

# Marine and Intermodal Transportation *Issues and Challenges*

**LESTER A. HOEL**

**A**t the TRB Executive Committee's second special session devoted to major transportation issues, held in January 1989, a panel of transportation experts presented their views on marine and intermodal transportation issues. Held during TRB's Annual Meeting, these panel presentations are intended to familiarize executive committee members with various transportation modes, examine current issues and concerns, and develop an appropriate strategy for TRB in new and emerging issues.

Panel members in January discussed marine and intermodal transportation from the perspective of a carrier, a port authority, the federal government, and a logistics-management educator. Representing the different viewpoints were Eugene K. Pentimonti and Stephen C. Nieman of American President Lines, carrier; Lillian C. Liburdi of the Port Authority of New York and New Jersey, port authority; Gary S. Misch of the Maritime Administration, government; and Bruce W. Allen of the University of Pennsylvania, logistics-management educator.

One of the major conclusions of the Executive Committee's first special session was that traditional modal distinctions have become blurred as the private sector responds to a new economic and regulatory climate. Transportation companies are becoming more consumer-oriented by furnishing a broad spectrum of transportation services that are more

---

*Lester A. Hoel is Hamilton Professor and Chairman, Department of Civil Engineering, University of Virginia. He is a former chairman of the TRB Executive Committee and a member of several TRB committees and task forces that deal with freight shipments and multimodal transportation.*





closely linked to shippers' needs. Evidence of these changes includes the growing use of containers and the expansion of steamship, trucking, and railway companies in ways that best use the attributes of each, coordinated by non-carrier entities that offer a wide selection of services to shippers.

These are new areas of growth that present a new set of problems—problems that are often not well handled by existing institutions because the solutions typically break down at the boundaries where the modes intersect. TRB has developed considerable activity

then loaded onto a conventional ship. With the use of containers, the handling of individual cargo was eliminated, ships could be loaded and unloaded more quickly, and containers could be transported on rail cars or as truck bodies to their final destinations.

The growth of containers went from essentially zero 30 years ago to 55 million twenty-foot equivalent units (TEUs) in 1985. Recent growth has been at a rate of 6 million TEUs per year, and by the year 2005, it is expected that there will be 205 million TEUs worldwide. As international trade ex-

spurred by competition. The need for uniformity in container sizes was met by agreement on standard lengths and widths developed by the International Standards Organization, thus assuring compatibility around the world. Typical international container sizes are 30 or 40 feet long and 8.5 or 9.5 feet high. The most recent domestic container design is 53 feet long, 8.5 feet wide, and 9.5 feet high, reflecting changes in U.S. truck size and weight laws.

Recent vessels designed for container use carry about 4,600 TEUs and are the largest container ships afloat today. These ships are inherently stable, require no ballast, and can be loaded on a "first in first out" basis regardless of container weight, thus assuring minimum loading and unloading times. These vessels are so large, however, that transit through the Panama Canal is precluded, and their draft requirements of 40 to 45 feet limit access to certain ports because of channel depth restrictions.

The trend in ship sizes would indicate that even larger vessels are possible. The weak link in this chain is the capacity of ports and terminals to accommodate this large volume of container freight within a period of time sufficiently short so that the ships can be seaborne again. Even today, in a typical North Atlantic trip totaling 14 days, as many as 4½ days are spent in port, with additional delays clearing the product through customs and to its ultimate destination.

Some academic planners envision the possibility of a jumbo barge carrier—literally, a floating dry dock—that would carry 12,000 TEUs, or 3 times the capacity of the largest ship today. Because barges would be off-loaded from this main carrier, the need for deep-draft ports would be eliminated, dredging would not be required, and investments in additional load center facilities (that is, well-equipped ports) would be reduced. In the interim, however, port expansion is needed, including facilities for traffic flow, container handling, and intermodal operations within the marine terminal dock.



At the special session on marine and intermodal transportation issues held during the 1988 TRB Annual Meeting, members of the TRB Executive Committee listen to presentations expressing four different viewpoints. From left, Ray Petthel, John Clements, Gary Byrd, Wayne Muri, Thomas Deen, Bruce Allen, Herbert Richardson, and Lester Hoel.

in all of the modes, particularly highways, rail, air, public transit, and trucking, all of which have distinct service, design, and operating characteristics. A logical extension of these activities is in the area of marine transportation, a mode in which the interaction of rail, trucking, and marine services occurs at major ports to form connecting links that span the globe.

## Containerization

The recent revolution in freight transportation has been brought about by the introduction of containerization, which has replaced the time-honored method of transporting ocean-borne cargo. In the past, cargo was separately handled and repacked as it was taken from a warehouse by rail or truck and

pands with a growing world economy, particularly if countries such as the People's Republic of China and the Soviet Union open their markets, growth potential could be enormous.

## Shipping

American President Lines (APL) is one of the two major intermodal companies (the other is Sea-Land) that provide door-to-door container transportation. As with other steamship lines, the traditional method of operation relied on the strength of longshoremen to move crates, barrels, and other items. Even the introduction of pallets in the late 1950s did little to improve efficiency. The 1960s and 1970s saw the change-over to containerization—a move



## The Landbridge

The APL network extends from the Asian Pacific Basin to destinations on the U.S. East Coast. In 1977 the all-water routes were discontinued, and in their place, a "landbridge" from the U.S. West Coast was created by using both containerization on rail flat car (COFC) and trailer on flat car (TOFC) for cross-country movement. The changeover to intermodal transportation was dictated by reasons of service and economy. In 1984 the decision was made to expand cross-country capacity by using double-stack trains. Several factors were behind this decision:

- The large increases in freight from the Pacific Rim nations that occurred in the 1980s;
- Competition from other carriers that chose to build jumbo ships for east-bound round-the-world service;
- Legislation passed in 1984 that permitted ocean carriers to quote through intermodal rates;
- Design of a new double-stack car with lighter weight and lower operating costs than the conventional single-stack COFC; and
- Investments (which came later) by railroads in lowering track and raising bridges to provide necessary clearances.

Once again, service and economics were the driving forces that ensured a continued role for landbridge freight travel by rail. Today, a typical double-stack train consists of 24 cars each carrying 240 forty-foot containers, or 480 TEUs.

The intermodal or landbridge element of international freight transportation suggests several areas that must be addressed if the United States is to remain competitive in world markets. Among these are highway congestion, deterioration of the nation's transportation infrastructure, environmental concerns, and determination of the most productive aspects of each mode.

## Load Centers

Ports and terminals are the interfaces between the shipping mode and landside transportation services. Just as an aircraft discharges its passengers through an airport terminal, so a ship discharges its cargo through a seaport terminal. Both modes use special docking facilities, and both transfer cargo to some form of surface transportation.

Not all ports are equipped to handle container ships. Of the 160 or so ports in the United States, only some 40 are so equipped, but even fewer are consid-

ered major container ports, with the requisite substantial investment in handling and storage facilities. In much the same way that airlines have selected a few favored airports as major "hubs," shipping companies have selected some ports as "load centers," relegating others to relative obscurity. The advent of larger container vessels has strengthened the load center concept, and today the process is all but complete. Far fewer locations today serve as ports-of-call than was the case in the past.

## Regional Impacts

The influence of a seaport on a region's economy can be illustrated by considering the largest U.S. port—New York Harbor. In addition to operating four airports (Kennedy, La Guardia, Newark, and Teterboro), tunnels and bridges (George Washington Bridge and Lincoln Tunnel), and public transit (Port Authority Trans Hudson and Port Authority Bus Terminal), the Port Authority of New York and New Jersey is responsible for more than 20 seaport terminals, including 7 that can service container vessels. Among these are Port Newark, Port Elizabeth, and ports within the New York City region.

The ports in the New York City region were originally the catalyst that created this great metropolis, which serves as a hub of commerce and the principal international gateway to the United States. Today the balance of trade in New York is such that about 75 to 85 percent of all cargo handled is imported. With containerization, the activity of the Port Authority of New York and New Jersey has become less visible, and its contributions to the economic well-being of the region are not as readily apparent to the public as they were during earlier years. Nonetheless, port activities in the New York City region are estimated to generate about 200,000 jobs, \$14 billion in economic activity, \$4 billion in direct and indirect wages, \$2 billion in business income, and \$0.5 billion in income and sales taxes. It is on the basis of these and similar statistics



A typical double-stack train can carry 480 twenty-foot equivalent units.



that port authorities throughout the nation seek to defend continued investment by state or city governments who must consider the extent to which expenditures of taxpayers' dollars for terminal facilities are justified.

One question raised by port development critics concerns the socially optimal number of ports that would be sufficient to handle containerized freight demand. Although port investments can be shown to pay off, comparisons with other investment alternatives are not usually made, nor are the opportunity costs for investments computed. In addition, the use of a multiplier effect may overstate the beneficial results of port investments.

## Port Management and Operations

Ports are usually owned by public bodies, but the operation of port facilities is typically the responsibility of private terminal companies who lease the land and physical plant but provide cargo-handling facilities (although some state port authorities do operate their own terminals). Use of a container terminal might be restricted exclusively to a single carrier, or managed as a common-use facility, or operated on a

preferential basis. Further, terminals must contain storage facilities to allow time for a trucking company or railroad to effect the necessary transfer. Thus the movement of containers between ship and truck or rail is often an indirect one, with the terminal facility serving as the vehicle of transfer.

Efficient operation of a terminal requires information about the industry that the terminal is serving. Yet the private nature of steamship lines often precludes securing data about the economics of these firms. As international restructuring takes place, from the European Economic Community in 1992 to Hong Kong in 1997, the more aggressive intermodal companies are positioning themselves with hub-spoke arrangements similar to those of some international airline companies. Meanwhile, some port authorities are unable to develop competitive service strategies because of a lack of information from the shipping industry, whereas others work closely with the same industry to plan expansion tactics. Knowledge about international relations, export strategy, and U.S. policy on trade relations is also needed if U.S. ports are to remain competitive.

In addition to loading and unloading facilities, port authorities must provide extensive container storage. Originally,

storage requirements were about 15 acres per berth, but with the new, larger ships, land requirements have increased by more than 300 percent. Better terminal management may be a solution, and if containers can be moved more quickly, a reduction in storage requirements could result. For example, paperwork simplification and preclearing of cargo could result in time savings and might eliminate some warehousing needs. Reduction in delays by trucking operators who sit in long lines waiting to enter a terminal or expecting an outbound shipment should also be possible through better scheduling and improved handling of paperwork.

## Labor

The task of off-loading and on-loading containerized freight is done by stevedoring firms hired by shipping companies or cargo owners. These firms, in turn, hire longshoremen. In some of the larger ports, stevedoring firms may be either the terminal operator or a large ship line that then handles its own vessels as well as serve other ship lines.

Few comparative data are available on labor productivity of ship-to-shore container movement. Managers need better comparative data on labor costs, particularly from nonunionized ports. These data are vital because competition with other load centers requires that the work performed must be of the highest quality but at the lowest possible cost. Work rules have a major impact on port productivity, and better data on the impact of labor practices are required.

## Weight Issues

One current concern of the maritime industry is overweight containers. This is a complex issue that involves shippers, truckers, ship lines, port authorities, terminal operators, state and federal departments of transportation, and law enforcement agencies (see News Brief on page 26). Because enforcement of truck weight limits varies from state to



PACIFIC GATEWAY, PORT OF TACOMA

Foss tug towing and handling a ship in Sitcum Waterway, Port of Tacoma. Container cranes are visible at left and right.



state, and maximum allowable weights may differ as a result of "grandfathering," some ports see themselves as being at a competitive disadvantage. For example, the Port Authority of New York and New Jersey operates under more stringent rules than do the ports of Baltimore, Montreal, or Halifax. An equitable solution to this problem will be needed if all ports are to operate on an equal basis in regard to truck weight. A related problem is the broad issue of highway and rail access to major port facilities, including bridge and road designs that reflect the special characteristics of heavy vehicles and ensure safe operations.

## Harbor Dredging

For many marine terminals, constant dredging is required to maintain the channel depths necessary to accommodate large container vessels. New York harbor, for example, has a natural depth of 18 feet but must maintain a depth of 35 to 40 feet to handle the 5,300 or so commercial ships that use the terminal each year. Other ports with similar problems include Oakland, Los Angeles, Long Beach, Houston, and New Orleans. The responsibility for harbor dredging rests with the U.S. Army Corps of Engineers, acting in partnership with the ports.

The disposal of dredge material and challenges from environmental and community groups on the impacts of dredging are increasing problems. Although scientific investigations indicate that present methods of disposal (a mud dump 6 miles off the New Jersey coast) are environmentally and economically reasonable, the challenges to find alternatives persist. Addressing this problem requires that the federal government join with port authorities to assure community groups that present and proposed methods are environmentally sound. Harbor dredging should also be examined in a broader context that reviews its role and considers innovations in other technologies that could result in lower costs and fewer environmental impacts.

## Federal Role

Through the Maritime Administration, the federal government's role in marine transportation is to improve the economics and defense readiness of U.S. flag vessels (merchant marine), U.S. port and terminal facilities, and loading and unloading functions provided by stevedore companies. Of primary concern are the sealift capabilities of the United States and the readiness of ports

## Future Challenges

The presentations to the TRB Executive Committee in January 1989 revealed that the field of maritime transportation has become increasingly complex because of the international nature of the market and the many transportation links and modes now required to move freight from its origin (often an Asian Pacific Rim nation) to its destination (frequently a business or home in the

---

*The intermodal or landbridge element of international freight transportation suggests several areas that must be addressed if the United States is to remain competitive in world markets. Among these are highway congestion, deterioration of the nation's transportation infrastructure, environmental concerns, and determination of the most productive aspects of each mode.*

---

to handle mobilization in times of national crisis. Thus projects and interests of the Maritime Administration stress either economic or defense aspects of ports and shipping.

Among the economic- and defense-related issues in which the Maritime Administration has been involved are overweight containers, double-stack trains, port productivity, cargo handling, safety, port security, container standards, port capital expenditures, port economic impact models, vessel emissions, port readiness and emergency training, queuing and operations analysis, human resources allocation on ships, ship performance, waterway development, and technology transfer. Recently, TRB agreed to conduct a study for the Maritime Administration Office of Technology Assessment on the technological and institutional issues that result from changes in government regulation of intermodal marine container shipping. The work will include a historical and analytical assessment of the relationship between deregulation and technology innovation.

United States). Complications have been magnified by three factors. First, the level of paperwork created by customs regulations, quota systems, and government policies has increased. Second, the breaching of international boundaries creates security, drug smuggling, and terrorism problems and requires knowledge of local customs, language, and currency exchange. Third, the physical distances involved require use of many modes and transfer points to complete trips, presenting delays and special problems because of the multiple handling of freight shipments. National policies can be an additional barrier; for example, some countries specify preferences for control of certain land transportation facilities.

The special session clearly demonstrated that many problems remain to be solved and that the transportation research community has a major role to play in this emerging arena. Following the session, the Executive Committee created a special Task Force on Marine Transportation to explore additional appropriate TRB activities in marine and intermodal transportation.