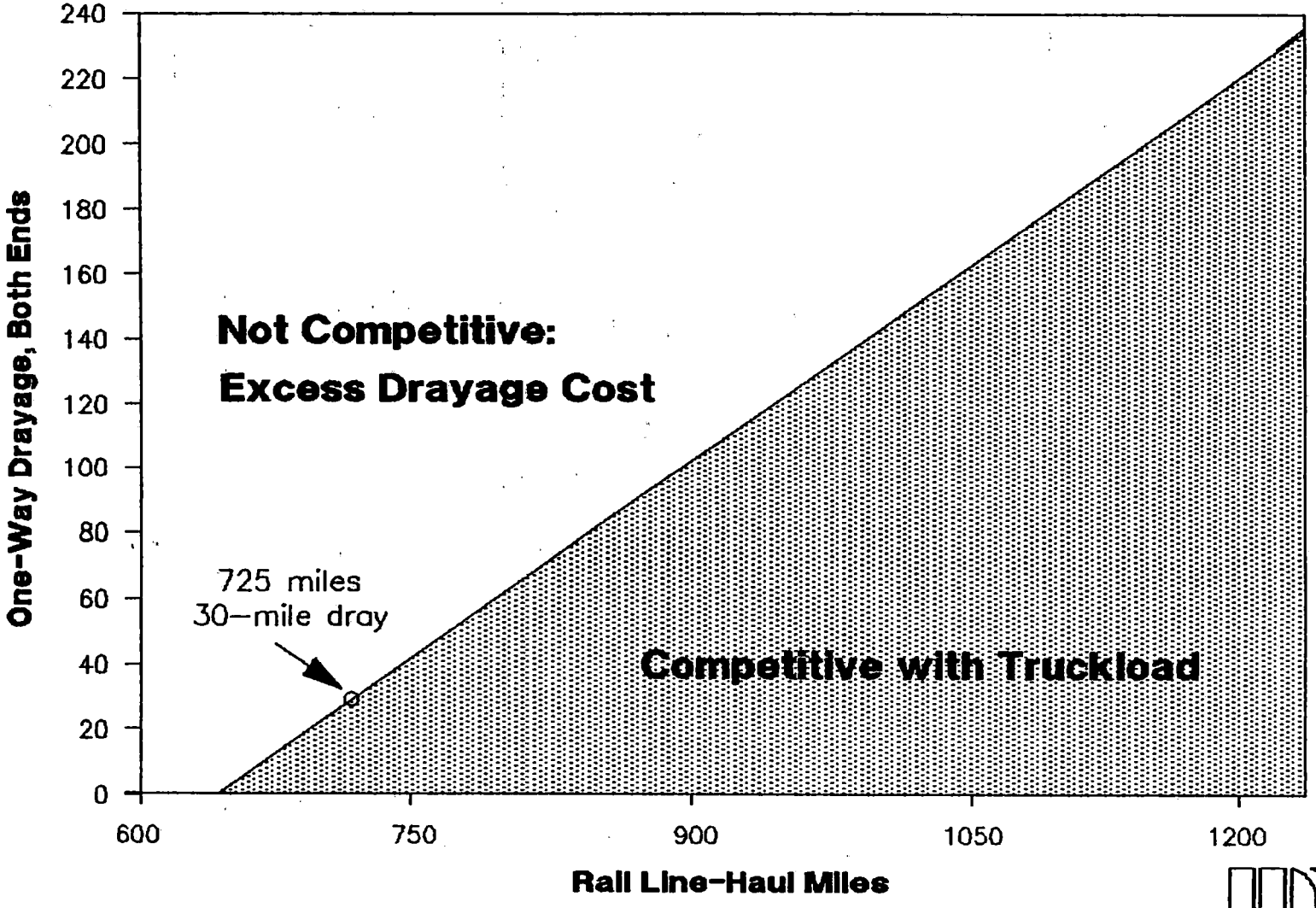
- Beyond the metropolitan hubs, drayage line-haul is comparable in cost to truckload line-haul.

- Longer hauls permit greater drayage reach:

	1-Way Miles	Max Time	Est Rate*	Rate Per Mile	Rate Per Line-Haul Mile 500	1,000	1,500	2,000
Zone 0	30	4 hrs	140	4,667	0.280	0.140	0.093	0.070
Zone 1	80	6 hrs	210	2.625	0.420	0.210	0.140	0.105
Zone 2	130	8 hrs	280	2.154	0.560	0.280	0.187	0.140
Zone 3	180	10 hrs	350	1.944	0.700	0.350	0.233	0.175
Zone 4	230	12 hrs	420	1.826	0.840	0.420	0.280	0.210

* At $35 per hour

RELATIONSHIP BETWEEN DRAYAGE DISTANCE AND COMPETITIVE LENGTH OF HAUL



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POTENTIAL TRUCK-COMPETITIVE DOUBLE-STACK NETWORK: SELECTION CRITERIA

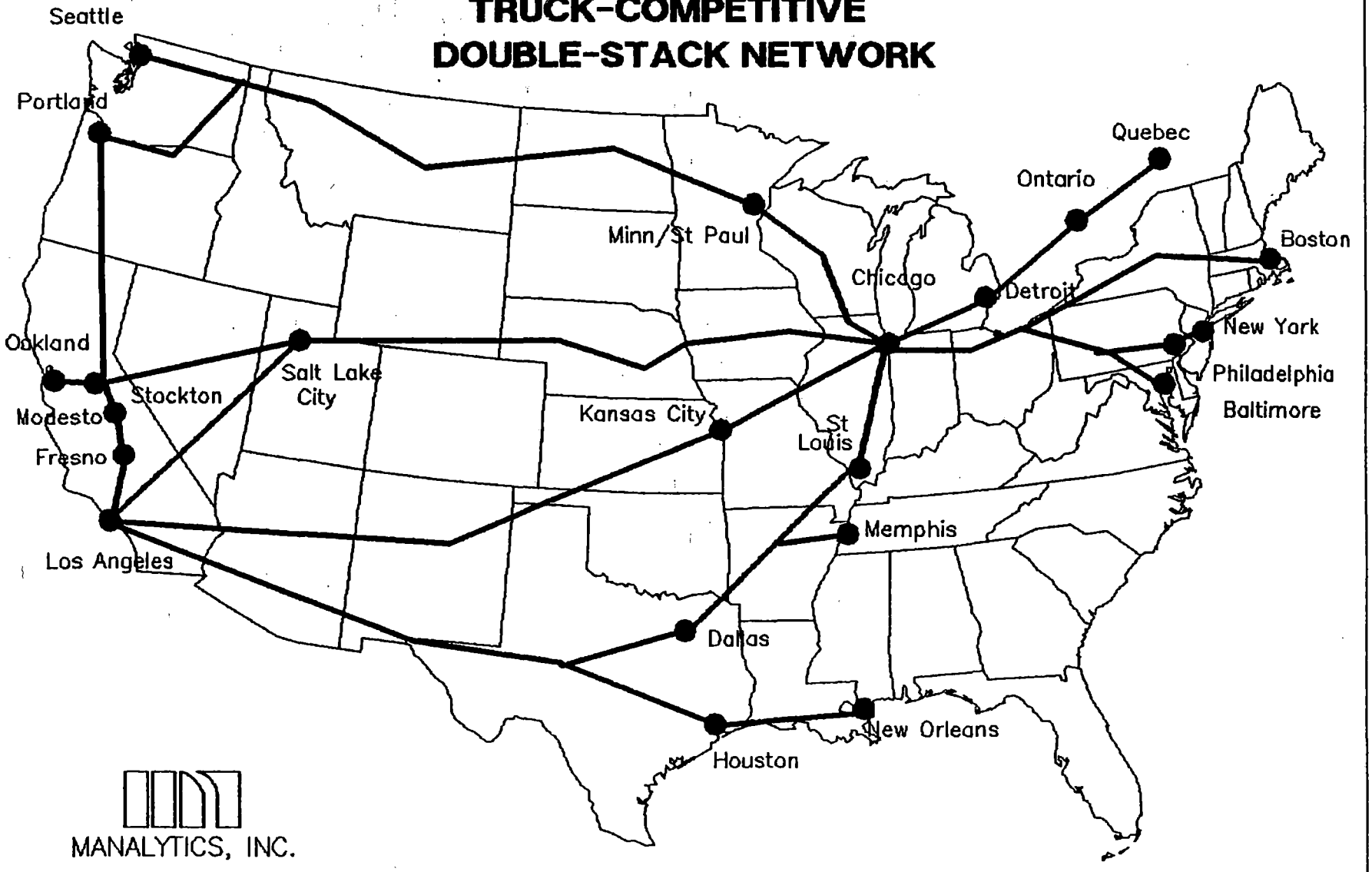
MAJOR HUBS

- All rail traffic flows where:
  - Hub-to-hub distance is at least 725 miles; and
  - Relevant 1987 rail traffic is at least 28,080 annual containers or equivalents (60 percent of 46,800).
- No distinction between railroads or rail routes in the same corridor.

INTERMEDIATE POINTS

- Within the major hub-to-hub corridors, double-stack service is potentially truck competitive where:
  - Length of haul is at least 725 miles; and
  - Relevant 1987 rail traffic is at least 1,560 annual containers or equivalents (60 percent of 2,600).

HYPOTHETICAL 1987 TRUCK-COMPETITIVE DOUBLE-STACK NETWORK



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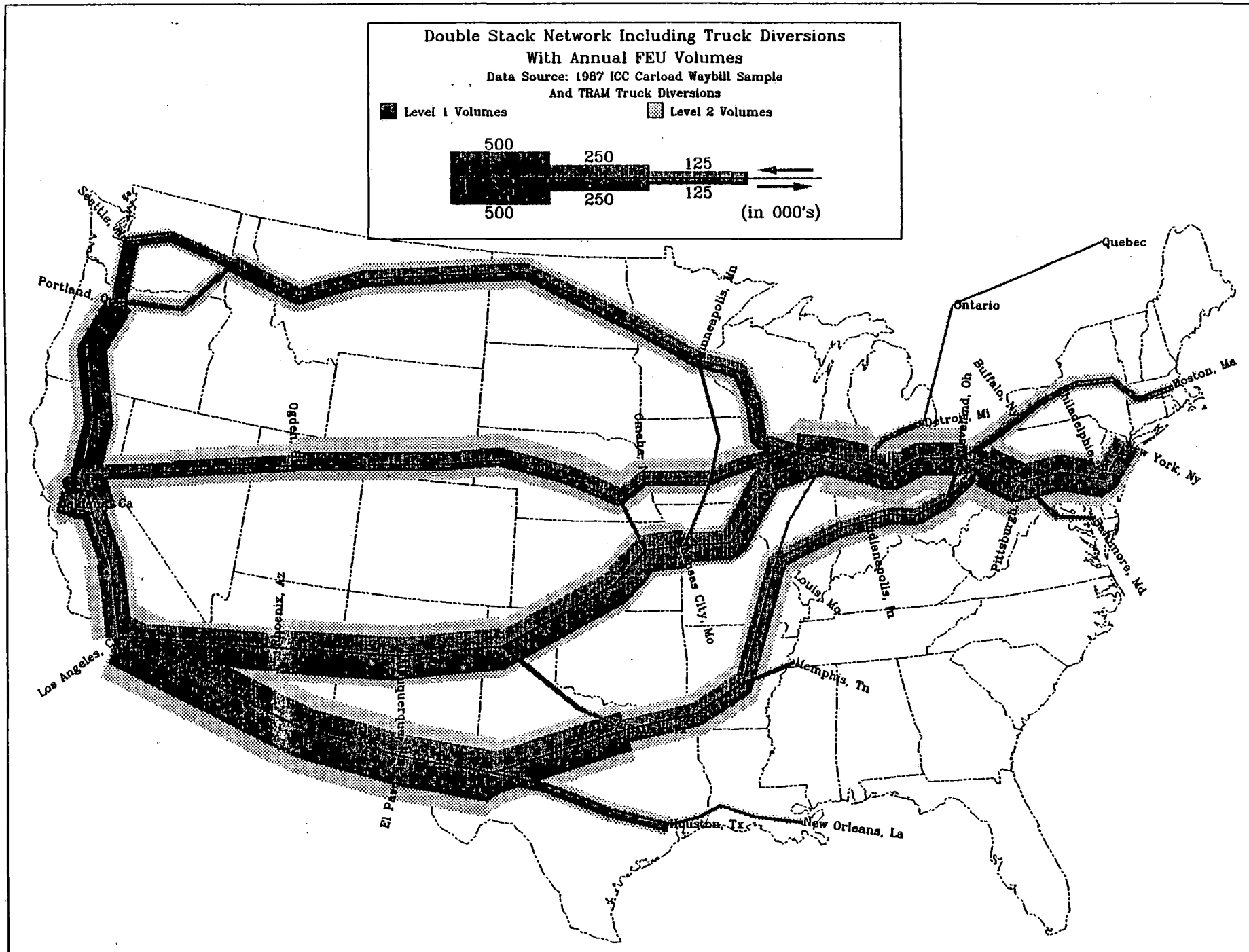
Note: Lines indicate service corridors, not specific railroad routes

POTENTIAL TRUCK-COMPETITIVE DOUBLE-STACK NETWORK: RAIL CORRIDORS AND TRUCK DIVERSIONS

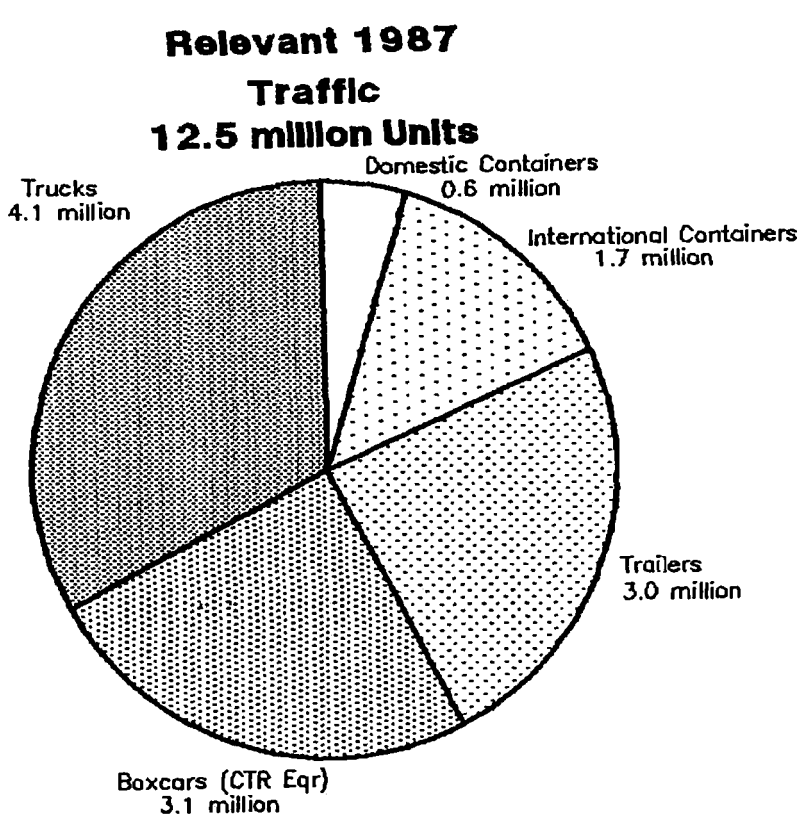
- There are 1.1 million units of convertible trailer traffic, and 400,000 container equivalents of convertible boxcar traffic.
- There are 3.2 million annual units of potentially divertible truckload traffic.

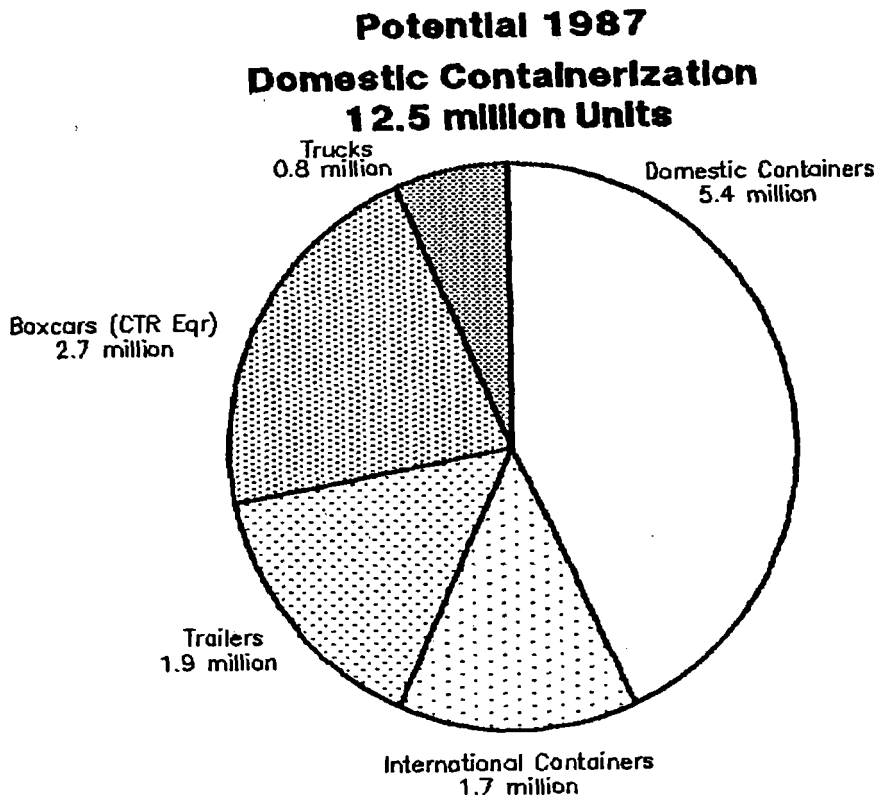

Double Stack Network Including Truck Diversions
With Annual FEU Volumes
Data Source: 1987 ICC Carload Waybill Sample
And TRAM Truck Diversions
Level 1 Volumes
Level 2 Volumes
500
250
125
125
250
500
(in 000's)
Seattle, Wa
Portland, Or
Minneapolis, Mn
Quebec
Ontario
Buffalo, NY
Detroit, Mi
Boston, Ma
Philadelphia
New York, Ny
Baltimore, Md
Pittsburgh
Ogden, Ut
Omaha
Kansas City, Mo
Louisville, Ky
Indianapolis, In
Los Angeles, Ca
Phoenix, Az
Albuquerque, NM
El Paso, Tx
Memphis, Tn
Houston, Tx
New Orleans, La

POTENTIAL TRUCK-COMPETITIVE DOUBLE-STACK NETWORK: TRAFFIC SOURCES

- The potential truck-competitive double-stack network could carry:
  - 52 percent of the 1987 container traffic;
  - 37 percent of the 1987 trailer traffic;
  - 13 percent of the relevant 1987 boxcar traffic; and
  - 79 percent of the identifiable relevant truckload traffic.
- If there were about 600,000 domestic container movements in 1987, the potential exists to increase the volume nearly eight fold.

DOMESTIC CONTAINERIZATION: THE POTENTIAL





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THE DOMESTIC DOUBLE-STACK CHALLENGE: MAJOR MARKET OPPORTUNITIES

SECONDARY HUBS AND CORRIDORS

- Setout/pickup service at intermediate points.
- Lower volume flows built around a few major customers, e.g. Ford, Maytag, Gallo

REFRIGERATED TRAFFIC

- Untapped market: boxcar and piggyback shares are very small.
- Half of the reefer backhauls are dry freight: reefers are up to half the market in some major east-west longhaul corridors.
- Door-to-door service quality is the barrier, not technology or cost.
- The market wants a truck-competitive choice.

IMPROVED AND EXTENDED DRAYAGE

- The cost and time required for drayage severely limit market penetration and reliability.
- Drayage cost and reliability can both be improved.

DOMESTIC DOUBLE-STACK CHALLENGE: PRICE COMPETITION AND DISCOUNTING

PRICE COMPETITION

- Railroad double-stack service remains an undifferentiated commodity, sold on price and heavily discounted.
- With nearly equivalent service offerings from competing railroads, ocean carrier-affiliates and third parties negotiate for lowest price.

DISCOUNTING

- Customers still perceive intermodal service in general as inferior to truckload service, chiefly in terms of reliability and customer service.
- Customers expect a discount of around 15 percent to use domestic container service rather than trucks.

THE DOMESTIC DOUBLE-STACK CHALLENGE: SERVICE DIFFERENTIATION

- Customers see little difference between the door-to-door service offerings of railroads and other double-stack operators: "brand-name" domestic container service is not yet fully established.

- Domestic double-stack services (except for API) do not yet have national or regional networks or identities.

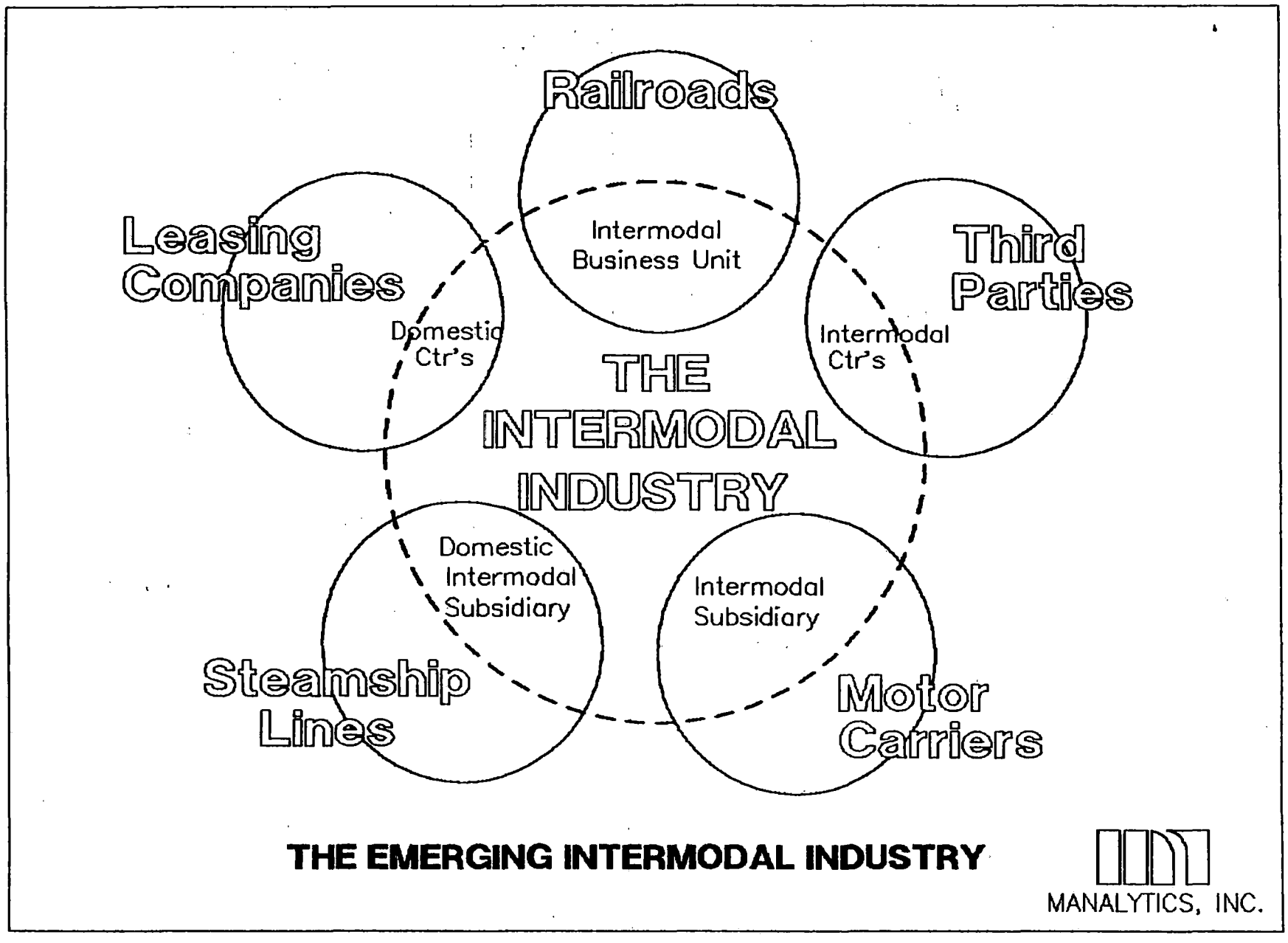
- If the railroad double-stack "product" is limited to hub-to-hub service, railroads will be limited to a minimal returns on plant, equipment, and labor.

- In most cases, either the shipper or a third party fills the gap between hub-to-hub and door-to-door, and keeps the revenue for managing the movement.

- Service improvement and differentiation appears to be the major opportunities to improve profitability by pricing closer to trucks, above the commodity level.

THE DOMESTIC DOUBLE-STACK CHALLENGE: THE INTERMODAL INDUSTRY AND RAIL ROLES

- An "intermodal industry" is emerging, encompassing all the elements of door-to-door service.
- The intermodal industry is made up essentially of subsidiaries, business units, and other intermodal sub-groups of transportation firms.
- Links between participants can include ownership, contracts, VCA's, and strategic alliances.



THE EMERGING INTERMODAL INDUSTRY

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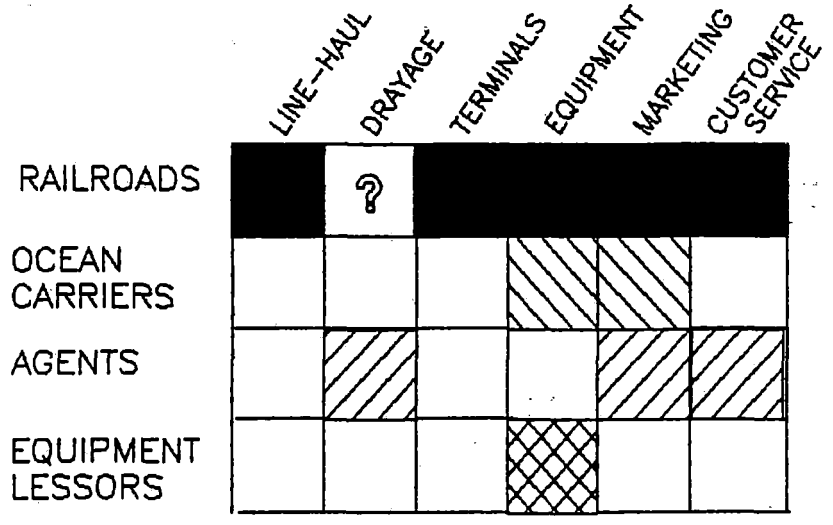
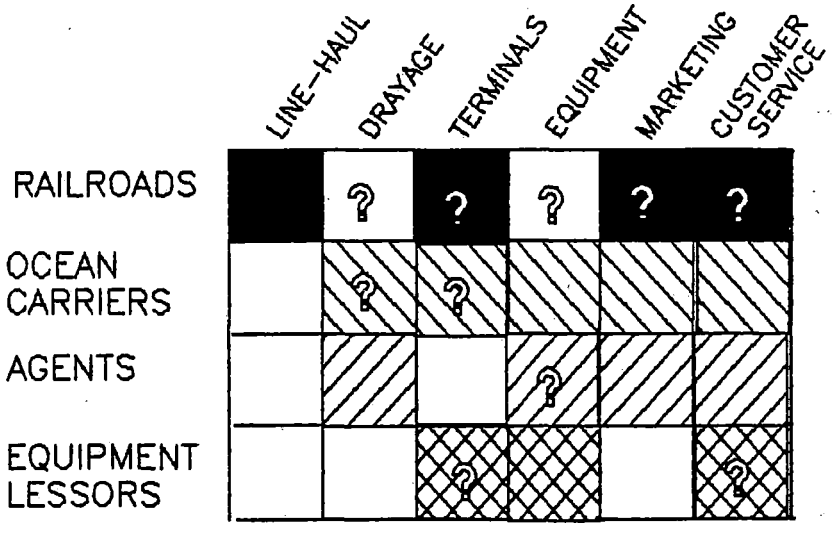
Changing Intermodal Roles



1980 - Static Roles



1989 - Changing Roles

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THE DOMESTIC DOUBLE-STACK CHALLENGE: MULTIMODAL OWNERSHIP

- Multimodal ownership is incidental to the provision of intermodal service.
- It is not necessary to own something to control it, nor does ownership necessarily yield better control.
- As a means of cost reduction, ownership and internal incentives must be compared with contractual incentives, case by case.
- As a means of market coverage, the benefits of ownership must be weighed against the possibility of hindering cooperation with outside participants.
- The standard of performance -- high quality door-to-door service -- is the same, whether achieved through ownership, contract, or strategic alliance.

IMPLICATIONS FOR RAILROADS AND DOUBLE-STACK OPERATORS: EQUIPMENT NEEDS

- Total container, chassis, and car investment for the potential 1987 truck-competitive network totals $3.9 billion:

	Units	1987 Price ($)	Cost ($M)
Domestic Containers	264,046	8,000	2,112
Chassis	132,023	6,500	858
Double-Stack Cars	5,281	180,000	951
TOTAL			3,921

- The investment would be spread over the whole intermodal industry: railroads, double-stack operators, Trailer Train, and leasing companies.

- Additional investments would also be needed in motive power, lift equipment, and drayage tractors.

IMPLICATIONS FOR RAILROADS AND DOUBLE-STACK OPERATORS: TERMINAL REQUIREMENTS

- Overall, the major hubs have sufficient track capacity to handle the potential 1987 domestic container network and other intermodal traffic.
- Shortfalls were noted in Portland and St. Paul, with a combined expansion cost of $4.7 million at $150,000 per acre.
- Individual terminals, however, may require re-configuration, additional lift equipment, and additional parking.
- Ocean carrier affiliates and other intermodal participants may provide part of the terminal capacity.

IMPLICATIONS FOR RAILROADS AND DOUBLE-STACK OPERATORS: TECHNOLOGY

EQUIPMENT

- Equipment technology is not a major obstacle to double-stack growth, since that technology is being incorporated in fleet expansion.
- Marginal improvements would be desirable in:
  - Container tare weight and door openings;
  - Tare weight of chassis and dray tractors; and
  - Tank, flat, refrigerated, and other container types.

MANAGEMENT

- The greatest opportunity appears to be in "management technology" to increase service quality.
- Electronic information technologies such as EDI, AEI, and ATCS can help.
- The challenge to the railroads and double-stack operators is to exploit management technology, create organizations, and train people to deliver a dramatically improved service.

IMPLICATIONS FOR RAILROADS AND DOUBLE-STACK OPERATORS: TRUCKING COST CHANGES

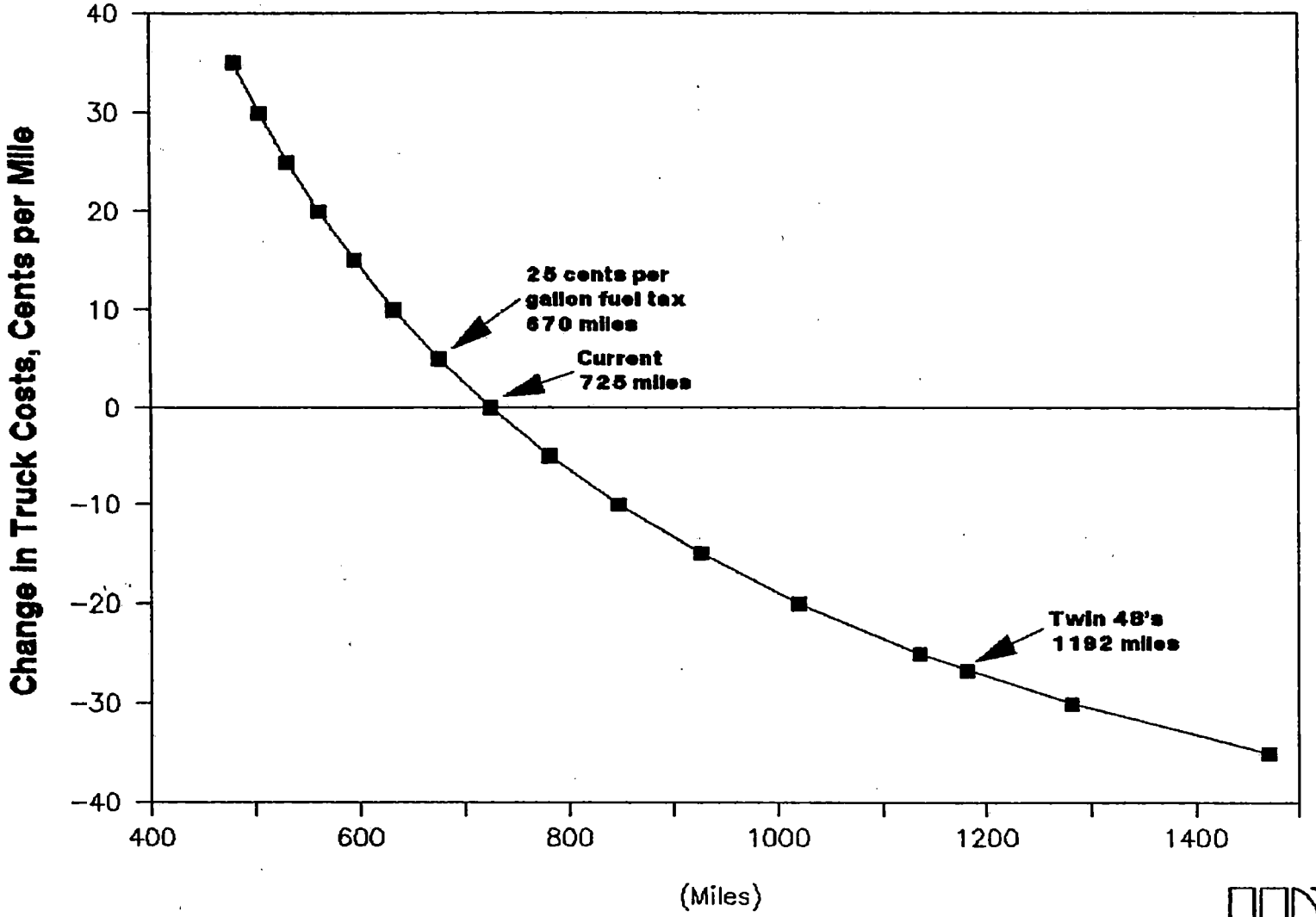
TWIN 48's

- Double-stack services will remain vulnerable to truck cost reductions as long as they must compete on price and offer a discount.
- The use of twin 48's could reduce truckload costs from $.89 to $.62 per laden mile.
- Minimum length of haul for competitive costs would rise from 725 miles to 1,192 miles, effectively eliminating double-stack services within much of the Eastern U.S.

LABOR AND FUEL COST INCREASES

- Truck labor costs increases, due to driver shortages or other factors, would reduce the minimum length of haul, and open up new double-stack markets.
- Increased user fees, fuel taxes, or fuel prices would likewise reduce the minimum length of haul and open new markets.

TRUCK COSTS AND MINIMUM DOUBLE-STACK HAUL LENGTH



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IMPLICATIONS FOR OCEAN CARRIERS AND PORTS: MARINE-RAIL COMPATIBILITY

OCEAN CARRIER AFFILIATES

- All major ocean carriers have North American or U.S. affiliates active in double-stacks, but those affiliates are divided in their domestic commitment.

- Most ocean carrier affiliates view domestic traffic as a means of cost reduction: backhaul revenues defray the cost of repositioning. They are passive in marketing and operating domestic service, and compete on price, with a permanent "sale" mentality.

- A few ocean carrier affiliates view domestic traffic as a profit center, or a separate product, and have become active marketers and operators. They compete on service as well as price, and attempt to maintain profitable rates.

TECHNICAL AND COMMERCIAL COMPATIBILITY

- Variations in marine and rail container sizes can be an operational nuisance, but they will not be a significant barrier to the development of a combined network.

- ISO containers have less capacity than domestic boxes, but they are heavily discounted and will continue to attract price-sensitive domestic traffic as long as international container flows remain imbalanced.

- Until high-quality, door-to-door domestic services are established, the industry remains vulnerable to downward rate pressures and balance problems from low-priced ocean carrier backhauls.

IMPLICATIONS FOR OCEAN CARRIERS AND PORTS: PORT ROLES

- Ports will not be significant players in domestic double-stack service.
- Ports will devote their limited resources to intense competition for discretionary international cargo.
- Ports may have some role in improving rail clearances and access.
- Domestic impact on on-dock facilities will be minimal: all parties have incentives to keep domestic containers out of on-dock facilities that are at or near capacity.

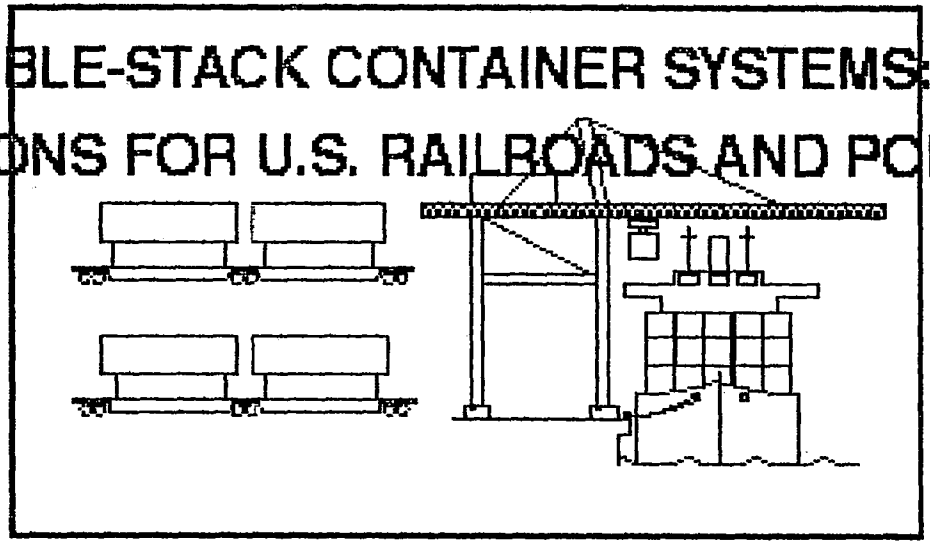
ARE THERE POTENTIAL PUBLIC POLICY ISSUES? YES.

- The development of double-stack services, both domestic and intermodal, would benefit from resolution of overweight container issues.

- Public action on truck size and weight, and on truck fuel taxes and user fees, will affect the competitive balance.

- Improvements to terminal access may benefit double-stack operations at both ports and inland rail terminals.

DOUBLE-STACK CONTAINER SYSTEMS: IMPLICATIONS FOR U.S. RAILROADS AND PORTS



REPORT TO:

FEDERAL RAILROAD ADMINISTRATION

MARITIME ADMINISTRATION

MANALYTICS, INC.

WILL MARKET FORCES BRING ABOUT EFFICIENT DOUBLE-STACK SERVICE? YES.

- The volume and revenue potentials are very large relative to existing domestic intermodal traffic.

- Numerous initiatives by ocean carrier affiliates, railroads, and third parties demonstrate the existence of incentives and commitment.

- The obstacles to be overcome are commercial, rather than technological, legal, or regulatory.