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Research Needs Related to Intermodal Freight Transportation

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PREFACE

Freight transport in the United States is currently undergoing many changes; some due to deregulation; some due to new technologies such as super containerships, automated movement in ports, double-stack container rail service, and integrated truck/train concepts; and some due to an ever expanding international and domestic flow of containerized goods.

At the same time shippers are demanding more competitive prices with increased levels of service quality. Sizeable investments for ports/terminals and for carrier equipment will be needed to cope with the increasing demand. Responding to all this calls for tough, innovative decision-making by managers of freight movements who have a broad transportation system's perspective and the ability to utilize a range of planning tools. With all of these changes comes the increasing use of intermodal transportation.

With deregulation moving forward with a full head of steam, the data formerly required by regulatory agencies and used for much research is no longer available. This raises a concern as to the research community's ability to effectively answer some of the pressing questions.

The Transportation Research Board's Committees on Intermodal Freight Transport and Intermodal Freight Transport Terminal Design offer a new research agenda; one that will govern their activities for the next several years. Questionnaires requesting research needs were sent to over 200 persons representing all aspects of intermodal transportation. The 120 research suggestions received from 50 respondents have been used to form the backbone of this research agenda.

Priorities for research are organized in response to the ten critical issues in transportation established by the TRB's Executive Committee. The four issues for which research is most needed in intermodal freight transport include intermodal transportation and U.S. competitive position worldwide, improved productivity, relieving congestion of facilities, and deregulation. Study areas involve: (1) data base development, (2) economic and financial alternatives, (3) regulatory and legislative impact analysis, (4) demand forecasting, and (5) improving the tools for managers including an improved understanding of operational/price/service tradeoffs, especially as they are impacted by technological change.

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1. INTRODUCTION

Cognizant of the revolution going on in intermodal freight movement in the United States, TRB's Committees on Intermodal Freight Transport and on Intermodal Freight Terminal Design are in the process of reviewing and rethinking their research agenda. This paper sets out to provide a basis for that process. A questionnaire was sent to a list of 200 representatives of shippers, carriers, shipping companies, port and terminal managers, government, academia and the consultant community. Just over 50 responses presenting about 120 suggested research questions were received, with approximately equal representation from all the groups solicited. The questionnaire requested respondents to postulate a hypothesis or research premise and then present a series of questions important to developing the premise.

1.1 SOME ELEMENTS OF CHANGE

The revolution is due, in part, to significant revision in government policy and increasing trade with Pacific Rim countries over the last few years. These changes have led to significant new competition between carriers, between ports and between modes. The demand for containerized freight to the United States and across the United States has increased over ten percent annually during the last few years.

Ports must service larger and larger container ships. The next generation of container ships will have slots for over 3,000 large standard forty-foot containers. Shipping lines are demanding that their vessels be unloaded faster and that their containerized freight start moving inland immediately. Technology being developed to respond to possible port saturation includes super cranes, automatic container yards, trains that can carry containers in a two-high configuration, adjustable truck chasses, upgraded communication/information systems, and the like.

The Staggers Act of 1980 (PL #96-448) and the Shipping Act of 1984 (PL #98-237) have provided a new climate for increased competition by relaxing rate-setting policies and creating new entry possibilities. Further, growing international freight traffic, which presently accounts for about 35 percent of the railroad intermodal business, appears to be the driving force behind lower rates in domestic freight as well. Shipping companies like the American President's Lines (APL) and Sea-Land (now part of CSX), both experts in international freight movement, have postured themselves to market domestic freight services hoping to load containers with domestic freight for the backhaul to the western states. Unfortunately, such moves tend to undercut the normal rates charged for usual westbound fronthaul of TOFC (trailer on flat car) traffic by charging only the marginal cost to transport the loaded domestic containers from the East and Midwest to the West Coast.

Railroads are still assessing their competitive approaches to double-stack service. One major railroad negotiates roundtrip contracts which permit the ocean shipper to solicit westbound traffic on their own, while another has attempted to retain control of the westbound traffic.

1.2 SOME EFFECTS OF CHANGE

Changes like those mentioned above are occurring in a competitive environment. This will prompt considerable increase in investment in ports, vessels, railcars and track (primarily for higher clearances), truck chassis, and a new information system to tie the system together. The pressure will increase to provide more throughput and to reduce costs at intermodal terminals and ports. Marketing and pricing become all important, particularly to reduce the empty (expensive) backhaul of the containers. New technology will be needed not only to improve productivity, but also to develop a management information system to accurately keep track of each container.

With pressure to offer better and lower cost service, and without the restraint of entry, the industry structure could well change in the direction of fewer, larger transportation companies, each with nearly the full capability of providing end-to-end service. Management of such companies will likely require a new-style, well-informed person who can make quick tradeoff analyses to inform sound business decisions. Yet, since the time when comments were solicited, United States Lines has gone bankrupt; and the I.C.C. disapproved the proposed merger between Southern Pacific and Santa Fe Railroads. In the opposite direction, however, is the purchase of Sealand Corporation by CSX, which moves closer to becoming a full intermodal company with the capability for end-to-end moves under one management. The impact of these and other changes is not yet clear in terms of its effect on intermodal transportation. (This also becomes a research topic discussed later.)

1.3 RESEARCH DATA

Questionnaire data are organized according to functional areas: industry structure, management, service quality, operations, marketing, pricing, investment and technology (innovation vs. standardization). Viewing the intermodal system by function has led to the proposed research agenda.

The key elements of this report are:

- (a) The bringing together of diverse and wide ranging concepts and research ideas from a spectrum of experts in the field of intermodal transportation.
- (b) The development of a taxonomy suitable for capturing the broad range of issues in intermodal movement.
- (c) A research agenda which provides cross-cutting of modes in order to fully consider intermodal freight transport as a system. Included are:
 - (i) Building and maintaining a strong data base in support of intermodal research.
 - (ii) Performing research to better understand the cost structures and investment centered across the intermodal system combining performance with economics.

- (iii) Continual analyzing and evaluating of existing and projected legislation.
 - (iv) Performing studies on operations/service/price trade-offs.
 - (v) Forecasting scenarios related to intermodal changes in use of technology or changing patterns of flow.
 - (vi) Looking at management issues including case studies and the management information system so vital to successful management of intermodal moves.
- (d) A preliminary prioritization of research based on the TRB Executive Committee's ten critical issues facing transportation (6).

This paper presents all the research issues submitted even though the results of some of the proprietary research may not be made available to TRB. Transportation research is performed in both the public and private sectors but usually for differing motives. That conducted in the private sector is usually for competitive advantage and hence is of a proprietary nature. That done in the public sector (or that available to the public) is usually performed in support of federal, state, or local government policy or in response to challenging problems by those in universities and colleges. TRB must, to the extent possible, be cognizant of it all. No attempt has been made in this research agenda to separate between private and public research.

The organizing principles are described in Section 2. The research views in areas (a) Industry Structure and Management, (b) Marketing, Pricing, and Service, (c) Operations, (d) Investment, and (e) Technology: Innovation and Standardization are presented in Sections 3-7. The research agenda organization with preliminary prioritization is in Section 8. The questionnaire is presented as Appendix A with all the detailed responses received as Appendix B. The latter is to provide the reader with an added insight into the individual research concerns expressed by the respondents.

2. THE ORGANIZING PRINCIPLE

Intermodal freight movement is a complex system of inter-related activities, each of which performs a portion of the movement of freight from origin to destination. Efficiencies demand that each portion of the movement have an integrated or coordinated relationship with the others. Further, each of the modal components is, for reasons of its own effectiveness, likely to optimize its individual systems. While good for the particular mode, such changes can become sub-optimal when considering the performance of an overall intermodal system.

For example, in order to take advantage of economies-of-scale, super ocean-going containerships will be built to achieve lower container slot costs, so important for competition on all-water routes. However, when used as part of an intermodal movement, the docking of a vessel with 2,000 to 4,000 containers to be unloaded and moved quickly, can temporarily saturate the port's handling facilities.

A three-dimensional view of the functions involved in intermodal movement, shown in Figure 1, is proposed. This functional approach is one way to bring some semblance of rationality to this complex large system issue. The major aspects of the functional view of intermodal freight transportation are:

1. The COMPONENTS of the system (e.g. rail, ports, water, etc.)
2. The FUNCTIONAL CHARACTERISTICS of freight transportation (e.g. service quality, operations, marketing, etc.)
3. The MAJOR VARIABLE AND EXTERNAL FACTORS that often influence or dictate costs and operational concepts (e.g. government regulation, environmental impact, etc.).

Functional analysis has been applied previously to individual transportation modes by Hazard (1), and its general construct is used to assess the intermodal system, its activities, issues, and potential research needs.

2.1 COMPONENTS

In general, any intermodal move will involve at least three components; namely, the two line-haul segments and the interconnection between the line-haul modes, usually called a port or terminal. (Since a terminal is really a point of connection where the change is made between one mode and another and not the terminus of the trip, there should be a better name than terminal.) For example, a TOFC movement involves a truck leg from the shipper's dock to the piggyback terminal, a shift to the rail leg and then a shift at another piggyback terminal to truck for delivery to the consignee. The intermodal movement, to be effective, must pay strict attention to the costs and services involved in all facets of the move.

2.1.1 Water Carriage involves a wide variety of vessels. The range of vessels is from the super containerships previously mentioned, to smaller ocean-going ships, some with special purposes like the Roll On, Roll Off ships (RO-RO ships move truck vans across water), to smaller vessels that may be part of a load center delivery system (Great Lakes or intercoastal vessels may fall into this category), to tows and barges that are so effective for movement on the inland waterways.

2.1.2 Ports are those points of connection usually associated with the transfer of movement from water to land. Ports are different in the sense that they are often publicly owned and their activity generally has a significant impact on the economic development of the area around the port. Because of this, they are often in competition with ports in other localities also seeking economic growth.

2.1.3 Rail Carriage in North America covers a sizable network taking advantage of the high efficiencies of steel wheel on steel rail. The railroad industry is generally a private industry that is responding to the demands for traffic, whether intermodal or not. The cars for intermodal movement are usually special ones that efficiently carry either a truck trailer or a container. TOFC denotes movement with a Trailer-On-Flat-Car and COFC,

Container-On-Flat-Car. The advantage of rail in intermodal movements can be inferred from the comment by one respondent that much of the recent growth of intermodal (TOFC) has come from traffic that formerly moved in boxcars.

2.1.4 Land Intermodal Terminals generally form the interface between highway movement on truck and the movement by rail. Pickup and delivery by truck is becoming more and more important because the access to many shippers and consignees is only by highway. Because of land use constraints, ports sometimes operate or use auxiliary land terminals with drayage moving containers from dockside to railhead or truck terminal some short distance away.

2.1.5 Highway Carriage involves trucking companies, generally privately owned, with about 40% serving the role of common carrier. The way is usually provided by the public sector as part of the United States ubiquitous highway system. The interstate system provides high speed, safe movement for large trucks. Drayage, even of several miles, is also considered part of this movement.

2.1.6 Air Carriage represents a growing segment of the freight system. It is almost always intermodal since it is rare that both shipper and consignee are located at an air terminal.

2.2 CHARACTERISTICS

The characteristics involved in analysis of the various intermodal movements are those that would be identified for any transportation system. Management of movement may be by several individual industries operating individually, as a consortium, as a supercompany, or as a third party. The characteristics chosen to describe and to explore intermodal movement are:

- o Industry Structure and Management
- o Service Quality
- o Marketing/Pricing
- o Operations
- o Investment
- o Technology: Innovation and Standardization

These characteristics for organizing thought leading to development of the research agenda are presented in Sections 3 through 8.

2.3 MAJOR VARIABLES AND EXTERNAL FACTORS

Every potential intermodal movement is subject to pressures such as the following:

2.3.1 International Trade has a vast impact on domestic intermodal movements. The recent boom in double-stack trains and the upsurge in domestic containerization indicates one way this has affected the intermodal system. In fact, with increased movement from the Pacific Rim to the U.S., just supporting newly "foreign managed, U.S. based" durable goods manufacturers should increase intermodal movements. Similarly, growth of third world countries will also affect intermodal movements.

2.3.2 Government Role and Policy has a tremendous impact. There are a large number of federal agencies with some involvement in any transportation movement. However, recent deregulation has served to provide much more incentive for developing a more competitive environment. State and local governments are almost always involved in the ports because of their role in the region's economy and in economic development. Certainly, our foreign policy and support for trade specific treaties like the United Nations Conference on Trade and Development (UNCTAD) become important inputs into intermodal planning and investment.

Government also sets environment policy which can affect each of the transport modes and points of transfer. Environmental rules and regulations can affect both operations and the technology that can be used. Hazardous materials, a commodity often moved intermodally, are also a special concern.

2.3.3 Competition exists, since for each intermodal move, there is usually competition by a single mode as well as other intermodal possibilities. The question is whether or not that movement has the price or service advantages to make it attractive to the shipper. Each mode continually strives for improvements in productivity which can lead to lower costs. Such improvements will ultimately impact the total intermodal movement.

2.3.4 Market Demand is clearly an important factor in a demand responsive system. However, a market can be altered as a function of the service offered by transportation. However, in most instances the shipper is major determinant in the choice of modes and routes.

2.3.5 Labor is a major variable because of the vast number of different labor groups involved in a major intermodal move. Transportation prices and productivity are impacted both by the mix of labor and capital for each component element of the system and by the wide variety of existing labor agreements throughout the system.

2.4 A TAXONOMY FOR RESEARCH ISSUES

The three dimensional representation in Figure 1 is the tool suggested to help in ordering the issues involved in the intermodal freight system. In fact, it could be used to organize research questions into narrow areas such as that represented by the intersection of a single entry from each of the three axes (e.g. the effect of operation related to unloading and loading containers in a given port under the influence of certain labor agreements). The functional characteristics are used in this paper to identify research areas across the components and external factors and major variables.



FIGURE 1. Taxonomy of Intermodal Freight Movement

3. INDUSTRY STRUCTURE AND MANAGEMENT

After so many years of very precise regulation covering topics ranging from market entry, corporate mergers and anti-trust, the transportation industry now has much more freedom. The potential exists to explore significant mergers, major joint ventures and other mechanisms that would lead to the formation of "super transportation companies." Ultimately, such companies could own and have direct responsibility for the complete end-to-end intermodal move.

Intermodal movements, whether combined into one company, operated as a consortium, or simply a movement put together by a shipper or consolidator, represent the involvement of several diverse transportation entities or operations. New management techniques and thinking, especially at the system's level, i.e. for the end-to-end move, are needed. Good management of each of the individual components of the move is also required. A system's understanding of the move will be essential for both the operator and the shipper.

3.1 BRIEF ANALYSIS

3.1.1 The Change in Industry Structure: It is now clear that one of the results of deregulation in the air industry is the survival of a few sizable airlines operating between major hubs. The new airline companies have resulted from complex friendly mergers and from less friendly buy-outs of often unprofitable or marginal lines. Northwest, through purchase of Republic and Frontier, moves to a very large carrier, as does Continental, with the buy out of People's who had previously bought out Britt. Both of these airlines are in the process of assimilating equipment and rationalizing their total route structures.

A similar phenomena is occurring in the freight transportation system as major railroad companies have worked out mergers in order to extend their service areas and provide across-country through service as a single rail company. Strongly opposed under past regulation, the recent CSX mergers first with the American Commercial Barge Lines and then with Sea-Land Corporation open the possibility for a single management having complete control of intermodal moves. With the increase of containerized commodity flow, a truly integrated full-service carrier becomes much more likely. American President Lines, with ownership of double-stack rail cars and ocean-going vessels, is another example of a company that will be able to offer service over an entire route. Alternately, the recent demise of the U.S. Lines may be another reflection of the changing industry structure.

3.1.2 New Management Challenges: The postulated formation of multimodal "super transportation companies" suggests a series of special management requirements which include training for employees to be successful managers across the breadth of an intermodal company and the development of new cost allocation procedures to manage modes and terminals which have vastly different cost structures. Such management will, of necessity, involve a broad operational understanding of all facets of the freight movement, plus creativity in marketing and planning. Shippers, consolidators, and distributors will also need to have a broad understanding of the various moves as well as sufficient knowledge to make the tradeoffs between competitive forms of transportation to aid in their decision making.

3.2 RESEARCH PREMISE

Spurred by continuing government deregulation, need for trade management, desire for growth in efficiency and the exploding use of containers, truly integrated, full service carriers will emerge with the capability to handle origin-to-destination freight movements as a "single-firm-managed" service. Such companies will become giant transportation companies with controlling interest in several modes of transportation and often with special interests in certain geographically located points of connectivity, i.e. terminal and ports. They will encompass many transport services and will become trans-national or multi-national corporations.

Those large companies that survive will be well managed, and be able to "engineer" market influencing tradeoffs. They will develop coalitions with freight forwarders and consolidators to enhance their market penetration. A new breed of tough managers, with perceptions of where risks will be worthwhile and where they will not, will succeed to top management.

3.3 EFFECTS TO BE CONSIDERED

Should the premise have validity, there are a number of possible impacts and effects that bear investigation.

3.3.1 A Transport Oligopoly or Consortium: If the mergers and growth are successful, a few giants will emerge. While competitive among themselves, the large companies will so dominate the industry that they will, in effect, exert control over rates, costs, service standards and the like. They may become

profitable enough so that in the long term they may be merged with large corporations in other related fields. If the capital required becomes too massive or if profit margins are not sufficient, the super transport companies might rather take the form of consortia of partners, each providing management in its specialty. Such consortia could alter the nature of services, set their own rules, offer through-service, and enter into special exclusive agreements with ports, terminals and load-centers.

3.3.2 Increased Role in Economic Development: The advent of super companies will result in identifying potential locations for exclusive interchange and port operations. Communities that meet the criteria could be leveraged by the large companies to promise large economic development packages, including land, tax relief, and new major facilities for services (roads, water, electricity, etc.) in order to compete for the jobs and growth.

The quest for new locations for hub-and-spoke and other interchange operations may create an economic development stimulated competition between cities/states similar to that seen between potential sites of new automobile assembly operations like Bloomington, IL and Georgetown, KY.

An alternative to be explored could be the development of jointly owned or public facilities. The economies of scale in the construction and operation of rail intermodal facilities are significant, yet railroads individually operate multiple terminal facilities in metropolitan areas. However, since many intermodal facilities will need to be upgraded in the next 10 years, an enterprising entrepreneur or a consortia may attempt to provide the coordinated development of new, jointly used intermodal facilities. The politics involved in attracting such a joint venture may change, but the effect on economic development will generally be significant.

3.3.3 Economies of Intermodal Ownership: It is not clear whether or not the economies of full-service ownership will be sufficient for multi-modal mergers to take place. There is a difference between (1) owning and operating a railroad and developing a merger with another railroad and (2) owning and operating a railroad, acquiring a barge line and a shipping line, as well as developing the local drayage capability at some distribution points for the movement of containers from the port to the rail head.

3.3.4 Organization and Management: Structuring the new major transportation company may look more like the corporate situation of a multi-billion dollar multi-product company. Those who move to the top in such companies will have an innate capability for analyzing the macro aspects of the corporation and be able to function in a relatively high-risk environment. Analysis of the change of management structure that has occurred in APL and CSX, as well as other diverse service industries, may provide clues as to how the successful integration of the corporate entities may take place.

Management training will become an important focus for the new corporation. The old transportation "hip-pocket" methods must be replaced with modern skills aided by the best information technologies that can be developed. For example, a management information system for better control of containers and equipment will be needed. More than ever before, the pressures of Just-in-Time inventory by the shipper and the explosion in container traffic

will initiate new container control methods. Management information systems will require a data base ample to facilitate management attention on all factors influencing the end-to-end shipments and the meeting of service criteria.

Managers of ports and, to a lesser extent, of railroads will need to develop capacity to manage the potential peaks and valleys resulting from super containership arrivals. This involves investment in adequate facilities, handling a potentially unbalanced labor requirement, and working with customs to expedite containers through the ports of unloading. Owners of super vessels will not want to have multiple ports of call in close proximity to each other and will demand quick unloading and turn around.

Another segment of the industry is the marine terminal and stevedoring companies where workload changes when containers are passed directly to an inland destination by rail or truck. The loss of transloading from international container to domestic container or to another form of freight distribution reduces the amount of stevedore labor. The contracting by the port for some port services may well end with the advent of large transportation companies.

3.4 SOME MAJOR QUESTIONS FOR RESEARCH

It seems to be a safe assumption that large, powerful transportation companies will emerge, but the manner in which such will happen is, by no means, certain. Research may be appropriate into such questions as:

1. What forms will horizontal integration of industry take? Will full-scale corporate mergers or specially formed consortia to handle specific movements be seen? Alternatively, will there be a growth of third party managers that will cause ocean carriers and rail carriers to become operators only offering space on a charter or space available basis?
2. What will happen to ports and their major tenants? Is it possible that private ports will emerge as part of the new transportation companies?
3. Does horizontal integration make the necessary capital formation easier or harder? Under what circumstances?
4. Can such companies become so monolithic and controlling that they will bring a fresh new wave of regulation? How will this happen when the company contains a large foreign component?
5. Will transportation in U.S. change radically as the U.S. economy becomes less industrialized?
6. Can an effective organization emerge or evolve from existing management?
7. Management of large scale intermodal moves will involve a level of decision making previously unknown in the industry. How will these decisions be made?

8. Will such integration lead to more hub-center or load-center operations as has happened in the airline industry? What ports and intermodal connection facilities are prime candidates to become such centers? What are the criteria for selection of new centers or centers for growth? What impact will such centers have for industry structure and management?
9. What performance standards will be applied to various movements of freight? What tools will management use to evaluate how they are doing in various aspects of intermodal moves?
10. What data and technological breakthroughs are needed to provide information to enhance equipment utilization, accomplish load planning, and track containers within the system?
11. What internal data is required to achieve a cost expenditure knowledge to be used for future cost allocation?
12. What new unique kinds of training and/or job rotation will be needed for future managers of intermodal moves?
13. What are the potential labor issues that will plague end-to-end intermodal movement, and what are possible solutions for a smooth management labor interface?
14. Can cross-modal information systems and communication standards be developed to provide the extensive/timely results/modal information needed by managers?

4. MARKETING, PRICING, and SERVICE

Professor George List from RPI sums it up in his response, "Pricing strategy and market capture are in a state of flux." Some intermodal moves compete with others, but also they must often compete with single mode operation. Two examples are (1) all-water routes versus intermodal landbridge and (2) TOFC versus with door-to-door long-distance trucking. Service and price trade-offs are the key to market penetration since the service provided becomes the bottom line; depending, of course, on freight value and customer requirements.

By definition an intermodal carrier takes the responsibility for the entire movement of a shipment just as a single mode carrier does, e.g. trucking lines. There are also the times when for price, service or equipment availability reasons the traditional single-mode carrier utilizes an intermodal move, although the customer may never be aware of it. For example, one national LTL (less than truckload) carrier regularly ships by TOFC from the Midwest to the Northwest.

Basically, service is defined by the joint agreement between the shipper and the provider of transportation that indicates what the shipper needs in the way of system performance for the price he is willing to pay. Price, speed of movement, timeliness of delivery, reliability of delivery, and the condition

of the freight at delivery head the list of needs in which the shipper may be interested, and for which he is usually willing to pay. Steven Fuller from Leaseway comments in his response, "A marketing approach to developing services based on shipper's needs will make service, not mode, the issue {for freight movement}..." ({added})

4.1 BRIEF ANALYSIS

From a marketing point of view, the key to successful intermodal penetration will be the ability to market the right service and to price it competitively. Professor W. Bruce Allen of Pennsylvania states in his comments that "intermodalism is a great revenue business, but a poor net revenue business." If true, then the potential sales are there; and it becomes more a matter of improved productivity of both equipment and labor so that the price remains attractive and the profits improve. Marketing the service, backed by contracts (with penalties and /or incentives), becomes key.

Since providing service is the bottom line in competition, every provider of transportation is keenly aware of the associated risks as well as the rewards for good performance. Because intermodal movement implies that the freight will pass through multiple sets of hands, it appears to be a riskier way to move freight, even though the service provided might be cheaper, more selective, and/or faster. Key aspects in thinking about service quality for intermodal movement are:

- o the freight undergoes multiple handlings,
- o the freight is subject to several different sets of vibration, shock and other environmental conditions,
- o portions of the move will generally occur under different managers,
- o there are more ways for freight to get lost,
- o the usual higher valued freight is more theft prone, and
- o the freight may be subject to customs or other inspection.

It is within this framework that the transporter must guarantee the main service goals such as timeliness, reliability, and damage-free delivery. This framework may not appear to be much more stringent than the usual LTL delivery, but with the number of modes involved, it could be a consideration.

The movement of sealed containers from shipper to consignee will make the concern of damage and loss less important. (Although the military reports that some containers have been mysteriously lost over-board on some of their overseas shipments). If both the dunnage and container have been designed to withstand the rigors of the various transport environments and if cranes don't drop the container too far, then most container movement is safe, takes less time, and reduces the port labor compared to the labor involved in transloading from container into box-car or into truck van.

Just-in-time requirements from foreign and domestic automobile assemblers in the United States, Canada, and others who have such requirements, will pressure intermodal service with the requirement for delivery on-time, every time.

The growth of intermodal will, to a great extent, depend not only on management provided, but also on the service quality coupled with competitive pricing.

4.2 RESEARCH PREMISE

Spurred by fundamental changes in the U.S. economy and industrial base as it moves to the post-industrial era, new extensive international traffic flows are being created. As a result, the service/price trade-off inherent in many shipper decisions regarding carrier modal preference will also shift. One example is structural change in the auto industry where final assembly will occur in the U.S. with parts from many places in the world shipped in containers. Pressures to provide Just-in-time delivery of containers to Midwest assembly plants will place a premium on management control of containers.

Consumers will be more interested in reliability and cost than in all the steps in the multi-modal movement. This will result in a renewed drive to improve efficiency, especially for improvement in the intermodal transfer process. Real-time knowledge of container location and control of its movement from centralized management will become very important in providing the services.

Deregulation, especially in entry and backhaul movement, offers the opportunity to market new service options and to improve service resulting in some productivity/profit gains. There is also the matter of commodity capture. For example, it has been suggested that some bulk (e.g. grain export to the Far East) cargoes could occupy containers providing a backhaul to either the West Coast or the Pacific Rim.

4.3 EFFECTS TO BE CONSIDERED

4.3.1 Service Philosophy: If intermodal is to be successful, carriers must stress service. Fast, efficient movement of trains or vessels is a necessity. It is, however, not sufficient. A new awareness of caring for the freight transfer must be developed. It seems that, with containers, intermodal will or could move to a concept of the container occupying a reserved space on a given train or vessel. Deregulation and increased reliability of service called for in contracts seem to be pushing in that direction. "Just-in-time" service is growing as out-sourcing from overseas by American industry grows and as the new foreign plants built in the United States require it. Pressure exists for management to provide both interchange facilities and information systems to ensure on-time delivery, every time.

4.3.2 Backhaul: The backhaul movements of double stack and front-haul standard COFC/TOFC movements are in competition. With the upsurge of Midwest container delivery as the last leg of an international intermodal move,

shipping companies have been looking for return hauls for their empty containers. To the extent that these moves take away the front-haul freight now moving by TOFC, traditionally from east to west, then the two movements are in competition. On the contrary with sufficient demand the two movements are potentially a perfect fit in a transportation system which reduces empty backhauls in both directions with the better service at reduced cost coupled with highly efficient equipment utilization.

4.3.3 Value of Goods - Time in Transit: Some companies will choose a more expensive but faster intermodal movement because of the cost of the goods being transported. Intermodal needs to make sure that the scheduling of transfer movements meets the required delivery service. The improvement in time of delivery to the east coast from the Pacific Rim is over seven days when land-bridge is used rather than its all-water equivalent (2).

4.3.4 Marketing to Small Communities: Hub centers have the potential to improve service to smaller communities. The combination of technology innovations, such as transfer to RoadRailer from double-stack rail, for improved hub-center operations, should present one area of investigation.

4.3.5 Rating: Total price and profitability will depend on international exchange rates. Under certain conditions, some freight may not move. On the other hand, trade in the other direction can increase. In addition intermodal movements will generally involve several different cost structures which will make the process of rating more complex. Yet knowing how to fairly price the service is critical.

4.3.6 Cost Factors: Cost is, as always, of critical importance. Of particular concern are those places where extra costs "sneak in" and give a low or even negative profit. Such cost factors like drayage, time lost in storage, poor labor practices, etc., need more than their share of the constant attention that must be given to all cost factors.

4.3.7 Facilitation: The generation and movement of the paperwork of major transportation moves is a complex logistics process in its own right. Electronic data interchange (EDI), is growing and will become more and more acceptable as intermodal transport gains momentum. Work to develop standardized formats for documentation, especially between domestic and overseas, bills of lading, tariffs, etc., has been underway for several years with the Transportation Data Coordinating Committee leading the way. Their work needs to continue to bear fruit. Interactive computer systems, available to link all parties in the international exchange of goods together, will need to meet increased acceptance by banks, governments and insurance companies to obtain maximum efficiency. The U. S. Customs has recently designated several ports as service centers to experiment with an EDI hook-up with their clearing house in Franconia, Virginia as a part of their project to use EDI to improve the customs service.

4.3.8 Government (DOD/DIA) Goods Movement: As the largest shipper in the world, the U.S. Government's use of intermodal needs attention. It is not clear what the peacetime role of intermodal transportation for the movement of defense and other government impelled cargoes should be. Not all defense

shippers accept intermodal movement as their preferred route. Since they view service/inventory costs somewhat differently their market will be different. Further, the restriction of government cargoes to U.S. flag carriers at various percentages may influence some intermodal moves. It is an area that needs further attention.

4.4 SOME MAJOR QUESTIONS FOR RESEARCH

Since the competitive nature of transportation covers such a wide range of service, market and price issues, many questions could be developed. A few of the more important ones are:

1. Is marketing strategy for intermodal different than for most single-mode movements? If so, how? How can one intermodal company (e.g. a railroad) turn the marketing of an intermodal move over to another (e.g. a shipping line) and still maintain control over its pricing and profits?
2. Does the intermodal marketing manager call for a new breed or can former modal marketing managers be successful?
3. What are the explicit service and cost comparisons between intermodal movements and their single mode equivalent? To what extent does using each mode to perform in its most efficient manner offset the costs of time and money utilized in shifting from one mode to another?
4. Does the multiple modal movement enhance or detract from guaranteed delivery reliability? In what ways? What are the trade-off areas?
5. What is the ultimate market for domestic containerized freight? By commodity? By stage length? By intermodal components? What service quality is required by what commodities? Can and should bulk commodities be carried in intermodal containers, especially for backhaul rates? At what product value does such a move become profitable?
6. How will load center or hub-center concepts develop in response to the demand, and how can they help in marketing?
7. A vast number of Japanese automakers have decided to locate plants in various Midwest states and in Canada. What will increasing demand for freight from Japan and other Pacific Rim countries do to the intermodal system? Will they want Just-in-time inventory approaches? How will these impact the system performance and service?
8. Can port/airport/terminal facilities be designed to provide service needed to expedite Just-in-time cargoes?
9. What are the service/price tradeoffs used by shippers in their decision-making? What does intermodal offer with which a single mode cannot compete?

10. Will intermodal have more or less "staying power" to weather periodic economic downturns and recessions?
11. Are we moving to the use of reserved space on a mode, e.g. trains, instead of unlimited service at a specified price?
12. Participation in intermodal affects the market share of each of the forms of carriage. What does it mean to profit? To the corporation goals? And to the marketing effort?
13. What is the relative peacetime role of defense and other government related cargoes in intermodal carriage? What are the trends? What are the long-term requirements?
14. Given that U.S. Government cargoes are reserved to U.S. flag operators in varying percentages by cargo preference laws, is it important to determine the role of defense and other government-type cargoes (e.g. Public Law 480 shipments) in the operation and marketing of such carriers? How much does intermodal movement affect business strategy of U.S. flag carriers? How do these cargoes reflect themselves in the competition between U.S. and non-U.S. flag operators?
15. How sensitive are the issues of flag carrier requirements and government business to exchange rate fluctuations?

5. OPERATIONS

Research of an operational nature is vital since, ultimately, it is performance in this aspect of the transportation system that determines whether or not profit is possible. Because of its more complex scope, intermodal transport hosts a variety of operational problems; while some are peculiar to intermodalism alone, many simply reflect problems of handling freight within a given mode or at one of the ports or terminals.

Probing into operational activities is usually of great interest to transportation researchers. Here, clues can be found for improved productivity, for improved safety, for increased system-level understanding and for developing management requirements. Unfortunately, operational analyses often suffer from the lack of ample data from which sound conclusions can be drawn. Data used and results obtained from experiments run in the private sector are usually proprietary and generally not available to the transportation research community at large. Data gathered in the past by regulatory agencies is no longer required from the carriers and operators, and hence is no longer available to the transportation researcher.

5.1 BRIEF ANALYSIS

5.1.1 Data Gathering: While gathering adequate data as a basis for research studies is a problem for all the areas of investigation, it has been included under the operations section because it is here that the paucity of data seems to have the major impact. Sources of data include publicly available data,

data offered by the private sector (often where the source is protected) and from case studies where the data pertaining to individual cases can be shared with other analysts. The cost in time and money for gathering some forms of data can become very high.

5.1.2 Systems Analysis: One research concern for intermodalism is to be careful that a decision made in one mode, for the efficiency of that mode, does not undercut or suboptimize the overall efficiency of the intermodal movement. Yet, this is one of the forces with which intermodalism has to be concerned in a competitive world. Why shouldn't the individual modes work to enhance their own competitive position? As previously discussed, the advance of super containerships can have a deleterious operational impact by saturating some receiving ports, and by producing an imbalance in load planning for the interfacing rail carrier and the local drayage handlers. Such peaks and valleys in demand have always been the "Achilles heel" in transportation. Certainly the port and rail system will have to respond to the high peak demand and find ways to mitigate any negative effects.

By pushing for larger and larger trucks, which help their productivity, trucking can continually throw a "monkey wrench" into container investment and carriage by rail and shipping lines. APL have redesigned their double-stack cars to accommodate the latest trailer (container) allowed on U.S. highways (48 feet long by 102 inches wide). The implications of an even larger van (53-foot trailers are, in fact, in use in some places) are great. What will the shipping lines and railroad companies do with obsolete equipment?

Further, systems analysis should be undertaken to avoid sub-optimization and the possible resultant reduction of profit. Shippers are often furnished such analysis as part of the service packages promoted by carriers or third party distributors. Shippers will need the capability to review such analyses. Carriers often have a limited and somewhat parochial view offering limited or partial service packages reflecting their own equipment utilization, inventory cost and operational needs. In any event competition will determine the choice made by the shipper (optimum or not).

5.1.3 Line Haul Modal Movements: Double stacking of containers is a new technology that is growing rapidly. TOFC and COFC are still well used intermodal moves. The capacity of the system to efficiently handle various types of intermodal moves under various market scenarios can be of major operational concern. Delays at terminals and docks are often the result of lack of capacity to move containers. Sometimes this is a problem in the port itself, other times, it is lack of rail and/or drayage capacity.

5.1.4 Terminal Operations and Planning: Terminal transfer costs seem to have the greatest impact on the cost of movement and on the competitiveness of intermodal transport. Research continues into the improvements that can be realized with the utilization of better, faster, more capable cranes and lifts. Improvement is needed in internal logistic planning in order to identify ways to minimize sizable drayage costs, as well as promote efficient handling of the arrival of super containerships. Research into the automated terminal is one aspect of an operational improvement that may help. (See Chapter 7).

The other significant predicted change is the growth of major points of freight interchange, called load centers or hubs. The airline companies have found it profitable to set up hub operations at one or more airports. Such operations tend to improve efficiency and promote better use of specialized equipment. The deregulation of trucking which permitted the small double trailer (27 to 31 feet) has altered the operation of general freight carriers over the last few years. Roadway, Inc. alone increased the use of 28' trailers in intercity operation from 8,431 in 1984 to 14,236 in 1985, while decreasing 45' trailers from 9,310 to 6,050 (Roadway, 1985 Annual Report, page 4). The small doubles permit increased truck productivity through more volume; important since the majority of common carrier loads cube out before they weigh out. The small trailers, also, are more readily fully loaded facilitating the direct delivery to smaller communities instead of moving that freight across the LTL dock at the hub before delivery. Hub and spoke operations, using the opportunities that intermodalism offers, look promising. Much needs to be learned about the advantages of alternative technologies and approaches for such operations.

Several ports are considered to be candidates as load centers. Indeed some presently operate that way. They not only send containers inland by truck and rail links but they, also, load smaller vessels with containers destined for smaller water ports with less extensive dockside capability.

The avoidance of some terminal costs is contemplated by the integrated "joinable freight transporter" and RoadRailer concepts. The lack of joint intermodal handling facilities plagues the railroads in places like Chicago, because they cannot attain the economies of scale of through-operation. The lack of joint intermodal facilities there and other places results in increased drayage costs to accomplish the "rubber tire" interchange from one carrier's TOFC facility to another's for reloading for the continued trip on a TOFC train.

Another concern is the major external influence on terminal operations from the U.S. Government's customs function. At present, the United States Customs Service is in the process of implementing a nationwide system called ACS (Automated Commercial Systems). Some ports are now being asked to use a portion of ACS called AMS (Automated Manifest System) module. Eventually, AMS will ensure on-line processing of present cargo paperwork much more expeditiously by Customs Service through the computer interface in Franconia, Virginia.

Port or terminal expansion is often looked at as providing opportunity for economic growth for some cities, particularly for an increase in jobs. With containerization, however, the labor component is more likely to be reduced as more and more containers remain sealed as they pass through the port. With the possible decrease in stevedore labor, other factors will have to be examined when reviewing the role of ports in economic development. The hinterland effects will certainly grow in importance.

The handling of hazardous cargoes by intermodal transport will increase in the future. Many accidents seem to occur with such materials as they are transferred from one mode to another in the terminal areas. Additionally, loss and damage regularly occur in terminal areas, especially when the seal is broken and high value goods are removed to be transloaded into other shipping vehicles.

5.1.5 Between Modal Components: Research is called for into several areas that occur only between the modal components. For example, each mode has its own independent cost allocation and accounting approach. How can overall costs be looked at holistically?

5.1.6 Defense Requirements: Sometimes overlooked are the peculiar requirements placed on operations by the needs of the world's largest shipper, the U.S. Department of Defense. Of particular interest are potential impacts generated by various DOD scenarios, such as peacetime defense movements or needed response to various models of threats to the national security. Changes in operations of the civil transportation sector are also of concern to the Defense Logistics Agency and the Military Transportation Management Command, which are responsible for much of the transportation of defense goods. They could, also, generate important requirements for some transportation operations. For example, the DOD input has been instrumental in limiting railroad abandonment where such was deemed not in the best interest of national defense.

5.2 RESEARCH PREMISE

Intermodalism is in its infancy and will be a fast growing approach to goods movement as shippers learn to make their freight decisions using the most efficient method that provides the needed service. Operational procedures needed to handle an increasing demand with their impact on rates will surely create a climate for improvement in the efficiency of intermodalism. As growth occurs, so will operational problems with each participating mode, especially at the points of interchange.

5.3 EFFECTS TO BE CONSIDERED

5.3.1 Data: The paucity of useful data will cause researchers to look for other tools for analysis. With the speed and low cost of today's computer systems, empirically based models will need to be developed to simulate the integration of the various transportation opportunities and modes, so as to enable the investigation of costs and benefits of various operational alternatives.

5.3.2 Containers: An ability to quickly interchange containers, including maintaining a record of the identification of them, will become increasingly important. Accommodation to various size containers will be essential for all components in the intermodal move. More and more kinds and types of freight will likely be slated to be shipped in containers. Even the containerization of bulk commodities such as grain are being considered to reduce empty backhaul costs. (This is akin to adding the refrigeration capability to some TOFC trailers by Santa Fe several years ago to reduce empty backhaul costs by bringing east-bound California agricultural product to Chicago on backhaul rates.) Further, while transloading from marine containers into rail boxcars could reduce the imbalance of container equipment for steamship lines, leasing companies, and railroads, to do so removes some of the reasons for shipping containerized freight in the first place and reduces efficiency.

5.3.3 Peak Volume Handling: The advent of double-stack container trains, larger container vessels, more intermodal terminals, increased terminal mechanization, and the "hub-center" or "load-center" concepts suggest an increased impact of peak volume surges on intermodal facilities. This should result in the development of new handling equipment. In fact, growth in container handling technology is likely to play a key role in intermodalism. Prospective technologies such as automated terminals, crane designs, etc. will also be important in the competition between ports.

5.3.4 Hazardous Materials: As the intermodal movement increases its share in goods movement, it can be expected that increased amounts of hazardous materials will also be shipped in this manner. Safety provisions will need to be adequate, as will the documentation and/or identification of hazardous materials in intermodal service. One question that often arises concerns the marking and emergency procedures for handling hazardous materials.

5.4 SOME QUESTIONS FOR RESEARCH

The operational capability of the system to respond to new demands and its ability to continually improve the quality of service at ever decreasing costs is the thrust of all the research in this area. Some of the more apparent questions about operations are:

1. Are existing mechanisms for gathering transportation data being fully utilized to obtain intermodal data? Is a TOFC movement counted double (if it is counted at all)? What do we know about the stage length of each leg of the move? Is the data so sparse that a special program to obtain data needs to be developed? (Care needs always to be exercised that data is not being collected for "data's sake" alone, but for some reseach question.)
2. Is there adequate publishing and gathering of case studies to help provide added data?
3. What impact will JIT requirements have on port/terminal operations? Is the paper work and customs handling adequate to meet the JIT requirements? Are there operational ways that domestic JIT traffic can be handled successfully intermodally?
4. Can a container identification system be automated? Will it be unusable because of poor reading reliability (like the aborted railroad ACI system)?
5. How will the hub-center concept shape-up? What traffic will it attract?
6. What operational changes are possible to reduce the drayage costs of both port operations and door-to-door piggyback services?
7. How do government policies/regulations impact intermodal operational efficiency? What needs to be done to reduce the impacts?

8. How can the labor component in many of the operations be reduced or become more productive? What would a terminal with a much higher level of automation look like? What will it do for operational costs?
9. What are the trends in the use and availability of specialized container equipment? Trends in container size and capacity?
10. What are the trends and implications of the use of shipper-owned/controlled containers? Are there useful case studies?
11. Given the dependence on intermodal container services by the U.S. Department of Defense, what are the potential defense or national security implications of intermodal trends in operations and industry organization?
12. Are adequate provisions made for the handling of hazardous materials in the intermodal environment?

6. INVESTMENT

The investment potential of the industry will dictate how quickly changes take place. The total investment in vessels, ports, railcars, containers, and rail-truck intermodal terminals has been on the increase for many years. When investments in highways, railroads, harbor navigation, navigable inland waterways, and multimodal docks are added, the total investment will be sizable, maybe staggering. A bridge height adjustment may be required to accommodate double-stack railcars and become another cost of providing intermodal transportation. On the other hand, the upgrading of a mainline railroad serves all rail traffic and only a share for intermodal should be allocated. Additionally, shipping companies like the American President Lines (APL) and Sea-Land, both experts in international freight movement, have invested in domestic containerized freight service in order to reduce the empty backhaul. The industry's ability to attract the necessary capital and to successfully manage projects of the size indicated is a pertinent concern. Because they occur in a competitive environment, changes, such as those previously discussed, will prompt a considerable up-grade in investment in ports, vessels, railcars and track (primarily clearances), truck chassis, and new information systems to manage all the array of information that is generated and needed for management.

6.1 BRIEF ANALYSIS

6.1.1 Port and Vessel Investment: The present investment in ports, containerized ships and containers is about \$70 billion and is due to reach about \$130 billion by the year 2000 (3). The containerized ships apparently do provide economies-of-scale since they are being designed with significantly more space, promising lower "slot cost" per container. The next generation of containerships will have slots for over 3,000 large ISO containers. Shipping lines demand their vessels be unloaded quickly and the containerized freight start moving inland immediately. Investment in technology is responding with super cranes, automatic container yards, trains that can carry containers in a

double-stack configuration, adjustable truck chassis, upgraded communication/information systems, etc., designed with significantly more space, promising lower "slot cost" per container.

To remain competitive, ports must invest in loading and unloading equipment, expanded dockside storage, and new ways for providing contiguous space for efficient railcar loading. Ports with established intermodal capacity have generally relied on extensive truck drayage to move containers from dockside to the rail loading facility. They must now reevaluate that as well as all portions of their operation to improve productivity.

6.1.2 Rail Investment: The railroads are beginning to invest in equipment to support the double-stack services. In several cases, it is the shipping line that owns double-stack cars (APL has over 235 double-stack cars, each with a capacity of 10 FEU containers). The railroads are expected to be able to load and unload containers of various sizes and pull the shipping lines cars. The right-of-way must provide adequate clearance through tunnels and under bridges to accommodate double-stack cars via the most direct and efficient routes. Double-stack trains are estimated to require about 50 percent less energy than their TOFC equivalents. Double-stack pricing has made land-bridge from west coast ports to east coast ports very competitive with all-water carriage through the Panama Canal.

6.2 RESEARCH PREMISE

Efficiency will be the single most important factor in the design and operation of future ports, intermodal terminals and operation of the modal components. Trade, especially with the Pacific Rim countries, will continue to increase and the U.S. economy, as it becomes more information/communication oriented, will see more delivery of parts from offshore with final assembly on the North American continent.

6.3 EFFECTS TO BE CONSIDERED

The effects of the investment will be seen largely in improvements of technology, although some refinements will be made strictly for cost savings in logistics. Land purchased and direct rail access will eliminate costly (out of proportion to other costs) drayage. Tunnels will be heightened to facilitate the most direct routing of double-stack trains. New regional centers will come into being for carriers to take advantage of the economies of hub and spoke, as will lower-cost TOFC-type terminals to accommodate improved delivery to smaller communities.

6.4 SOME QUESTIONS FOR RESEARCH

1. What is the true investment needed? What estimates need to be made? On what time scale are the various investments required? Are there enough capital resources available to meet the needs?
2. How will investment at various ports and in various railroads affect the distribution of trade?

3. Is there a good cost allocation model that will permit a benefit/cost analysis of potential intermodal investments to be made?
4. Are land and TSM strategies available to provide direct or nearly direct connection of containership dockside to railhead?
5. What are the economic consequences for a locale to support intermodal terminal investment?
6. Are there technologies that would provide the possibility of "conveyor belt" type movement of containers from dockside to railcar?
7. Where, and with what sophistication in design, should intermodal terminals be built?
8. What is the design and related investment required to establish a truly productive hub-center and how will it operate?
9. How much should be invested in "combined movement vehicles" (e.g. RoadRailer type) for moving containers in short-haul markets? Does such investment replace investment in new TOFC terminals? How does it relate to hub-center concepts of logistics?

7. TECHNOLOGY: INNOVATION AND STANDARDIZATION

The technology employed by any system is the basis for productivity, cost-effectiveness, competitive edge, and service quality. Important technology areas for the future of intermodalism are: (1) innovation in each of the system components especially for improving productivity at the points of connectivity (ports and terminals), (2) an overall management information system (MIS) for monitor and control of total movements, and (3) questions of standardization in both equipment slated for use across various modes, but also for the computerized replacement of paperwork.

7.1 BRIEF ANALYSIS

7.1.1 Transport and Material Handling Technology: As in any competitive system, new technology will be deployed as it is proven and as it proves itself to be cost-effective and to improve efficiency. New technology in transport includes the super containerships, double-stack railroad cars and trains, RoadRailer trains, and the AAR's High Performance Integrated Train (HPIT) concept. The logistics governing the flow of containers at the ports, especially with the use of new crane technology, is very important. Development of automated container handling yards and improved container management techniques should include consideration of the best split of functions to be performed by a human controller and those which should be automated.

7.1.2 Management Information Technology: Information acquisition, processing, and displaying are presently a high technology growth area with many applications. The key for improving productivity and developing a strong

MIS is the ability to obtain real-time information on containers and on operational cost factors. Implied is the ability for automatic reading of labels on both the containers and the vehicles on which they move. The MIS will also need to include (1) a location determination system, (2) a means of moving the data to an appropriate processor, (3) data processing and (4) displaying it in a way and at a place where management can make decisions and implement corrective measures where needed.

The other key is the ability for all involved in a move including customs, financial institutions, brokers as well as shippers, carriers, ports, and terminals to establish a full capability electronic data interchange. Protection of proprietary data and simply learning how to participate seem to be the largest factors restricting EDI use.

7.1.3 Standardization: No single concern was expressed more by the respondents to the questionnaire than the need to limit future container size. Many felt that a standard size was required. This is an obvious concern because of recent increases in truck width to 102" and trailer length to 48', and continued trucking pressures for extension to a 53' trailer. As one respondent has indicated that the stakes are getting higher because of all the containers and the infrastructure investment that is already in place. International requirements and differing priorities will probably make further standardization more difficult. American transportation companies want to have larger equipment, while European companies reject larger equipment and want equipment that can accept heavier loads instead. Third-world nations, whose container-handling infrastructure is new or in development, reject the notion of larger or heavier containers because they cannot develop the facilities to handle them.

Another major issue of standardization involves the whole area often called facilitation, namely paperwork, forms, and data interchange capability. Not only is EDI important for the MIS (see above) but a higher level of compatibility of paperwork will reduce cost and speed up transactions. A number of industry/government working groups have been hard at work at the development of international standards for a number of years. This work is more one of negotiation than of technology.

Another area of needed standardization is in the automatic container identification area so that shippers, carriers and ports/terminals can all use the same reading equipment. It is the large container equivalent of "bar-coding" standards recently established for the automotive parts supply industry (4).

7.2 RESEARCH PREMISE

Technology will continue to respond to the increased demands of intermodal movement. There is considerable potential for utilizing new technology in intermodal transfer and movement. With efficiency and productivity in every part of the move critical, and with time and cost at ports and at intermodal terminals so very important, technology that improves the throughput will continue to find its way into the system. Standardization will become important not only for the size and maximum weight of containers, but it will

also be established for electronic data interchange and into bar coding, so that a useful computerized information system can play a larger and larger role in intermodal movement.

7.3 EFFECTS TO BE CONSIDERED

7.3.1 Communications and Information Technology: If companies are going to grow and develop, they must ensure that all the various elements in the intermodal move can readily communicate with each other, requiring growth in both the speed and volume of data processing requirements. "When a container vessel discharges 500 to 1,000 containers into a terminal and these boxes [are to go] out over a period of two to three days, some by truck, some by rail, some by barge, and when this particular vessel is one of maybe ten that is worked in a three-or four-day period, the need to process information becomes critical, not only for the terminal but also for the steamship lines, the truckers, the railroads, and the shippers and receivers. This area is one which will provide tremendous challenge for all the different facets of our industry in the coming years."(5)

Shippers still have the need to know the location of their particular boxcar, truck van, container, etc. Management in "super-transport" companies, like CSX, will need good data on which to base their market/price decisions. The use of existing communication and computer technology to provide for electronic data interchange, especially data concerning waybills, manifests, delivery schedules, tariff data, etc. is crucial to success.

7.3.2 Large Containerships: The very large or super containerships are being designed and prototypes being built. Their speed, efficiency, and capacity will greatly enhance movement and reduce cost over long water routes. To dock these vessels, the port will need special deep-water reception capability as well as adequate dockside cranes.

7.3.3 New Rail Equipment: Double-stack container trains are already a reality. The "Joinable-Freight-Transporter" and the RoadRailer/Railmaster type rail vehicles may each offer important advantages for intermodal use. The RoadRailer/Railmaster, in particular, does not require a crane or special terminal to move from rail to road or vice-versa. Its greatest use may come on lower demand routes where investment in elaborate TOFC or COFC equipment cannot be justified. RoadRailer/Railmaster may provide a cost-effective way to implement the low-density routes emanating from the hub in the hub-center concept. At the present time RoadRailer only replaces boxcar, requiring transloading of pallets and individual freight pieces from containers. The potential of a container compatible roadrailer needs to be studied.

7.3.4 Container Size: For many years the standard ISO container was 20' x 8' x 8'. It was extended to 35 and then 40 feet. Now in use are 40, 45 and 48 foot trailers. Vessel holding space and loading/unloading equipment may or may not be as efficiently utilized with a mixture of lengths and widths. Not only is container investment at stake, but so is the investment in double-stack rail cars, and some loading and unloading equipment. The concern is important since obsolete equipment can be a drag on profits and service.

7.3.5 Terminal Port Technology and Design: The terminal/port operator faces the dilemma of needing to service an ever increasing volume of freight. Thus, the port facility that offers the most efficient operation will always be the preferred port-of-call. Attention should be given to container lift and movement technology to enhance logistics flow and improve the utilization of precious space. Important technologies include having the speed of picking-up and landing a container and of having the flexibility to locate, latch onto, and quickly remove one specific container from within a large field of containers piled six to ten containers high. Another technology area needed is in intraport flow of containers, including the flow from ship to dockside and from dockside to the rail car. Technology improvements like the installation of the equivalent of an automatic conveyor belt to replace short-haul drayage and other concepts should be investigated.

Brian Maher also reports, "There are a number of techniques (for terminals and ports) to increase space utilization and, therefore, throughput capacity. These include computer controlled yard location allocations to maximize the utilization of the entire yard on a multi-user basis, high density grounding and stacking operations utilizing straddle carriers and/or large straddle cranes that span seven rows of containers, and vertical storage chassis racks which reduce the space needed to store chassis by almost 80%. Chassis racks also provide better protection and control for naked chassis and prevent damage."(5)

7.4 SOME QUESTIONS FOR RESEARCH

Some of the key questions for research are:

1. "Chassis without cars" and RoadRailers have been identified as potential lower volume feeder technologies that could complement double stack trains in long haul corridors operating to and from high-volume hub centers. Are these technologies operationally and economically feasible for such a market application? Are there other technologies available that could be used to expand the reach of double stack service beyond present double stack terminals? What parameters (density/identification) can gain the economic extension of domestic container service?
2. How much should be invested in "combined movement vehicles" (e.g. RoadRailer type) for moving containers in short haul markets? How about special RoadRailer cars designed to move containers? Should one be developed? Does investment in such cars replace investment in new TOFC terminals? How does it relate to hub-center concepts of logistics?
3. What is the design and related investment required to establish a truly productive hub-center or load-center? How will it operate? Is each city with a terminal in effect a hub-and-spoke center or should the reach of a hub to its satellite cities be different than the present reach from some cities?

4. Are there technologies that would provide the possibility of "conveyor belt" type movement of containers from dockside to railcar?
5. Is there an optimum size or family of sizes for containers and trailers? What are the considerations of foreign trading partners when it comes to container size and weight? Is the ISO container the optimum size? For whom? Why?
6. What limitations, if any, should be placed on the size of U.S. trucks. Should trucking van size be constrained because of international and intermodal efficiency considerations? Would trucking see some advantage of holding to the 48 foot length if turnpike doubles were permitted on the interstates?
7. What are the data and technological roadblocks that limit load planning and its planning horizon, particularly for ports and their interfacing modes?
8. How can new communications technology be used to improve equipment utilization and service? How can ship-to-shore and railroad-to-railroad coordination be improved, e.g. advance notice for equipment positioning and for run-through equipment?
9. Should an industry-wide freight transportation AVI or AEI (automatic vehicle identification or automatic equipment identification) system be implemented to provide better control and information for freight movement? Which AVI technology would be most appropriate for freight industry applications?
10. What major prospective technologies, such as automated terminals, crane designs, ship handling, etc. must be developed or improved to meet the ever increasing demands for volume and throughput speed?
11. What are the factors that make the ports competitive with one another and attract new calls at the port? How does technology bear on interport competition? For example, what can be learned from the experience of the Port of Richmond, CA where a brand new high technology terminal has not attracted any major ocean carriers?
12. What new technologies in automated guided vehicles, remote controllers, automated container lifts, improved refrigeration, short-haul equipment, etc. are potentially ready for intermodal use? How soon? What levels of increased productivity can be expected.
13. Electronic data interchange (EDI) is growing fast in its use. Have the agencies and industrial groups involved (e.g. TDCC, Transportation Data Coordinating Committee, or ANSI, American National Standards Institute) been able to agree with international groups on standard formats and communications protocol? What needs to be done to implement the technology worldwide? Are the present levels of security adequate?

14. What hazardous materials accident prevention measures must be provided for in the port/terminal area not now being adequately considered?

8. PROPOSED RESEARCH AREAS

Almost all major facets and issues in intermodalism were covered in the 120 research suggestions that were received. Each section of the report presents a "laundry list" of non-prioritized questions coming from the author's attempt to integrate and build upon the data submitted by the respondents.

While appropriate for a single study or even several studies, the lists of questions do not constitute a research agenda for the committee. This chapter attempts to further analyze the questions and intermodal issues in light of the TRB Executive Committee's recent listing of the ten most critical issues. (6)

In the adoption of the "Ten Critical Issues in Transportation" the Transportation Research Boards's Executive Committee set some areas that should receive priority for each of the TRB committees. While not all of the issues, for example, "Environmental Consequences of Transportation", are presently important for intermodal transport, many of them can serve to guide intermodal research. In Table 1 the ten issues have been compared against the characteristics that served to organize Chapters 3 through 7 in an attempt to determine the strength of interaction. These interactions then form the basis for the priority view governing the intermodal research agenda of the TRB Committees on Intermodal Freight Transportation and on Intermodal Freight Terminal Design.

8.1 HIGH PRIORITY ISSUES

Four of the TRB critical issues are considered to be those that should rate top priority for intermodal freight transportation research.

8.1.1 Transportation and U.S. Competitive Position World Wide: The United States depends on a fast, reliable, flexible system of transport to maintain many of our world markets and to expand other markets. At the heart of international trade is the intermodal system, particularly the effective and efficient use of containers. All of the topics discussed in the previous chapters have significant impact on our world position. Port technology, company management and structure, and efficient movement of containers both overseas and domestically are seen as key. The worldwide support of our defense system as it requires intermodal transport for logistics support may also be key.

8.1.2 Improved Productivity: Not all facets of an intermodal move are equally productive and maintaining the competitive edge will demand a focused attention to the productivity of all elements of the intermodal system both as a system and each element (e.g. drayage) as a subsystem that has an interface with other parts of the system.

8.1.3 Congestion of Traffic at Facilities: Since intermodal depends on efficient flow throughout the system, the potential of congestion especially at

ports and terminals is of major concern. The increased demand will generate the need for continued development of improved technology to maintain flow and keep the system handling thousands of containers daily from coming to a halt. The impact of changes in operations of various external areas such as U.S. Customs could also affect the smooth flow of containers.

Table 1. INTERACTION OF CRITICAL ISSUES AND CHARACTERISTICS OF INTERMODAL FREIGHT TRANSPORTATION

10 CRITICAL ISSUES	CHARACTERISTICS					
	Interaction Level	Industry Structure and Management	Marketing/Pricing Service Quality	Operations	Investment	Technology
■ Better Management of Public Capital Investments in Transportation	M			X	X	X
■ Improved Transportation Productivity	H	X	X	X	X	X
■ Priorities for Improved Transportation Safety	M					X
■ Transportation Finance	L	X			X	
■ Changing Roles of Federal, State, and Local Governments	M	X		X	X	
■ Transportation and the U.S. Competitive Position Worldwide	H	X	X	X	X	X
■ Transportation and Economic Health and Development	M	X			X	
■ Effects of Deregulating Transportation	H		X	X	X	X
■ Congestion of Traffic Facilities	H		X	X	X	X
■ Environmental Consequences of Transportation	L			X		

H = High, M = Medium, L = Low

8.1.4 Effects of Deregulating Transportation: Many of the moves to deregulate transportation have had a direct impact on freight movement as well as its supporting industry structure and management. Those effects as they bear on industry structure, management operations and investment are still an open area for research. The topics are far ranging and under this area items from entry of a railroad into a steamship line offering the potential for an end-to-end move under one management to size and weight regulations on trucks which may ultimately affect container size and loads will be investigated.

8.2 MEDIUM PRIORITY ISSUES

Three issues seen to be of somewhat lesser priority are:

- o Better Management of Public Capital Investment: While most largely a highway related topic, much of the investment in ports is also public. The management of the port coupled with the ability of new technology in crane and container identification methodology represents one area in which the use of the public investment can be better utilized.
- o Changing Roles of Federal, State and Local Government: Intermodal uses a mixture of public and private forms of movement. Further changes in government roles or in means of funding may have some effect in taxes, subsidies for harbors and navigation, perhaps even in how tariffs and customs are handled.
- o Transportation and Economic Health and Development: As it improves U.S. competitive position and as it offers new areas for economic development, intermodal will contribute to this issue.

8.3 LOWER PRIORITIES

Three of the issues, because they are not especially multi-modal or because they reflect passenger needs, are placed in the lower priority areas.

- o Transportation Finance mostly reflects public transport and highways. Intermodal is largely private and will only be financed to the extent it is profitable. Some of the shipbuilding subsidies and US flag carriage requirements of government cargoes may be a part of this area.
- o Safety is a concern where people, drivers and passengers are involved and where "community" safety is at stake as in the escape of hazmat in an accident situation, i.e. evacuations and emergency response measures. Personal safety through intermodal movement of hazardous materials, work place safety, especially in ports and terminals, and the safety of trucks on the highway as they participate in an intermodal move are the chief areas of concern.
- o Environmental Consequences reflect those of the mode being used and are not peculiar to intermodal transport.

8.4 RELATING THE ISSUES TO STUDY/RESEARCH TYPE

Further refinement in developing the research agenda will be found in combining the priorities enumerated above with the those types of study that are most prevalent in performing research on each of the issues. The study types include data gathering, economic and financial analysis, review and analysis of potential policies and legislative initiatives, forecasting demand and analyzing response to new demands and to study the management needs of intermodal transport. Table 2 is an attempt to look at each of these types in terms of the role that it is likely to play in research; namely, primary or secondary.

Table 2. STUDY/RESEARCH NEEDED BY CRITICAL ISSUE

ISSUES	STUDY/RESEARCH TYPE				
	DATA	ECONOMIC	LEGIS-LATIVE	FORE-CAST	MGMT
Highest Priority					
■ Transportation and the U.S. Competitive Position World wide	P	P	P	P	P
■ Improved Transportation Productivity	P	P	S	S	P
■ Congestion of Traffic Facilities	S	P	S	S	-
■ Effects of Deregulating Transportation	P	P	S	P	P
Medium Priority					
■ Better Management of Public Capital Investments in Transportation	P	P	-	S	P
■ Changing Roles of Federal, State, and Local Governments	-	S	P	S	-
■ Transportation and Economic Health and Development	S	P	-	S	-
Low Priority					
■ Priorities for Improved Transportation Safety					
■ Transportation Finance					
■ Environmental Consequences of Transportation					

P = Primary
S = Secondary

MONITORING ONLY

8.4.1 To develop and maintain a research data base: A strong data base in support of the intermodal research should be developed and maintained. Some of the specific research activities that will contribute to that are:

- (a) To maintain a current bibliography and data availability information for use by the transportation research community.
- (b) To work with DOT and DOC on making the census of transportation more useful for intermodal research.
- (c) To develop mechanisms to obtain commodity specific container data as well as flows in and out of terminals/ports.
- (d) To see that an inventory of scheduled intermodal movements to and within the U.S. as well as shipping company schedules and ports-of-call is maintained.

8.4.2 Economic and Financial Analysis: Research should be performed to improve the understanding of the cost structures and investment criteria across the intermodal system combining system performance elements with economics. Benefit-cost relationships should be performed on alternatives to improving system performance. Some specific research activities in this area are:

- (a) To simulate the container flow of ports/terminals leading to better understanding of benefits and costs of proposed changes to the port/terminal and to the overall system. Priority will be given for overall productivity and efficiency improvements.
- (b) To understand and quantify the essential differences between double-stack, TOFC, RoadRailer, truck and other line-haul systems. Compare single mode moves, e.g., all water through the canal to land bridge with their intermodal competitions.
- (c) To develop operational models to study how a "hub-center" and "load-center" concept would work, its pros and cons, and its financial visibility as a public or public/private enterprise.
- (d) Many simulations and studies are done all the time by carriers and ports for competitive purposes. TRB's role may be in attempting to have some generic research looking for common ways of analysis or in comparing alternatives in new ways.

8.4.3 Legislative Probe and Impact Analysis: The analysis of the impact of mode specific legislation (both existing and proposed) on intermodal transport is very important. In performing this function some of the specific research projects could be:

- (a) To analyze commerce, trade, and other policies that will affect intermodal performance.
- (b) To analyze the effect on intermodal transportation of having different modal components operating under differing regulatory legislation. For example, the relationship for rate setting is under the Shipping Act of 1984 and the Staggers Rail Act of 1980.

(c) To develop an understanding of state and local government actions as they affect intermodal transportation. How intermodal changes might enhance economic development of areas and how local/state and federal laws impact the economic development criteria of the region.

8.4.4 Forecasting Demand, Service, Etc.: Generally studies should advise the transportation community on future areas of intermodal involvement, on growth scenarios; should understand what service constraints and performance requirements will be demanded to meet service levels, stage lengths and delivery requirements; and should include technology forecasting and technology assessment. Regional, national and international forecasting all need to be considered. Some of the specific research studies would be:

(a) To monitor and analyze the east-west struggle between domestic containerization (enhanced by double-stacks) and standard TOFC. Is there a market for both? What is it? How might it develop?

(b) To determine how changes in monetary exchange rates and/or economic conditions - worldwide and North American - will impact the nature of intermodal movement? How do trade policies affect it? What are the tradeoffs if the U.S. becomes more service and less manufacturing oriented or if formerly Midwest and Eastern industries move to the "sun belt"?

(c) To consider possible effects of potential international and U.S. energy and cold war scenarios on the future of intermodal. Will markets between U.S. and underdeveloped countries increase or decrease and in what ways? And for what commodities?

(d) Forecast the potential demand of the changing nature of U.S. economy and the effects of foreign (Japanese) manufacturers operating in the United States. Look at ways intermodal might be able to meet the varying degrees of demand, such as just-in-time transport involving movement from outside the North American continent and from within.

8.4.5 Management: The complexity of intermodal moves and financial data suggests that research should be aimed at improving the decision-making process by performing studies of management techniques, and providing tools to assist managers in their decision making. Aided by fast, accurate, systemwide information and an understanding of the system interactions, specific research projects might include:

(a) Case studies on intermodal problems and actions taken by management to investigate the problems.

(b) Develop a set of system requirements for the management information system and electronic autointerchanges needed to support the full move. This includes cost structures, liability requirements, constant knowledge of container location, commerce documentation and the like.

(c) Possible training concepts and programs to help develop future decision-makers with the broad-base skills and understanding to be effective.

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APPENDIX A

**COMMITTEE ON INTERMODAL FREIGHT TRANSPORT
TRANSPORTATION RESEARCH BOARD
2101 CONSTITUTION AVENUE, N.W.
WASHINGTON, D.C. 20418**

Dear Transportation Expert:

The Intermodal Freight Transport Committee of TRB decided at its January meeting that it would compile a list of the major key system-level issues that face intermodal transportation, both domestic and international. It is hoped that these issues might help direct research programs and form a basis for future conferences. The issues, as we explored some of them, are complex, and for each one there seems to be both winners and losers depending on government policies, technological breakthroughs, and economic conditions.

The committee would appreciate it if you would take a few minutes to jot down, in a summary-way, the 3-5 issues that you see facing intermodal transportation in the next decade. We have asked Professor Robert K. Whitford, Purdue University, to collect these, sift them, and come to the summer meeting prepared to share them with the committee. It would be helpful if you include your name, affiliation, and phone number so that if there is a need for clarification, Dr. Whitford can contact you.

If you will, please fill out the attached form and mail it in the self-addressed, stamped envelope provided, as soon as possible, but in any event, no later than May 1, 1986.

Thank you,



Doug Smith, Chairman

Committee on Intermodal Freight Transportation

**ISSUES IN INTERMODAL FREIGHT TRANSPORT
FOR THE LATE 1980s AND EARLY 1990s**

EXAMPLE 1

PREMISE: The advent of double stack trains and the resulting imbalance of intermodal cargo flows have caused shipping lines to enter the domestic transportation business in an attempt to minimize backhaul.

QUESTIONS:

1. How successful will shipping lines be in marketing domestic container movement?
2. What are the problems in using international terminals for domestic container movement?
3. What impact will increases in domestic containerization have on standard TOFC movement?
4. How will domestic containerization compete with the larger, wider, over-the-road trucks?

EXAMPLE 2

PREMISE: U.S. Government Budget pressures will cause a reduction in U.S. Customs' workforce, resulting in the policy that all containers are to be cleared at the port of unloading.

QUESTIONS:

1. What will be the effect on the throughput of the port? Will more land be needed?
2. Will the number and capacity of the U.S. "ports of unloading" change?
3. Will there be a shift away from intermodal to all water carriage where that is feasible?
4. What will happen to the quality of service on delivery?

Name _____
Address _____

Affiliation _____
Phone (Work) _____
(Home) _____

YOUR ISSUES: Please state your premise first and then develop the issue questions.

ISSUE 1

PREMISE:

QUESTIONS:

- 1.
- 2.
- 3.
- 4.

ISSUE 2

PREMISE:

QUESTIONS:

- 1.
- 2.
- 3.
- 4.

(OVER)

APPENDIX B

The Appendix A questionnaire was sent to over 200 representatives of shippers, carriers, shipping companies, port and terminal managers, government, academia and the consultant community. Just over 50 responses were received, giving some representation to all the groups that were solicited.

In the format of the questionnaire, the respondent was to postulate a hypothesis or premise, followed by a series of questions that might be considered in looking at the premise. This approach to gathering research data was developed by the author when it was necessary to get reasoned input from a diverse set of persons. There were over 120 premises received, many on the same subject, many different and some looking at an issue from a slightly different perspective than the next one on the same subject, a fact which lends an element of richness to the data.

The comments have been generally organized according to the area that seemed most involved. In the paper, several comments actually contribute to several characteristics. The areas in which comments are organized are:

1. Industry Structure and Management
2. Service Quality, Marketing, Pricing
3. Operations and Facilitation
4. Investment, Technology, Equipment

All the responses received are included without the name or organization of the sender.

RESPONSES TO QUESTIONNAIRE

(G=Government, C=Carrier/Provider, A=Academic, S=Shipper, I=Consultant)

LIST 1: INDUSTRY STRUCTURE AND MANAGEMENT

(101) PREMISE: Continued deregulation and horizontal integration will cause the growth of giant transportation companies that have controlling interests in several freight transportation modes. [G]

1. Will this trend continue to the point that only a few very large companies control long-haul freight transportation in the U.S.?

2. Will the growth of these intermodal companies mean less competition and higher transportation rates in the future?

3. Will technological innovation flourish or be slowed under such conditions of concentration in the industry?

(113) PREMISE: Rationalization among carriers - possibly in the form of consortia - will change the nature of services provided. [S]

1. Will conferences continue to set tariff/rate policies or will consortia set their own rates?

2. Will consortia continue to call at all major ports or will they adopt the load center concept?

3. Will consortia buy intermodal services as consortia or as individual members?

(116) PREMISE: Management issues continue to be important. [A]

1. What improvements are required and can be made in domestic container tracing? Is TRAIN II adequate?
2. How can chassis pool management be improved?
3. What ownership/operational options are sensible?

(118) PREMISE: Cost-control will be a dominant issue in the American Economy. [C]

1. What change in container design will aid in cost-control efforts?
2. How much damage can containers withstand before safety is truly compromised?
3. Is the container transport industry going the route of scheduled airlines: toward consolidation, fare-cutting and red ink?

(201) PREMISE: The drive to gain efficiency in transportation will result in more vertical integration in the transportation industry. [G]

1. Where will the vertical integration commence?
2. What impact will this have on independent landside truckers?
3. What impact will this have on price in the short run? In the long run?

(210) PREMISE: Rail line mergers are now easily attained. [A]

1. For what payload types does this have significant competitive implications?
2. Do the increased efficiencies outweigh the competitive effects?
3. Have short line companies filled the void created by mergers?

(209) PREMISE: There does not appear to be sufficient consistency or "uniformity" in conduction of operations and developments. It's still largely go-on-my-own type of business. [I]

1. What are the best means of improving coordination between and among modes, including important intermediaries?
2. Can this be done effectively considering competition in the shipper business?
3. How does the regulatory reform affect coordination in intermodalism?
4. Should there be any significant regulatory role? If so, what?

(221) PREMISE: Managing an intermodal carrier company requires a broad scope of operational knowledge regarding all modes. [A]

1. Can an intermodal company be created through acquisitions of single mode carriers?
2. How should a profit-motivated company allocate freight among modes given the different cost structures found in each mode?
3. What are the differences between managing a single mode carrier and an intermodal carrier?
4. Can certain synergies be achieved through intermodalism or is it just the sum of the parts?

(234) PREMISE: Intermodal freight transportation will increase productivity and reduce costs. [G]

1. Will large intermodal freight transportation companies force small transportation companies, even though efficient, to go bankrupt?
2. Will intermodal freight transportation companies reduce transportation time or increase it?
3. How will the transportation management offices of shippers be affected?
4. How will the consumer be affected?

(202) PREMISE: Intermodalism implies through rates and full integrated control over the movement of containers. In response there has been a move toward increased intermodal mergers, including the recent merger between the railroads and barge and truck operators as a means of exerting control over costs and rates. [I]

1. What will the eventual competitive impact be in terms of intermodal competition in the U.S.?
2. In terms of economic development impacts and regional development, what will the regional and spatial impacts be on development if there are a few large multi-modal operators remaining as the major sources of competition?
3. Are there any adverse impacts (in economic terms) that might require, at a maximum, legislative/policy solutions or, at a minimum, careful monitoring to assure that adverse competitive results are offset by favorable impacts?
4. In effect, what are the long-run implications of growth in intermodalism?

(224) PREMISE: A major question for future growth and profitability is the management and control of the operation or system - which in essence includes a number of subsystems. [I]

1. Major training and adaptation to the intermodalism systems - how much and what kind is needed?
2. Are there sufficient training programs? formal ones? OJT?
3. Would these necessarily encompass both international and domestic intermodal methods?
4. Is there recognition of the types of training and education for the shippers, carriers and other intermediaries?

(312) PREMISE: State-of-the-art management information systems are an essential ingredient for profitable intermodal transportation providers. [S]

1. How will the policies of governments affect the integration of information systems across international boundaries?
2. What are the technical inhibitors to realizing necessary management information systems?
3. What design skills are necessary to define a realizable system?
4. Can intermodal standards be developed for data structures (format and content) to ease the development of the required systems?

(303) PREMISE: Intermodal transport can be managed, end-to-end, by a single organization. [S]

1. What are the competitive strengths and weaknesses of various possible organization structures?

2. What sorts of skills must key people in the organization possess?

3. Can the required organization evolve from an existing enterprise or must it be freshly developed?

(236) PREMISE: The traffic manager for shippers and carriers must be professional in the sense of being knowledgeable in the full distribution cycle - economics, marketing trends, domestic policy and trade policy. [I]

1. How will such persons become qualified and supported in an organization?

2. What are the best industrial requirements and opportunities for such capacity?

3. In foreign trade intermodalism, what knowledge is needed of foreign and international traffic and its special requirements?

(239) PREMISE: Intermodal freight transportation will result in unfair competition and cause government regulation to increase. [G]

1. Will this be beneficial to the economy?

2. Will this start a trend for government regulation in transportation?

3. Will this increase or reduce employment?

(302) PREMISE: The exploding use of containers suggests that a truly integrated full-service carrier should have been created to handle the origin to destination haul as a "single-firm-managed" service. [I]

1. Why have not integrated transportation companies become the norm for using trailers to provide service to shippers?

2. Is there any hope that integrated (all modes) carriers will have a major role in transport? Why or why not?

3. Will there ever be a real use of land-based (or ocean type) containers in air freight?

(317) PREMISE: Intermodal can provide a cost-effective and profitable transport capability. [S]

1. How finely disaggregated must costs and revenue be to enable financial assessment of its value?

2. What degree of difficulty is likely to be introduced in this analysis by international currency exchange rates and related matters?

3. What institutional barriers would inhibit a single-flag international intermodal company?

(213) PREMISE: CSX has owned ACBL for a year or more [I]

1. What have been the economies of intermodal ownership?

2. How has the experience been compared to the testimony for acquisition?

3. Should the railroads buy bargelines?

(222) PREMISE: Intermodalism is a wholesale business or intermodalism is a retail business. [A]

1. Which one is it?

2. What are the advantages of each? The disadvantages?

(304) PREMISE: With the advent of super carriers, as through mergers of CXS and American Commercial Barge Lines, which can handle rail, truck, barge moves with ownership of the interchanges included, barge competition will be severely impacted. [C]

1. Will barge competition survive?

2. If this is a trend that continues, what will the effect be on shippers by all modes?

(223) PREMISE: Technology, long-term capital needs, maintenance, operations and its integration with management control is critical. [I]

1. Do the participants in intermodalism have enough knowledge and tools to develop profitable and break-even traffic?

2. Are there sufficient resources available for future planning of innovative developments and their implementation?

(305) PREMISE: Major railroads will buy ocean carriers to lock up containerized traffic flow. [I]

1. Will this action result in an increase in rates since competition will be effectively stifled?

2. Are railroads making enough profit on the Double Stack business to justify the risk of buying ocean carriers?

3. What impact will this action have on the viability of secondary ports?

(314) PREMISE: There should be efficiencies of providing rail/barge movements by independent carriers (without common ownership). [C]

1. In what areas, or products, would rail/barge combination moves help shippers?

2. What should (or can) a carrier do to start and maintain such moves?

3. How can river terminals, served by rail, truck and barge encourage intermodal moves?

(408) PREMISE: The concept of "load-centering" appears to go hand in hand with this decade of strong intermodal growth. [C]

1. What are the benefits/costs of load centering for the transport industry as a whole?

2. What impact will load centering have on present intermodal competition?

3. How will load centering influence the strength of terminal and port labor?

(405) PREMISE: The trends toward multi-modal transportation companies and toward third-party or subsidiary responsibility for intermodal appear to be polar extremes. [I]

1. How well will multi-modal companies integrate their service offerings?

2. Can outside or subsidiary companies contract with carriers to offer one-stop intermodal service?

3. Can intermodal support this overhead expense in competition with trucking?

(407) PREMISE: Mergers across traditional industry boundaries appear to be complementing this decade of strong intermodal growth. [C]

1. What are the efficiencies sought after for such mergers, and will they be (are they) obtained?

2. Will the shipper receive a "better" transportation service?

3. Will such mergers stimulate or depress intermodal R&D?

4. What are the benefits/costs of such mergers on competition in intermodal transport?

(142) PREMISE: Deregulation of surface transportation by the Staggers Act and the Motor Carrier Act has reduced the need to collect industry data. [G]

1. Who are the data users, other than the regulators, of the data the regulators collect and process?

2. Are there alternative data sources?

3. Will the non-regulatory data users prevent the regulators from ceasing to collect and process industry data?

4. Who will collect and process the data once the regulators are gone?

(217) PREMISE: The full potential of intermodal transportation for reducing transportation and distribution costs will wait until work rules and operating practices at ports and on railroads are substantially revised. [A]

1. What types of economic inducements and job security agreements will be needed to obtain labor cooperation in work rule alterations?

2. Can creative methods of structuring conditions of employment result in labor cooperation and lowered total costs?

[1] like permitting partial retirement (where work will be 6 months and receive pension for 6 months with program starting at 55-60 and extending to age 70 with payments made to the pension plan while working full time).

[2] retraining for other jobs with dual seniority being permitted between jobs.

[3] use of shorter trains to absorb excess employees during transition thus providing better.

(313) PREMISE: Solicitation and control of intermodal traffic is a third party function. [C]

1. Can TOFC and COFC be profitable when competing with 48', 102" highway trailers?

2. Can railroads justify equipment expenditures to support the larger, longer trucks?

3. To whom do third party agents owe their loyalty?

(141) PREMISE: Physical Distribution management will begin to dominate freight-flows. [G]

1. Which industries are integrated enough to produce major pressures?

2. Will this lead to a higher level of use of large or smaller vehicles? long-haul concepts?

3. Will this lead to a diminution of the role of freight forwarders (dominate in Australia)?

(301) PREMISE: The goals of overall cost effectiveness and customer service has led to multi-modal transportation companies. [C]

1. How has this affected competition?

2. How has this affected customer service?

(211) PREMISE: More rail/barge mergers will occur. [A]

1. For what payload types does this have significant competitive implications?

2. Do the increased efficiencies outweigh the competitive effects?

3. Have short line companies filled the void created by mergers?

LIST 2: SERVICE QUALITY, MARKETING, PRICING

(117) PREMISE: In today's high risk environment and "accounting oriented" manager, the present level of I/M margin will not sustain margin. [C]

1. What non-price factors will draw volume? Will multi-level pricing (i.e. high price level for premier service) work?

2. Can major terminal thru-put be sufficiently improved without major investment?

3. Can equipment asset turnover rate be improved by reducing asset life with associated reduced cost? Will reduced asset life mean reduced risk or higher operating cost?

(124) PREMISE: Pricing strategy and market capture is in a state of flux. [A]

1. What will happen to the railroad's share of transportation value capture? Will they be reduced to wholesaler's?

2. Are we moving to the use of reserved space on trains instead of unlimited service at a specified price?

3. How extensive will the role played by empty backhauls be in determining future prices and market shares?

4. Will this always be major factor or is it a short-term phenomenon?

(125) PREMISE: Marketing organization may shift. [A]

1. What effect will load-centers have?

2. What about competition from Around-the-World shipping?

3. If the Port of NY were to change its unloading charges considerably, how would flow be affected? Who is most at risk?

4. What would happen if the 50-mile rule were strictly enforced?

(128) PREMISE: TOFC growth has occurred more by taking freight out of boxcars than by attracting new business. [C]

1. What can be done to attract additional new traffic to intermodal transport?

2. Are there new corridors to be concentrated on?

3. Is the HUB concept able to deliver service with efficiency and competitive effectiveness or are there better approaches?

4. How can profits on TOFC be improved and is the investment in specialized equipment justified by the profit potential?

(122) PREMISE: Increases in highly service sensitive, highly competitive traffic will cause a steady degradation in bulk commodity service. [C]

1. What traffic is jeopardized if investment \$'s are drawn to intermodal?

2. Can high volume bulk movement (with its contracts) coexist with intermodal?

3. Is the fixed plant capable of handling both speed-related tonnage and high wheel load tonnage (e.g. curves, line capacity)?

4. Is intermodal pulling traffic from existing assets at the price of added investment in intermodal? Can intermodal rates cover the cost of surplus boxcar capacity (e.g. equipment asset turnover)?

(126) PREMISE: The advent of Double Stack trains and the resulting imbalance of intermodal cargo flows have caused shipping lines to enter the domestic transportation business in an attempt to minimize backhaul. [A]

1. How successful will shipping lines be in marketing domestic container movement?

2. What are the problems in using international terminals for domestic container movement?

3. What impact will increases in domestic containerization have on standard TOFC movement?

4. How will domestic containerization compete with larger, wider, over-the-road trucks?

(127) PREMISE: The advent of Double Stack trains and the resulting imbalance of intermodal cargo flows have caused shipping lines to enter the domestic transportation business in an attempt to minimize backhaul. [C]

1. Will the 48' x 9' x 6 1/2' container enter into international trade?

2. What type of equipment should be specified for domestic intermodal and domestic international terminals?

3. What percent of the cargo movement of the combined domestic and international movement will require TOFC moves or railcars?

4. What impact, if any, will be made by international shipping on domestic railroads? Will railroads accommodate "friendly" competitors?

(130) PREMISE: piggy-back growth, to some degree, depends on the ability of railroads to compete in the short-haul market, i.e. distance under 700 miles. [C]

1. Wouldn't the trailer-without-car concepts (Roadrailer/Rail Master) designs offer the railroads the flexibility necessary to compete for this traffic?

2. If trailers can be fitted with steel wheels, why couldn't the tractors be so equipped and if so, why couldn't the tractor/trailer units replace the locomotive and train crew to reduce costs and thus enhance productivity and offer improved schedules?

3. If the trailer-without-car concepts are not an acceptable solution, will the rail industry adopt some of the other HPIT design concepts?

4. What are other possible solutions to successfully compete in the short-haul market?

(137) PREMISE: Recent moves toward economic deregulation of freight offer carriers the opportunity to provide new service options and new types of service for productivity/profit gains. [G]

1. What productivity gains and profit opportunities can be realized by offering intermodal service, either by one carrier, or, jointly, with another carrier (commodity-specific)?

2. Do backhaul discounts offer opportunity for carrier profits and rate discounts to shippers and to the public (commodity-specific)?

3. To what extent has negotiated, contract service expanded its share to trucker traffic (commodity-specific)?

4. Potentially which mode(s) will expand its (their) share of the freight market significantly by offering intermodal service (commodity-specific)?

(121) PREMISE: The majority of containers are empty for backhaul and there is potential for reversing this and gaining better utilization. [C]

1. What is the potential for filling containers with grain or specialty crops for a loaded backhaul?

2. Can containers be diverted for loading with agricultural produce without undue cost or delay?

3. Are the railroads and shipping companies flexible enough to develop and market container service to cut empty backhauls?

(131) PREMISE: Independent highway truckers and industry owned fleets are on the increase. [C]

1. What can the railroads do to attract this business?

2. Is it practical to assume these truckers/industries will ever haul locally while rails haul long distance?

3. Would it be possible for rails to transport truckers/industry tractor-trailer and driver units on flat cars to long distance destinations?

(145) PREMISE: Stack trains have contractual agreements between railroads and shippers, towit, unit train concept. [C]

1. Will this contribute to or erode the railroad's net?

2. What will the outcome be, for the rails, when transportation is their only responsibility (equipment, solicitation, pricing and terminal handling are the shippers' responsibility)?

(129) PREMISE: Dropping freight rates will be a part of changing world economy. [C]

1. Who will own the intermodal equipment (carriers, leasing companies, etc.)?

2. Will carriers change the manner in which containers are used?

3. Which movements will benefit/lose by this development?

4. Are there too many containers in the world for the foreseeable future?

(132) PREMISE: A vast short haul (300-700 miles) market exists that is dominated almost entirely by trucks. Improvements in rail intermodal technology (e.g. Double Stack) tend to offer benefits only in longer haul markets. [C]

1. What service performance improvements and price levels in the 300-700 mile market would be necessary to make significant diversions from truck?

2. What are the essential operating performance levels (e.g. terminal times) and cost levels (e.g. cost per lift, given certain assumptions) needed to meet those service and price levels?

3. What are the most promising technologies to meet those operating, performance and cost levels?

(140) PREMISE: Railroads face a problem in the movement of hazardous materials in rail intermodal service

because of inadequate notification to the railroad as to the presence and characteristics of the hazardous materials in the lading tended for shipments. [C]

1. How can the notification concerning the hazardous material be improved? Specifically?
2. What government regulations bearing on the shippers or motor carriers would improve notification in an effective and unburdensome manner?
3. Can railroad clerical procedures and information systems be modified to help railroads elicit the desired information at the earliest opportunity?

(150) PREMISE: The upsurge of Japanese related auto manufacturing plants in the midwest will mean an increase in containerized freight with a Just-in-Time inventory delivery need. [A]

1. What service-delivery promises can intermodal make?
2. Can rail/truck from the Port to Midwest meet specified delivery windows or will it come by Truck?
3. What will be the effect of customs?

(315) PREMISE: The growth of Just-in-Time (JIT) sourcing from overseas by American manufacturers has led to the need to better coordinate intermodal (overseas/domestic) moves. [I]

1. How can port/airport facilities be designed to expedite just-in-time cargoes?
2. What technologies exist to expedite modal transfers?
3. What type of information systems are needed to coordinate these flows?
4. How can carrier/broker/customs cooperation in expediting these cargoes be improved?

(327) PREMISE: By 1988 the U.S. will be importing approximately 7500 forty-foot containers per month into the midwest for:

1. Nissan ● Smyrna, TN
2. Honda ● Maysville OH
3. Mazda ● Flatrock, MI
4. Mitsubishi ● Bloomington, IL
5. Toyota ● Georgetown, KY
6. Isuzu ● Lafayette, IN. [C]

1. What impact will this have on the balance of both steamship and railroad equipment considering the present imbalance?
2. What effect will this increased traffic of eastbound containers have on leasing company depots?
3. Will this force export cargo and domestic rates to decline further?

(230) PREMISE: The vast preponderance of freight moving in North America moves less than 500 miles. However short-haul markets have been highly resistant to railroad intermodal service penetration. [C]

1. What, in quantitative terms, are the dimensions of the service and economic disadvantages currently experienced by railroads in short-haul intermodal markets?
2. What potential impact would the presently evolving intermodal train and terminal technologies have on reducing railroad disadvantages in short-haul markets?
3. What additional changes (including technological ones) would railroads have to make in order to achieve service and economic viability in short-haul intermodal markets?

4. Which changes would offer the greater potential for improvement?

5. What likely impact on their market and economic positions could railroads achieve by mounting a serious and determined effort to enter short-haul intermodal markets?

(207) PREMISE: Intermodal competition will substantively impact the relative competitive position of American (U.S. and Canada) ports vis-a-vis one another. This will be particularly true for Pacific/Atlantic ports. [I]

1. What ultimate distribution of trade will result as between the North Atlantic and South Atlantic ports and Pacific Coast port ranges?

2. Goods handling technology is likely to play a key role in intermodalism. What impact will major prospective technologies such as automated terminals, crane designs, ship handling, etc. likely to have on interport competition?

3. An important aspect of intermodalism's competitive stimulus lies in the historically high interest rates and emergence of "logistic" strategies. What changes would result if low interest rates continue over the next few years?

(402) PREMISE: The continued development of door-to-door (lump-sum) pricing with routing decision largely controlled by carriers has intensified price competition between coastal ports in an attempt to maintain port calls by steamship lines. [A]

1. Can traditional port marketing activities be justified in an environment where ports have little impact on routing decisions?

2. How can ports best identify their markets, both carriers and overseas areas?

3. What impact will door-to-door pricing have on the ability of ports to generate sufficient revenues to maintain investments (both new and replacement)?

4. How can volume incentive port tariffs be structured to attract traffic and simultaneously maintain the financial integrity of the port?

(219) PREMISE: The characteristics of lading and commodity traffic flows are changing radically as a result of fundamental structural changes in the economy. As a result, the service/price tradeoff inherent in many shipper decisions regarding carrier and modal preference will likewise shift dramatically. [C]

1. What are the transportation implications of the shift from manufacturing and extractive industries to service and high-value goods manufacturing industries?

2. What are the implications of the depression currently facing U.S. extractive and heavy manufacturing industries and the depression of the mid-continent consumer markets?

(143) PREMISE: The drastic number of rail abandonments will impact on the type of modal transfer available for the transportation of intermodal cargo. [G]

1. What is the relationship of highway cost to increased truck intermodal cargo commodity movements resulting from less rail availability?

2. What is the energy implication on increased use of truck vs. rail mode traffic for intermodal cargo?

3. What will be the market implications of having a limited modal choice with respect to competitive rate charges?

4. What will be the impact on cargo shipments of bulk goods that now travel more economically on rail?

(403) PREMISE: Survival of railroad intermodal service in competition with truck requires high standards of customer service to match the best available technology. [I]

1. Can rail management shift to an intensely managed, low-cost, high-service approach?
2. Will rail intermodal be helped or hurt by contracting out some services?
3. Can the railroads locate and capture their market?

(227) PREMISE: Pricing mechanisms for transportation in general have been placed more into the free market environment. [A]

1. Can we quantitatively measure the effect?
2. Are there pricing institutions that should be considered now (such as futures markets, open auctions, formula pricing, etc.) that were politically impossible before?

(226) PREMISE: Third parties have generally assumed a major role in the marketing of railroad intermodal service. [C]

1. What effect will third-party acquisition of Double Stack trains and domestic containers (48' x 9.5' x 102") have on rail international and domestic freight markets, and on rail control of their share of those markets?
2. What would be the likely economic impacts on the rail industry of such marketing changes?

(229) PREMISE: The Nation's railroads have failed to reduce their costs of handling TOFC/COFC sufficiently to permit their pricing of that service competitively yet profitably. [I]

1. Can significant cost savings be achieved?
2. If not, is the cross-subsidization by captive traffic a viable, long-term solution?
3. If savings can be achieved, will they come at the expense of labor?

(238) PREMISE: In a deregulated market, truckers have two options: (1) become a low cost carrier, or (2) find defensible market niches. [C]

1. What range in operating efficiency exists among truckload carriers who compete on a price basis in today's deregulated market?
2. What strategies have been most effectively developed to assure low-cost operations?
3. What strategies have been developed to identify and protect sheltered market niches?

(241) PREMISE: Double Stack trains have expanded rapidly in 1986 and will likely continue to increase in the future. [A]

1. What commodities are shipped in Double Stack trains and what rates are typical for them?
2. What transport options compete with Double Stack trains?
3. How much traffic will be diverted from trucks to Double Stack trains over the next four years?

4. How will Double Stack trains affect competition between western railroads?

(319) PREMISE: In the past two years several barge lines have started intermodal container movements and then stopped such service after a trial period. [C]

1. Are containers on barge moves valid for a particular move or commodity?
2. What is necessary to make such moves cost-effective for everyone?
3. How can a terminal, barge line or railroad encourage such movements?

(320) PREMISE: For package shipments, mode will cease to be the issue; service standards will be the selling point. [C]

1. Will the increase in competition in this market and increased shipper education make for rationalization of package shipments, i.e. urgent by air long distance - others by truck when the service level is competitive?

(231) PREMISE: Intermodal comparative advantage is in the long haul market (greater than 600? 700? 800? miles) but most traffic in the United States is in the short haul market. [A]

1. Can intermodal penetrate the short haul market?
2. Does the above answer change under less restrictive wage rules? lower wages? how much lower?

(225) PREMISE: Service for containers on barges operating on inland waterways have not been successful except for the Columbia river. [I]

1. What factors prevent economic utilization of inland barges for container movements?
2. What changes can be made? or should containers stay off of inland barges?

(301) PREMISE: The goals of overall cost effectiveness and customer service has led to multi-modal transportation companies. [C]

1. How has this affected competition?
2. How has this affected customer service?

(322) PREMISE: A marketing approach to developing services based on shipper's needs will make service, not mode, the issue. [C]

(237) PREMISE: Given the speed and low cost of today's computer systems, empirically based models can be developed to simulate the integration of various transportation modes so as to select the lowest cost alternative. [G]

1. Where will good data for such models come from?
2. What companies will be able to afford this type of research?

LIST 3: OPERATIONS AND FACILITATION

(109) PREMISE: Interactive computer systems will be available to link all parties in the international exchange of goods. [5]

1. What will the role of the forwarder become?
2. Will the structure of conferences and their tariffs change?
3. Will the governments, banks and insurance companies be willing to change from paper to electronic documentation?
4. Will the small shipper be able to afford the necessary computer systems? How will they be served?

(111) PREMISE: The differences in documentation requirements between domestic cargo moves and international moves are substantial. [C]

1. Are there likely to be significant developments to simplify international documentation?
2. Is there any possibility of a closer agreement developing between international and domestic bills of lading, tariffs and the like? Or will a whole new "animal" emerge?

(123) PREMISE: There will be a universal ability to interchange containers, including the identification of them. [S]

1. What problems would be encountered with the interchange of containers?
2. What benefits would be obtained in handling containers during loading a ship or a train?
3. Would the identification of containers be beneficial at port facilities?

(114) PREMISE: There is a trend toward smaller intermodal ramps and greater emphasis on the "HUB-Center" type of operations often accompanied by bringing in non-railroad/railroad subsidiary personnel to operate and manage the ramp facility. [C]

1. Will this trend continue in the future?
2. What factors are considered when closing ramps?
3. Does the railroad lose control when ramp operations are turned over to independent terminal managers?
4. Under the HUB-Center concept, it seems logical to expect that equipment will spend more time away from the terminal. Assuming this to be the case, does the HUB-Center concept detract from a move toward domestic containerization as this in turn would increase the chassis to container ratio needs?

(324) PREMISE: The ICC will be zero-budgeted by 1988. [C]

1. How will this impact the motor carrier's responsibility to self-regulate its safety conditions?
2. Will the relationship between motor and rail carriers be strengthened or weakened?
3. Will the role of states be greater and/or will there be more tax?

(321) PREMISE: The entry of railroads into door-to-door trailer service will divert a major portion of truck load business from highway to railroad. [C]

1. How will the motor carriers deal with the price competition?

2. What ownership situation will be in the public interest?

3. What will organized labor's response be?
4. Will organized labor continue to exert sufficient power to block moves toward increased efficiency?

(240) PREMISE: U.S. opposition to the UNCTAD liner code may reduce competition and intermodal transport by developing countries. [A]

1. Does the allocation of traffic to the national flag carrier of a developing country actually help their economy?
2. Does allocation of traffic to developing countries' lines promote competition, increase intermodality, or produce reduction of rates?
3. Would U.S. flag carriers and intermodal developments be harmed by acceptance of the UNCTAD liner code?

(228) PREMISE: Intermodalism is a great gross revenue business, but a poor net revenue business. [A]

1. Will intermodalism ever be a big money maker or will truck competition always keep the margin low?
2. What impact will cheap fuel have on truck competition?
3. What impact will the continued evaluation of the teamsters have on truck competition?
4. Can railroad companies lower rail cost by working work rule reforms?

(216) PREMISE: Railroad intermodal service economics is currently heavily influenced by origin/destination terminal operations, which are in turn dominated by the cost of drayage. [C]

1. What options are available to railroads and their customers that could significantly reduce drayage costs?
2. What potential marketing and economic impacts on the rail industry would these options have?

(328) PREMISE: Rationalization of international and domestic moves is needed. [S]

1. Do box size and design need standardization?
2. What are the rail and ship design issues related to compatibility?
3. How efficient can ship-rail transfer be?
4. How is the management control of the cargo to be handled?

(208) PREMISE: Numerous proprietary systems are springing up world-wide, each designed to facilitate intermodal movement and/or supplant TOFC/COFC/SWOOP. [I]

1. Will transport actually be better served overall as these systems develop?
2. What benefit is there universally in a number of proprietary systems?
3. Should not standardization be a major criterion to assure network compatibility?
4. Is not full interchangeability/compatibility actually the real world keystone to intermodalism?

(115) PREMISE: Some ocean carriers will choose to become only ship operators, offering space on a slot charter

basis (ferry boats) while others will lease operating vessels and become door-to-door transportation companies, contracting for modal services needed. [S]

1. What is the role of the conference? Do the ferry boat operators become members? the transportation companies, or both?

2. Can/will the shippers choose to book directly with the ferry boat operators and provide their own intermodal transportation or will they be more involved with the total transportation companies?

3. Will other entities such as the RR's, truckers, airlines, forwarders (and other third parties) become the transportation companies?

(144) PREMISE: As a result of changes in economic regulation of the trucking industry, truck freight service to many small markets has been improved or maintained. [G]

1. How many trucking companies now offer service in a selected set of small markets, relative to the service available before the 91980 Motor Carrier Act (commodity-specific)?

2. Has carrier productivity (hours per ton) improved since 1980 (commodity-specific)?

3. Is carrier utilization of equipment in selected small markets improving?

(401) PREMISE: Current trends tend to indicate that the largest (4400 TEU) containerships are uneconomical. [A]

1. How will this impact load centering and developments associated with load centering such as dedicated 2-stack trains?

3. Will this reverse the trend towards the use of intermodal pricing? (Or as they say on Wall Street, does this call for a correction in the market?)

(329) PREMISE: Trailer freight - truck and rail requires a high balance factor to keep rates low as do stack trains on domestic intermodal balances of import runs. [C]

1. Does such a deregulated industry, requiring balance, force a concentration of industry geographically?

2. Will this concentration be heavily influenced by off-shore production of goods?

3. If so, are such concentrations in the national interest?

(206) PREMISE: The maturing of the transportation industry where it integrates all modes of transportation (viz. land, rail and sea) into a unified system to save time and money, will result in an expansion of landside facilities at certain ports. [G]

1. What impact will this have on competition between ports?

2. Where there are joint ventures on landside development, will anti-trust be a factor on how these ventures take place?

(139) PREMISE: As the intermodal movement of goods increases its share in all goods movement, it can be expected that increased amounts of hazardous materials will also be shipped in this manner. [G]

1. Are the present safety provisions adequate?

2. Is there reason to believe that unidentified hazardous materials are being shipped as freight of all kinds, FAK?

3. Can the documentation and/or identification of hazardous materials in intermodal service be improved?

4. Have special handling measures for hazardous materials known to be in intermodal service been adequately developed?

(121) PREMISE: The majority of containers are empty for backhaul and there is potential for reversing this and gaining better utilization. [C]

1. What is the potential for filling containers with grain or specialty crops for a loaded backhaul?

2. Can containers be diverted for loading with agricultural produce without undue cost or delay?

3. Are the railroads and shipping companies flexible enough to develop and market container service to cut empty backhauls?

LIST 4: INVESTMENT, TECHNOLOGY, EQUIPMENT

(220) PREMISE: Capital costs of new facilities for intermodal shipment are a major impediment to increases in intermodality. [A]

1. What will be the impacts on employment and labor costs of further investments in intermodal facilities?

2. What will be the impacts of various public/private partnerships in facilities investments on U.S. ports and regions?

3. What will be the effects of intermodal facility investments on tax rates and shipping rates?

(243) PREMISE: Intermodal freight facilities are by nature both land intensive and metro area sited. Further, to be fully utilized, they must serve all possible modes, not just rail/truck or sea/truck. [I]

1. Is special zoning advisable to obtain the needed land areas?

2. Are TSM strategies in place to manage the highway interfaces necessary for intermodal terminal viability?

3. Is there an accountable set of algorithms to aid in selecting proper intermodal terminal locations?

(404) PREMISE: Rail intermodal cost and service improvements have been constrained by lack of capital. [I]

1. How is rail capital spending affected by outdated accounting and valuation methods?

2. Will recent write-downs improve apparent return on investment and encourage capital spending?

3. How much attention does the financial community pay to ICC revenue-adequacy standards?

4. Does profitability of intermodal traffic really justify capital investment?

(410) PREMISE: The advent of Double Stack trains coast-to-coast could foster development of "load centers" at Chicago or St. Louis where containers would be switched from train to train as necessary with domestic freight. [C]

1. Can railroads jointly market/manage transcontinental operations?

2. Will "load centers" eliminate switching of flatcars?

3. Can railroads compete successfully for land-bridge and domestic traffic using Double Stack equipment and load-center technology?

4. Where should "load-centers" be located?

5. What kind of joint reservation system will be required to fill the Double Stack trains?

(406) PREMISE: The rail industry has over-emphasized technological advance and the need for standardization. [I]

1. What is the right balance between specialized and standardized equipment?
2. What has the rapid turnover in technology done to intermodal profitability?
3. Would the customer be better served with more management and less technology?

(232) PREMISE: The drive for efficiency will bring about change in the transportation industry. Intermodal transfer efficiency is one manifestation of this objective. [G]

1. What are other manifestations of this objective?
2. How do the efficiency gains manifest themselves in terms of price to the consumer and the user of the facilities?

(108) PREMISE: U.S. ports have large capital assets tied to their container facilities. In order to protect these valuable assets, U.S. ports might try several strategies, such as: investment in rail facilities and rail equipment, establishment of independent road and rail transportation services, creation of "inland" ports and others. [A]

1. Should ports, which in most cases are political subdivisions and publicly funded, assume active roles in inland transportation?
2. Can active port intervention actually divert cargo flows? If so, will the "wealthier" ports "buy" the traffic from the financially weaker, but better located ports?
3. Can ports on each end of a trade route get together and share the traffic between them, e.g. Los Angeles and New York?

(134) PREMISE: Relatively new to the U.S. are the techniques of employing straddle carriers, in lieu of cranes and hostler drawn chassis, and multilane bridge cranes in direct transfer of containers between ship and train. [G]

1. Have the advantages and disadvantages of using these techniques been adequately weighed against other competing techniques?
2. Could and should the bridge train concept be considered for train to train transfer of containers in high volume rail hubs?
3. Should the optimum systems design concept for rail-ship interface be explored at least to the performance standard level?
4. What thru-put (in terminal time) standards should be the design goal to achieve the highest level of efficiency?

(330) PREMISE: Transloading from marine containers into rail equipment could improve the imbalance of equipment for steamship lines, leasing companies, and railroads. [C]

1. What programs could be effected to coerce steamship lines and railroads to work together in transload operations?
2. With Japan being the largest trading partner next to Canada, what could such a program do to influence present methods of intact requirements (i.e. Japanese are averse to transloading)?
3. What could the U.S. do to assist the Japanese in inducing them to transload? For example, could incentives offset new packaging requirements?

(233) PREMISE: An important element of reducing container handling costs lies in the effective control and planning with respect to minimizing the number of handling moves and utilizing cranes and other handling equipment productively. To some extent, productivity is captive to a range of working arrangements, practices and agreements that constrain productivity and work adversely--more so in some ports and facilities than others. [I]

1. For ports under greater constraint, what technology is available to minimize the number of handlings?
2. How can these technologies be combined into a systems approach?
3. The emergence of the concept of automated terminals indicates a potential for increased productivity and reduced container handling costs. What are these potentials and how would they operate?
4. Would such automated technology have significant implications for intermodal competition? What are they?

(310) PREMISE: New handling equipment is needed to improve port productivity. [C]

1. Can transloading concepts be improved?
2. Is equipment other than bridge cranes needed to reach the 2nd and 3rd track?
3. What are the innovative ways to reduce costs and improve efficiency?
4. Flexible equipment to handle different mixes of cargo is needed.

(409) PREMISE: The development of the Dallas-Smith robotic trailer will facilitate handling of finished automobiles from assembly plant direct to the dealer and return with auto parts on the backhaul. [C]

1. What are the implications for railroads?
2. Will separate multi-level auto parts equipment be required in the future?
3. What impact will result at terminals handling multi-level equipment today?
4. Can robotic trailers run like Road Railers?

(215) PREMISE: Very large containerships will encourage development of load center ports. Port user fees will require cost sharing for construction and maintenance of harbor waterways. [I]

1. How will neglected ports deal with the new environment?
2. Will states and municipalities make new investments in ports?
3. Will economic forces rationalize port capacity or will regional pride continue to encourage uneconomic investments?

(147) PREMISE: Making intermodalism responsive to shipper needs is also creating a hodgepodge of trailer, container and rail car types that do not always fit together, or that can't be handled by conventional equipment. [C]

1. How can trailer length and rail car capacity be gotten back into congruence?
2. How to deal with the increasing lack of standardization that is impeding interchange ability, creating training and parts supply problems?

3. How to get railroads to again share equipment testing and operational experience data, rather than protecting "competitive advantage" perceptions?

(311) PREMISE: Increased shipper control requirements will lead to increased demand for Electronic Data Interchange (EDI) among carriers for intermodal movements as well as with shippers. [I]

1. What type of information needs to be exchanged?
2. Are standard communication and data formats required?
3. What third parties (e.g. brokers, information companies) could provide the data?
4. Who should bear the costs of such systems?

(11) PREMISE: Communication limits equipment utilization and service, increases costs. [C]

1. What data and technological roadblocks limit load planning and its planning horizon?
2. How can ship-to-shore and railroad-to-railroad coordination be improved, e.g. advance notice for equipment positioning and run-thru equipment?
3. What third parties (e.g. brokers, information companies) could provide the data?
4. Who should bear the costs of such systems?

(112) PREMISE: More container movement will generate increased information processing requirements. [C]

1. What innovations have the most potential in the data exchange, transmission, and equipment identification aspects of container movement?
2. What sort of computer programs and protocols should be established to facilitate such transmissions?
3. What electronic systems can interface successfully with manual systems in less developed areas?

(323) PREMISE: Intermodal profitability has been a long-term problem, especially for rail carriers, leading to cautious investment in new technologies. [I]

1. How can intermodal costs be reduced?
2. Can increased service quality improve rates?
3. Will shorter haul corridors prove more costly to operate than long-haul?
4. Will third parties or shippers finance the next round of container investment?

(104) PREMISE: U.S.-based container movement will shift toward larger and wider containers. [C]

1. What will be the impact on the design of containers, handling equipment, and the highway/rail beds?
2. What will be the impact on intermodal movements, in terms of ship design, port development (especially in the third world), etc.
3. Will the "NOW" standard designs of containers become obsolete?

(306) PREMISE: Recent equipment advances and regulatory changes have permitted significant increase in the size of intermodal equipment. [C]

1. For long range planning purposes, what is the ultimate height of both rail and highway equipment?

2. How large a clearance envelope must be maintained in areas of new construction to prevent near-term obsolescence?

3. How heavy will both rail and highway freight movers grow to be?

4. Should highway ramps be designed for longer-length trailer equipment of any kind?

(242) PREMISE: Double Stack container technology offers significant cost saving opportunities in long haul corridors. However, technology has limited application in shorter new corridors. [C]

1. What parameters (density/balance/length of haul) define the range within which Double Stack trains can be economically operated?
2. What alternative technologies are available and could be used to expand the reach of Double Stack service into watershed movements beyond Double Stack terminals? What parameters (density/identification) can gain the economic extension of domestic container service?

(133) PREMISE: Technological change is still required to take full advantage of containerization. [A]

1. Do clearances need to be altered? RR and highway access to intermodal terminals?
2. Is there a solution to the ship-to-rail transfer problem that does not involve local drayage?
3. Is the highway access/congestion to remain a problem?
4. Is terminal design at a steady-state or are there major changes still to come?

(212) PREMISE: There are economies of scale in the construction and operation of rail intermodal facilities, yet railroads operate multiple facilities in most metropolitan areas. In the next 10 years many intermodal facilities will need to be upgraded, but consolidation only takes place through mergers. [A]

1. How much savings could be obtained through coordinated development of intermodal facilities?
2. What company or agency should take the lead in constructing such facilities?

(138) PREMISE: The advent of Double Stack container trains, fewer intermodal terminals, increased terminal mechanization, and the Hub-Center concept have increased the impact of peak volume surges on intermodal facilities. [G]

1. Is the present-day transfer handling equipment and paperwork processing adequate in handling the increased volume?
2. What research or new approaches are needed to more effectively handle these high volumes without unnecessary increases in capital or labor investments?
3. Is it cost-effective to attempt to operate mixed TOFC/COFC terminal facilities as the volume of both systems begins to approach equity?
4. Has the terminal container stacking versus non-stacking been adequately explored from a cost trade-off point-of-view?

(214) PREMISE: "Chassis without cars" has been identified as a potential lower volume feeder technology that could complement Double Stack trains operating in

high-volume hub center and their related long-haul corridors. [C]

1. Is "chassis without cars" technically, operationally and economically feasible for such a market application?

(307) PREMISE: With intermodalism, there is a move to standardize international and domestic container/trailer equipment. [C]

(103) PREMISE: In the next decade, intermodal equipment needs and standards for containers and trailers will continue to evolve. [C]

1. Will 48' trailer be replaced with a still longer one?
2. Is there an optimum size for containers and trailers? If so, what factors should be considered to anticipate what that size is (will be)?

(102) PREMISE: Maximum efficiencies in intermodal transport will be achieved only to the extent that equipment is interchangeable. Yet each mode currently is dominated by a different equipment type and size. [C]

1. Which equipment length is likely to emerge as the standard: 20', 40', 45', 48' or other?
2. What will be the impact on various modes of excess non-standard equipment?
3. How will the various operators deal with obsolete equipment?
4. Is a surge in investment in intermodal equipment likely?

(205) PREMISE: As trucks increase in size, the need to consolidate loads increases in order to obtain full truck movement economies. As a result, fewer shipments can be handled directly from origin to destination. [A]

1. Has the "basic box" become too large?
2. What are the economic and technological characteristics of a transportation system based on small containers and automated sorting/transfer devices?

(105) PREMISE: Rail flat cars are being built, refurbished and outdated because of fast changing trailer lengths and widths. [C]

1. What is the optimum trailer length and width for 1990?
2. Will industry convert pallets to 48" thus necessitating 102" wide trailers?
3. Will length standardize on 48' trailers in volume service and 27' feet for pups in LTL service?

(107) PREMISE: Increased allowable weights on the highways forces the railroads to increase capacity and efficiency of its trailer equipment in order to remain competitive. [C]

1. At what point in time will the railroads have to replace their 45' equipment with longer units?
2. What will the standard length be in 1988-1992?
3. Would the acquisition of shorter units for use in double-bottom/triple-bottom operations be a viable alternative for railroads?
4. Is there a likelihood of a period of stability with respect to equipment size and if so, at what point in time or in concert with what factors?

(106) PREMISE: The trucking industry will be successful in convincing Congress that current size and weight laws should be changed to allow nationwide movement of longer combination vehicles carrying up to 130,000 pounds. [G]

1. What will be the impact of this upon competing modes, mainly the railroads?
2. What effect will these larger vehicles have on intermodal shipments?
3. How will the railroads respond in terms of TOFC/COFC markets?
4. What impact will nationwide operation of larger and heavier trucks have on international shipping?
5. Will trucking gain increased markets at ports for domestic movement of containers and bulk goods?

(119) PREMISE: Changing the permissible size limits (especially width) of a trailer (102") will permit improvements in trucking productivity and costs for selected commodities. [G]

1. How will trucking costs be affected for key commodities?
2. What diversion of freight from other modes will occur for "key" commodities?
3. What are the resulting safety impacts in urban areas?
4. What improvements in productivity (hours/ton) will occur for key commodities?
5. What improvements in energy usage might be realized?

(203) PREMISE: Intermodalism requires a great deal of standardization to work effectively. [A]

1. What will be the standard size for freight containers (20', 40', 45', 48')?
2. Does the presence of containers designed solely for domestic carriage threaten intermodalism in international carriage?
3. Will regulations regarding equipment size and weight become standardized among trading nations?
4. If not, what is the future of intermodalism internationally?

(309) PREMISE: New trucking technology (e.g. 48'/102" trailers) continue to offer lower cost/better service than intermodal movements domestically. [I]

1. Will rail technology be able to leap-frog truck technology?
2. Can railroads ever compete in the shorter haul (under 500 mile) markets?
3. Will more liberal size and weight laws be adopted for motor carriers in the near future?

(204) PREMISE: The trucking industry, in the past, has improved productivity through increases in the Federal and State weight and size limitations applied to heavy tractor trailer combinations. [C]

1. What federal and state weight and size limit objectives are now being sought by the motor carrier industry?
2. What effects would projected changes in motor carrier size and weight limits have on currently emerging railroad intermodal technologies?
3. To what degree would the implementation of proposed size and weight limit objectives improve the motor carrier productivity?

4. What effect would projected motor carrier productivity improvements have on future economic viability of currently emerging railroad intermodal technologies?

(308) PREMISE: The increasing liberalization of highway trailer size restrictions will make the standard ISO container, 20's and 40's outmoded in the U.S. for domestic transport. [I]

1. Will container liners or container owners provide price incentives designed to increase the use of an ill-matching trailer in the domestic scene?

2. Will these ill-sized containers eventually become uneconomical to use?

3. Will this encourage the transfer of freight from and to domestic truck trailers at the port with the inefficiencies of restuffing?

4. Is there a need for a larger or different standard for international trailers to match this technology change?

(316) PREMISE: Larger long-haul trucks cannot operate efficiently in many dense urban areas. [C]

1. Is there a significant role for increased containerization in the traditional highway carrier business?

2. Can this containerization be beneficial in easing transport from over-the-road trucks to local PUD units?

3. Is there a role for a distinctly new technology "joinable freight transporter" which can be interconnected for over-the-road haulage?

(318) PREMISE: Truck sizes will continue to increase, first to 53' and then beyond. [I]

1. Will the railroads be able to standardize intermodal equipment in the wake of size increases?

2. Will today's equipment, designed for 48' to 50' truck sizes, be made prematurely obsolete?

(326) PREMISE: The AVI systems will be incompatible with present rail car and train systems. [C]

1. How can a system be put in place that all the modes in the intermodal system will use?

(325) PREMISE: Technology for Automatic Vehicle Identification (AVI) systems is rapidly evolving. [C]

1. Should an industry-wide freight AVI system be implemented to provide better control and information for freight movement?

2. Is there any danger to persons or hazardous material cargoes from microwave AVI installations?

3. What AVI technology would be most appropriate for freight industry applications?

4. Is there a possibility of a widespread vehicle identification locator and tolls collection AVI system for both freight and passenger modes?

(135) PREMISE: Automatic equipment identification (AEI) and other low cost automation systems are causing the different modes to again look at AEI systems as a means to improve productivity. [G]

1. Should the government or the private sector take the lead in ensuring that compatibility will exist between modes? If so, who and how?

2. Should each mode be permitted to come up with its own system? What is the impact on containerization?

3. What consideration must be given to securing proprietary information in any shared data base?

4. How will international standardization be assured?

(235) PREMISE: Increasingly domestic and overseas freight shipments will be truck-air-truck. [I]

1. Can a volume container be devised to permit such intermodal movements?

2. What might be done to increase equipment utilization?

3. Does such intermodal transportation depend upon integrated ownership?