



U.S. Department  
of Transportation  
**Federal Highway  
Administration**

# **National ITS/Intermodal Freight Program Requirements**

**Final Report,  
ITS/Intermodal Freight Program**

Commercial Vehicle Fleet Management and  
Information Systems, Phase II

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<b>16. Abstract</b>  <p>This report recommends the development of a national intelligent transportation system (ITS) program for intermodal freight that will promote the application of ITS technology to enhance the safety, reliability, and responsiveness of the intermodal freight system.</p> <p>The report describes current applications of ITS technologies to freight movement and opportunities for the U.S. DOT to accelerate the application of ITS technologies to intermodal freight movement. The private sector has played the primary role in developing and applying advanced information technology to shipment and asset management, including shipment tracing and information systems; inventory and stowage management systems; and asset location and management systems. There has been parallel development of intelligent transportation systems by the public sector for traffic and highway management, including traveler information systems, toll collection systems, and traffic management systems.</p> <p>Three areas of opportunity for the U.S. DOT to improve intermodal freight movement through the application of ITS technologies are:</p> <ul style="list-style-type: none"> <li>• Business strategy – develop business and organizational strategies that will increase interaction and collaboration among the intermodal stakeholders in the public and private sectors;</li> <li>• Information technology – improve intermodal freight operations through the development of data-exchange standards and interoperable freight-identification technologies; and</li> <li>• Intermodal operations – improve shipment tracing and management, reduce congestion at gates and terminals, and improve route and fleet management through a series of operational tests that apply information technology and ITS to intermodal freight problems.</li> </ul>					
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# National ITS/Intermodal Freight Program Requirements

## Final Report, ITS/Intermodal Freight Program

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Commercial Vehicle Fleet Management and Information Systems, Phase II

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## **Executive Summary**

This report recommends the development of a national intelligent transportation system (ITS) program for intermodal freight that will promote the application of ITS technology to enhance the safety, reliability, and responsiveness of the intermodal freight system.

The work was commissioned by the Federal Highway Administration (FHWA) of the U.S. Department of Transportation (DOT) with support from the Secretary's Office of Intermodalism and the ITS Joint Program Office.

The executive summary and report cover three topics:

- Profile of the intermodal freight systems;
- Key intermodal freight issues and impediments; and
- Recommended activities and initiatives for a national ITS/Intermodal Freight Program.

### **PROFILE OF INTERMODAL FREIGHT INDUSTRY**

The intermodal freight industry has four major segments: air, ocean, rail, and trucking.

#### **Air**

Air cargo, which is intermodal in nearly every case, consists primarily of high-value commodities and time-sensitive deliveries. This segment is expected to grow as more high-value commodities travel by air. From 1996 to 2006, U.S. revenues for air freight shipments are expected to more than double.

#### **Ocean**

Cargo moved by ocean carriers, similar to air cargo, is intermodal in nearly all cases. It is estimated that the volume of international maritime trade will increase by three times within 20 years as the globalization of manufacturing continues to grow. The larger ocean carriers, often referred to as global carriers, have extensive international networks and global coverage. In addition, the top ocean carriers all have extensive intermodal rail operations in North America. However, as a result of ocean shipping deregulation, which took effect May 1, 1999, ocean carriers are increasing their focus on core competencies and may decide to leave the rail industry.

#### **Rail**

Historically, intermodal movements represent only a small portion of the railroads' business and their profit margin. The Association of American Railroads estimated that the intermodal portion of rail revenue in 1997 was 18 percent. However, intermodal freight transport has been

increasing in importance to railroad operations in recent years. Eight million intermodal trailers and containers now moving by rail, almost three times the volume moved in 1980.

Revenues for rail intermodal shipments are projected to increase by more than 50 percent between 1996 and 2006. Growth in intermodal rail revenues can be attributed primarily to the growing number of high-value commodities traveling by rail.

Railroad mergers and acquisitions since 1995 have changed the face of the rail industry by reducing the absolute number of rail competitors. Now, 90 percent of the Nation's total rail freight revenue is accounted for by four carriers: CSX, Norfolk Southern, Burlington Northern Santa Fe, and Union Pacific.

## **Trucking**

Trucking is the dominant mode in intermodal freight transportation. Nearly every intermodal move in the United States involves transport by truck. Intermodal movement involving trucks and trains is among the fastest growing sectors of intermodal transportation; trucks also continue to serve as the primary mode of access to U.S. ports. Trucking is expected to continue its dominance in domestic freight transportation.

Dray carriers are responsible for two types of local freight movement: between a point of origin (or destination) and an intermodal transfer facility; and between modes at an intermodal transfer facility. Drayage costs usually represent 15 to 20 percent of the total cost for intermodal transportation. Some dray carriers are large trucking firms that have successfully integrated advanced communication and information systems into their daily operations. However, the vast majority of drayage companies are small, owner-operated businesses that have not invested in advanced information systems or other sophisticated technologies and represent a weaker link in the intermodal system.

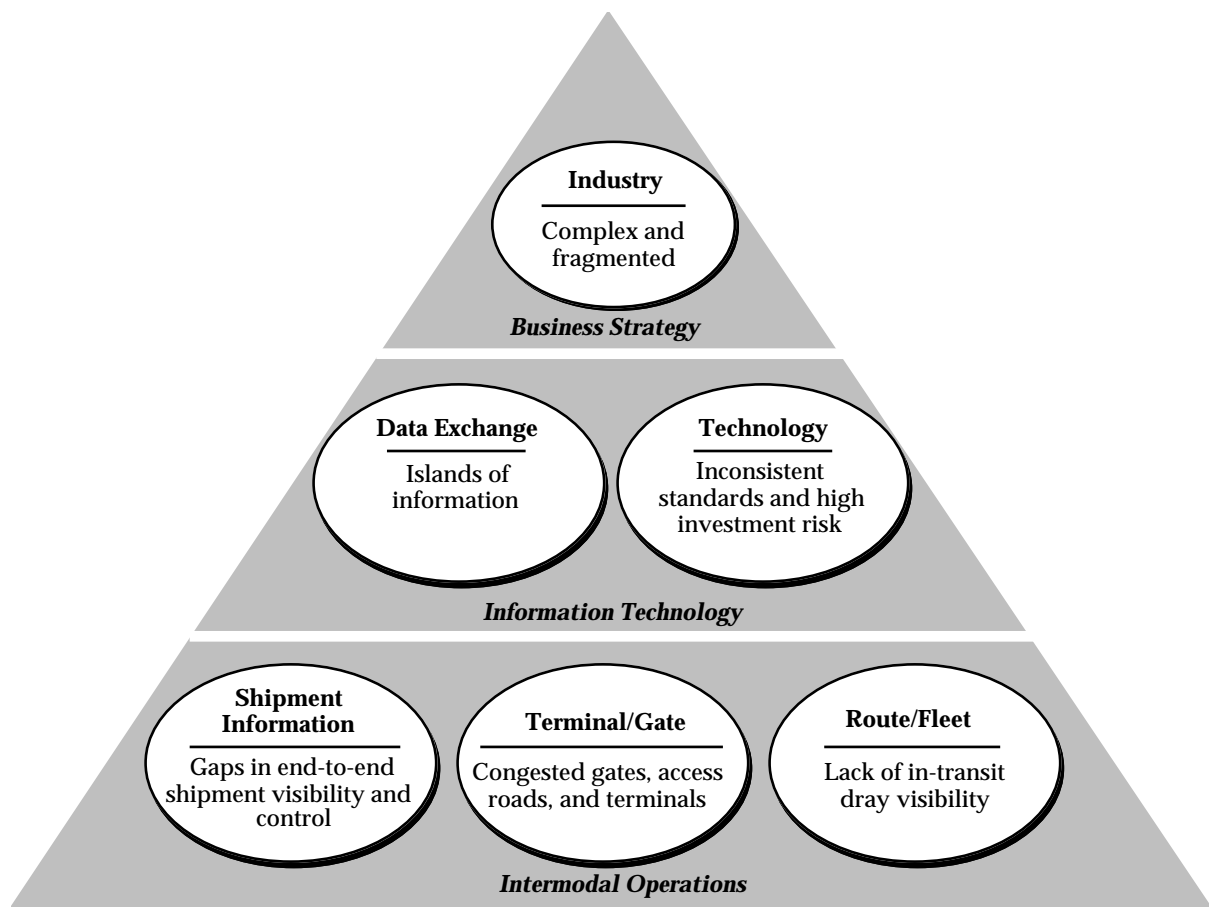
## **KEY ISSUES AND IMPEDIMENTS**

A range of issues impede intermodal freight transportation. Only those issues and impediments considered most critical and where ITS technology can be applied are addressed in this study. The issues are summarized in three areas: business strategy, information technology, and intermodal operations, as shown in figure ES-1.

### **Business Strategy**

The first level, business strategy, addresses issues and impediments on the organizational and institutional levels.

- **Complex and fragmented industry** – The intermodal industry is fragmented. It is a complex industry composed of a large number of diverse stakeholders across multiple modes in different geographical locations. Although intense competition and tremendous growth in the intermodal industry have forced some level of cooperation among industry segments in recent years, collaboration and institutional isolation remain significant issues. Effective



**Figure ES-1. Intermodal Issues and Impediments**

daily management and long-term planning suffer because the modes and stakeholders are operating independently of one another. There are few clearly understood benefits of and incentives for technology interoperability, institutional collaboration, and timely information sharing by stakeholders. These benefits and incentives must be identified and communicated clearly to industry and government stakeholders to promote a new approach to intermodal planning.

In addition, government regulations can be complex, duplicative, and inconsistent across administrations and agencies, Federal and state governments, and countries in the case of customs clearance. Intermodal freight transport would benefit significantly if regulatory requirements were simplified, streamlined, and made consistent.

## Information Technology

The second area, information technology, describes problems related to data exchange, technologies, and standards.

- **Inefficient data exchange** – Paper-based systems of data exchange impede the flow of information related to intermodal freight transport. Such systems are slow, inefficient, prone to easy introduction of error, and unable to respond quickly and easily to changes. With the rapid improvement of information technology it is possible to secure and exchange documents within a completely electronic environment. Current business practices, such as just-in-time (JIT) delivery and manufacturing, demand immediate action and response. Therefore, regulatory requirements, enforcement, invoicing, credit, inventory, customer response, scheduling, routing, and staffing must change to keep pace with today's increasingly electronic business environment.
- **Inconsistent technologies standards** – Technologies are changing rapidly. Given the lack of a unified intermodal industry standard, their rapid development makes linkages and interoperability more difficult. Standards for intermodal technology would encourage interoperability across the logistics chain and facilitate gains in long-term efficiency and productivity for all participants.
- **High investment risk** – There is uneven investment in information and advanced technologies by different businesses in the logistics chain (e.g., shippers, carriers, third-party logistics brokers, and terminal operators). The degree of investment risk and the financial limitations of some dray carriers and less technologically advanced carriers in the logistics chain prevent uniform and sophisticated response by carriers and terminal operators to shippers, freight forwarders, and other business partners.

## Intermodal Operations

The third area, intermodal operations, focuses on operational problems at gates, terminals, en route, and with the overall tracing and management of shipments.

- **Shipment information** – Shipment tracing and management information systems affect the end-to-end visibility of freight moving between shippers and receivers. Weak oversight of cargo, security lapses, and operational inefficiencies result from information gaps.

- **Congestion at gates and terminals** – Congestion is a major impediment in intermodal freight movement for all modes. Congestion and capacity constraints exist at intermodal terminals, gates, and ports. The means must be found to better manage the movement of freight across existing transportation facilities, or to increase capacity of the transportation facilities themselves.
- **Lack of in-transit or en route visibility** – Tracking and tracing systems allow cargo and vehicle movements to be visible at all times and at all points along the logistics chain. Few small carriers and dray carriers have invested in these types of technologies. This lack of continuous cargo visibility significantly weakens the ability to respond to changes and problems as they arise.

These key issues and impediments form the basis for identifying projects and initiatives where ITS may be used as part of a national ITS/intermodal program.

## RECOMMENDATIONS

This section recommends a program of activities and initiatives to address intermodal freight issues and impediments. The activities and initiatives focus on issues and impediments that can be addressed by an ITS program. These activities are the foundation of a U.S. DOT National ITS/Intermodal Freight Program and will support its mission to promote a safe, reliable, and efficient intermodal freight transportation system for the Nation through the application of ITS technology.

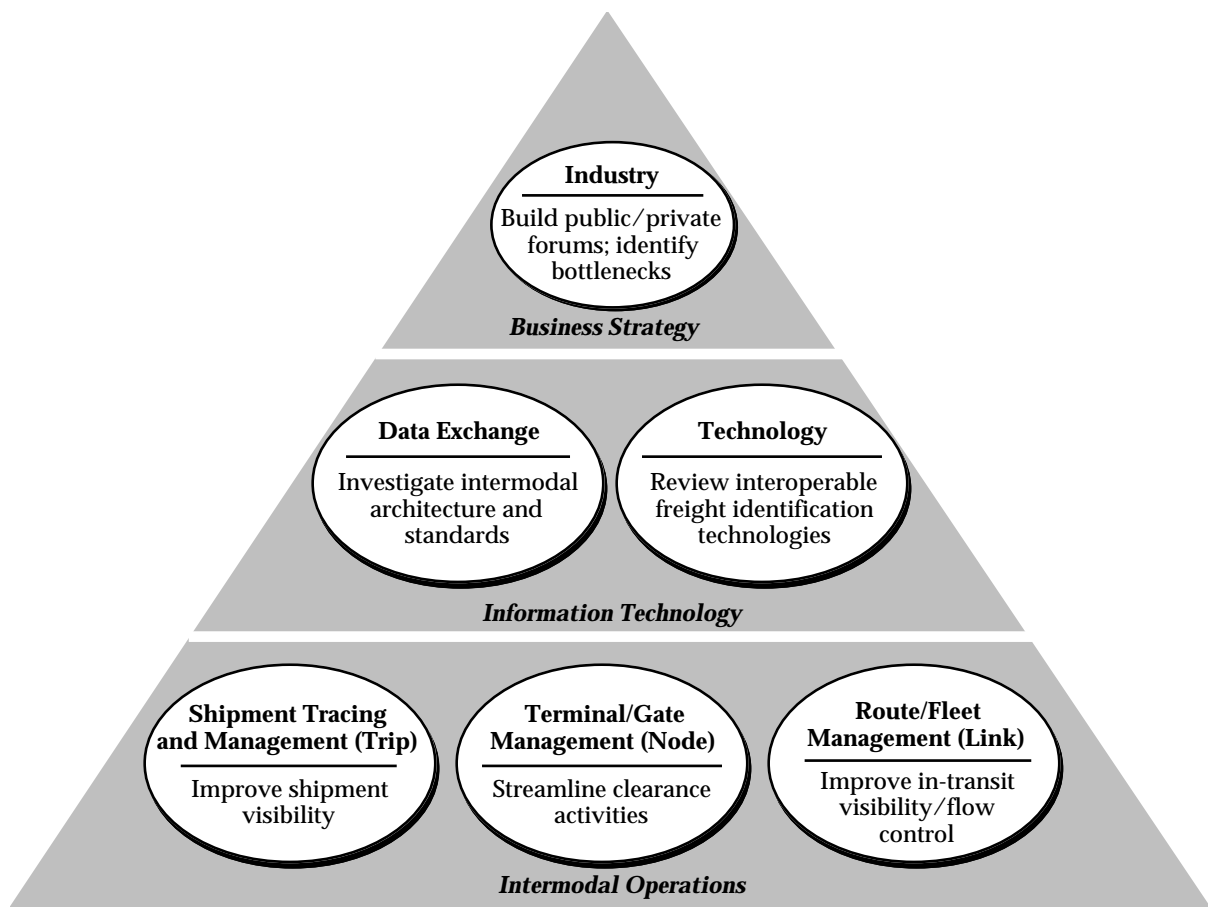
The activities are organized into three areas as illustrated in figure ES-2:

- **Business Strategy** – The objective of these activities is to increase cooperation and collaboration among the private and public sector on intermodal issues.
- **Information Technology** – The objective of these activities is to improve intermodal freight operations through the development of data-exchange standards and interoperable freight-identification technologies.
- **Intermodal Operations** – The objective of these strategies is to improve shipment tracing and management, reduce congestion at gates and terminals, and improve route and fleet management through a series of operational tests that apply information technology and ITS to intermodal freight problems.

## Business Strategy

### Overview

Within the context of the ITS/Intermodal Freight Program, the area of business strategy emphasizes a strategy of cooperation and collaboration among private businesses and government agencies to improve intermodal freight operations.



**Figure ES-2. Opportunities for ITS/Intermodal Initiatives**

Elements of the business strategy program area should include:

- Improved coordination of Federal intermodal freight-related activities;
- Support for emerging public-private partnerships, intermodal freight technology forums, and technical working groups; and
- Development of educational and training initiatives focused on the application of ITS to intermodal freight operations.

These initiatives are explained below.

## ***Recommendations***

### **Improve Coordination of Federal Intermodal Freight-Related Activities**

Consistent with the U.S. DOT Secretary's ONE DOT initiative, the DOT should continue to strengthen coordination among Federal agencies and administrations for intermodal freight activities and initiatives.

The U.S. DOT should empower the existing ITS/Intermodal Freight Steering Group to address the issues and problems of intermodal freight transportation in a unified and collective manner. The U.S. DOT should expand the membership of the U.S. DOT ITS/Intermodal Freight Steering Group, establish a clear mission, and task the Steering Group with overseeing the implementation of the national ITS/Intermodal Freight Program.

The U.S. DOT should work with the U.S. International Trade Commission to streamline trade regulations affecting international freight movement. The DOT can contribute its expertise to facilitate and expedite the process of simplifying regulatory requirements and applying information technologies to international goods movement.

### **Support Emerging Public-Private Partnerships, ITS/Intermodal Freight Forums, and Technical Working Groups**

The U.S. DOT should support public and private forums and working groups that can identify intermodal freight issues and promising ITS applications. The U.S. DOT should work with forums and groups at the international, national, regional, and local levels.

#### *International Level*

The U.S. DOT should support ITS applications, intermodal technology standards development, and international ITS/intermodal programs in international forums. The United States participates in many important trade and freight transportation forums and should use these forums to promote the development of international policies and technology standards for intermodal freight.

#### *National Level*

The U.S. DOT should promote national-level national forums to gain insight and obtain technical guidance for the Federal Government on intermodal freight programming and project



development. The DOT should also support conferences and workshops that focus on specific aspects of intermodal freight technology or operations to draw new people and perspectives into intermodal program development and implementation and improve communication between the private and public sectors.

#### *Regional or Multistate Level*

The U.S. DOT should host regional meetings on intermodal technology issues that are either topic- or site-specific to develop regional support for ITS/intermodal freight initiatives. Regional meetings and “listening sessions” facilitate participation, yet permit discussion of issues of more local interest.

#### *Local Level*

The U.S. DOT should promote the development of local freight advisory groups that draw from the private and public sectors. Many issues and bottlenecks in intermodal freight movement occur at local transfer points and inspection sites. The U.S. DOT can encourage local and regional discussions of issues and provide information on working with the private sector, success stories from other localities, and current national initiatives.

### **Develop Education and Training Initiatives Focused on the Application of ITS to Intermodal Operations**

The U.S. DOT should take steps to educate intermodal stakeholders about the benefits and costs of ITS technology for intermodal freight operations, including:

- Collecting and disseminating data on the costs and benefits of interoperable intermodal technologies to industry stakeholders;
- Developing a better understanding of the private sector’s costs and benefits and developing a shared vision with private-sector participants on the costs and benefits of technical interoperability; and
- Sponsoring research studies to expand upon the information and studies performed to date.

The ITS America web site should serve as a clearinghouse for ITS/intermodal projects. The recent deployment and evaluation of freight and intermodal ITS technologies have generated valuable information and lessons from which future initiatives should benefit. The ITS America web site should include a list of relevant ITS/intermodal activities, project scopes and status, project evaluations, and lessons learned.

The U.S. DOT should expand its ITS Professional Capacity Building (PCB) Program to include training courses related to the application of ITS to intermodal freight. Extending the ITS PCB program to the intermodal freight area would help intermodal professionals realize the benefits of applying ITS technologies to their current operations and facilitate and expedite the deployment of intermodal technologies nationwide.

The U.S. DOT should encourage collaboration among university, government, and industry sectors to promote training and education in the area of intermodal freight. Successful

collaboration among university and industry segments to promote training and educational opportunities in intermodalism and technology applications is occurring, but should be broadened.

The U.S. DOT should accelerate its efforts to educate municipal planning organizations (MPOs) and the general public about the importance of intermodal freight transportation and the issues surrounding it. The Federal Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 mandated that MPOs oversee local freight planning. Some MPOs have been able to meet the challenge; however, due in part to a lack of resources, many agencies have found it difficult to meet growing expectations for freight planning, including education of the public about freight and intermodal concerns.

## ***Information Technology***

### **Overview**

These recommendations address the strategies that the U.S. DOT can undertake to improve intermodal freight operations through the development of data-exchange standards and interoperable freight-identification technologies. The DOT has established its ability in effecting information technology (IT) solutions to problems of national interest and should continue this in the area of intermodal freight.

Elements of the IT program area in the ITS/Intermodal Freight Program include:

- Developing intermodal architecture and standards; and
- Developing interoperable technologies.

### **Recommendations**

The U.S. DOT, as the primary sponsor and supporter of the National ITS Architecture, should help the private sector assess the need for and determine the scope of an ITS intermodal freight architecture and ITS intermodal standards. Participants at industry forums have recommended developing an ITS architecture user service to improve intermodal freight operations. The U.S. DOT should help and support industry representatives and other private sector stakeholders to explore the need for and determine the scope of an intermodal freight user service in the National ITS Architecture and intermodal freight standards.

As part of the architecture development process, it also will be necessary to define the ITS standards critical for an intermodal freight user service. Standards and protocols, collectively referred to as “standards,” define how the components of a system interconnect and interact within the framework of the National ITS Architecture. The architecture and standards should address linkages across modes for such services as cargo identification, tagging, and tracking.

As an intermodal freight user service for the National ITS architecture is still in the future, the U.S. DOT should take immediate steps to promote interoperability of intermodal freight technology through demonstration projects, the development of compatible intermodal technologies, and leveraging of existing public and private sector applications of freight and vehicle identification technologies. Identification and tracking technologies for intermodal cargo, containers, and conveyance constitute the core aspects of IT applications to intermodal freight transportation.

## **Intermodal Operations**

### **Overview**

These recommendations suggest a series of operational tests. The U.S. DOT should solicit and fund proposals for ITS/intermodal freight operational tests at terminals and gates, for routes and fleets, and for shipment information. Intermodal freight operations can be improved significantly by linking existing private sector shipment information and asset management systems with public sector traffic and safety management systems. In this way, terminal operators, freight carriers, and state and metropolitan traffic operations managers can share information to optimize flows and better utilize equipment and facilities. The operational tests would benefit the intermodal industry, the businesses they serve, and the general public. The tests should be designed, staged, and evaluated in 24 months or less. These operational tests will improve intermodal freight operations by:

- Demonstrating how linkages across information systems and data sharing will improve intermodal operations by increasing efficiency and productivity;
- Increasing private-public collaboration and facilitate future cooperation;
- Building and strengthening networks and institutional links;
- Spurring innovation in technology, operations, and business procedures; and
- Assessing the need for and determining the scope of an ITS architecture and ITS standards.

Opportunities for intermodal operational tests fall into three areas:

- Gates and terminals (e.g., management of ports, terminals, gates, clearance sites);
- Routes and fleets (e.g., management of trips between terminals, ports, shippers, and receivers); and
- Shipment information (e.g., management of status and location information for shipments).

### **Gate and Terminal Management**

#### *Definition*

Currently there is significant congestion at transfer points in the intermodal freight logistics chain. In addition, certain operational practices can impede the efficiency of the freight movement at these locations as well. Backups and congestion can occur inside the terminals and ports, at the gates, or approaching the site. Clearance sites, such as Customs clearance, weigh stations, and terminal gates often requires cargo movement to stop and various activities to take place before the cargo may continue to move or before the cargo can be transferred to the next carrier.

The U.S. DOT has the opportunity to accelerate ITS applications at intermodal terminals, gates, and clearance sites, thereby mitigating congestion at gates and terminals, accelerating Customs clearance activities at international borders and ports, and increasing productivity and efficiency.

In addition, lessons learned from other private and public sector asset management and clearance activities (e.g., ITS/CVO, ITS/electronic toll collection, international land border clearance) should be applied to intermodal gate clearance systems and activities.

#### *Support Operational Tests*

There are many opportunities for operational tests to improve or leverage terminal and gate systems and to link them to other elements of the intermodal system. Potential operational tests are summarized below.

#### Intermodal Outbound Flow Management

The objective of this operational test would be to improve the mobility of trucks exiting terminal gates by adjusting street traffic signals based on real-time conditions or optimized signal timing plans. It would address problems of congestion, queuing, and delays for trucks approaching and exiting the terminal gate caused by traffic signals on terminal access and egress roads and corridors.

#### Pre-Trip Safety and Weight Screening

The objective of an operational test for pre-trip safety and weight screening would be to reduce the frequency and duration of stops at weigh stations and other inspection sites for safe and legal motor carriers. The system would allow for terminal operators at the terminal gate to verify driver credentials and safety status. The weigh station clearance system would clear the truck and allow it to bypass verification at the gate.

#### Motor Carrier Credentials at Terminals

The objective of this operational test would be to enable a motor carrier to obtain a permit at the terminal to transport an oversize or overweight load, thereby reducing the need for oversize or overweight permits and the delays associated with such requests.

### **Route and Fleet Management**

#### *Definition*

Route and fleet activities in an ITS/Intermodal Freight Program would include increasing the in-transit visibility of assets, improving the flow of traffic leading to and from intermodal transfer facilities, and improving load planning of vehicles and vessels. These activities affect the in-transit portion of the intermodal move.

#### *Support Operational Tests*

There are many intermodal operational tests that would improve route and fleet activities and better link these activities to other events in the intermodal system. Potential operational tests are summarized below.

#### Terminal Inbound Flow Management

The objective of this operational test concept is to improve the management of inbound truck and container traffic at terminals by using information on expected inbound volumes and arrival times to distribute the arrivals. In this way the inbound traffic at terminals can be managed

to match processing capacity and eliminate the queues that may extend onto access roads, reduce delays, and avoid high peak-period operating costs.

#### Incident Avoidance

The objective of this test is to provide motor carriers that transport intermodal loads with real-time information on incidents, congestion, construction, and other traffic conditions that will enable them to optimize their routing and dispatching to intermodal facilities and avoid incidents, delays, and congestion costs.

#### At-Grade Rail Crossing Advance Notification

The objective of this operational test concept is to enable vehicles to avoid delays at at-grade highway/railroad crossings by providing advance notification of train arrivals.

#### Intermodal Hazmat Incident Response

The objective of this operational test concept is to improve the response to incidents that involve the intermodal shipment of hazardous materials. This test will address the need for a timely and effective hazmat incident response and the problems incurred by responders who cannot identify what is involved in a crash or spill.

### **Shipment Tracing and Management**

#### *Definition*

These recommendations address the productivity and efficiency of shipment information and documentation moving from shipper to receiver. The opportunities to advance IT and ITS technologies in this area fall primarily within the domain of the private sector; however, the public sector should encourage and facilitate the application of IT and ITS to improve the use of shipment information. Opportunities to further improve the efficiency and security of shipment information rely upon improved cargo visibility, communications, and proper sharing of information about shipments and their movements across modes.

#### *Support Operational Tests*

The private sector will lead efforts to demonstrate the value of IT and ITS in the areas of shipment information and security systems. However, public support of an operational test in this area should focus on security because of the clear public interest in the security of commercial and military cargo.

#### Security of Intermodal Shipments and Assets

The objective of this operational test concept is to improve the security of goods and assets in-transit and address problems of theft and vandalism of vehicles, containers, and goods as theft and cargo crime have reached critical proportions. A security system for intermodal shipments and assets would link onboard trailer and container security systems with terminal and traffic management systems to reduce theft and improve the response to criminal attempts.

# 1. Introduction

## OBJECTIVE

The objective of this project is to develop recommendations for an Intelligent Transportation Systems (ITS) program for intermodal freight that will promote the application of ITS technology to enhance the safety, reliability, and responsiveness of the intermodal freight system. The program will contribute to the Nation's goals to:

- Promote safety, mobility, economic growth, and trade;
- Protect and enhance human and natural resources; and
- Ensure the Nation's security and stability.<sup>1</sup>

## OVERVIEW OF INTERMODAL FREIGHT TRANSPORTATION

Intermodal freight transportation is the movement of freight by the coordinated and sequential use of two or more modes of transportation.<sup>2</sup> For the purposes of this report, intermodal transportation focuses on:

- Freight transportation, especially containerized transport;<sup>3</sup> and
- Intermodal movement of goods, especially among trucks, trains, airplanes, and ships, and the transfer of cargo between modes at ports and terminals.

Figure 1 includes typical examples of intermodal freight moves: truck-marine, truck-rail, and truck-air.

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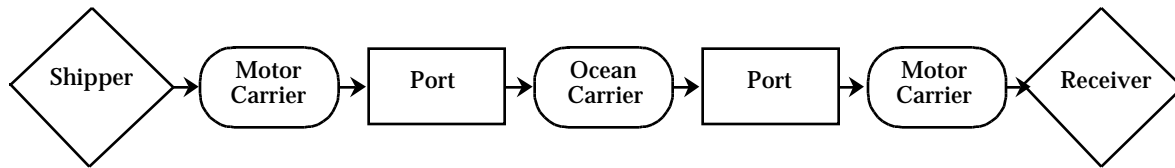
<sup>1</sup> U.S. DOT, Strategic Plan, 1997.

<sup>2</sup> U.S. DOT FHWA, Intermodal Freight Transportation, December 1995.

<sup>3</sup> Containerized transport refers to containers that may be transported by ocean, rail, and highway, but does not include containers transported by air.

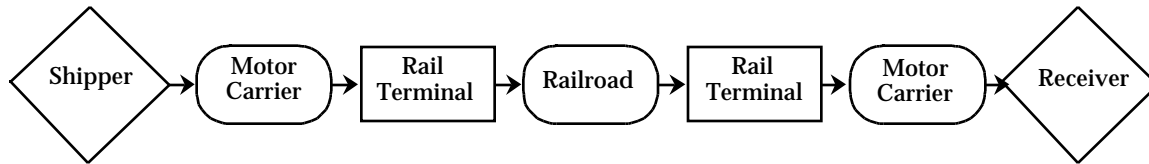
**Truck-Marine** – This example of a typical truck-marine intermodal freight movement begins with the shipper or consignor, who loads the cargo into a container. A motor carrier picks up the container from the shipper and transports it to a seaport where the container is transferred to an ocean carrier. The ocean carrier transports the container to an overseas port, where the container is transferred to a second motor carrier, who delivers it to the receiver or consignee.

#### Truck-Marine Intermodal Move



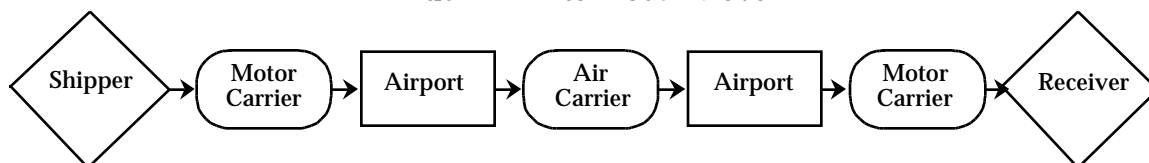
**Truck-Rail** – In a truck-rail intermodal movement, a motor carrier picks up the cargo, which may be in a container or an intermodal trailer, from the shipper and transports it to a rail terminal where it is transferred to a railcar. The railroad transports the container or trailer to another intermodal rail terminal where a second motor carrier picks it up and delivers it to the receiver or consignee.

#### Truck-Rail Intermodal Move



**Truck-Air** – The third example is a truck-air intermodal movement. In this movement, a motor carrier picks up the cargo from the shipper, packages it with other air freight on a shipping pallet, and transports it to an airport freight terminal where it is transferred to an airplane. The air carrier transports the pallet to another airport where a second motor carrier picks it up and delivers it to the receiver or consignee.

#### Truck-Air Intermodal Move



**Figure 1. Illustrative Intermodal Freight Movements**

## GROWTH IN INTERMODAL FREIGHT MOVEMENT

Intermodal freight volume has increased steadily over the last two decades. As shown in figure 2, domestic intermodal traffic has grown from three million trailers and containers in 1980 to 8.7 million in 1997.<sup>4</sup> The domestic intermodal fleet<sup>5</sup> grew by nearly 30 percent between 1992 and 1996, from approximately 124 thousand in 1992 to 159 thousand in 1996.<sup>6</sup>

Substantial growth in intermodal freight transport is projected for the coming years. Domestic intermodal freight is predicted to rise by more than 50 percent between 1998 and 2006.<sup>7</sup> Domestic trade is projected to double over the next 20 years.<sup>8</sup> Growth in international intermodal freight movement can be expected as growth continues in international trade,<sup>9</sup> the U.S. economy, and the world's population.

## COMPLEXITY OF INTERMODAL FREIGHT MOVEMENT

The intermodal movement of freight is complicated. Intermodal freight transportation requires coordination of efficient and safe operations by multiple stakeholders, including carriers, terminals, shippers, and receivers. These stakeholders have diverse, and sometimes conflicting, interests, priorities, and levels of productivity. Intermodal facilities, which were designed for more modest levels of freight activity, today often are overburdened, inadequate, and outdated. As there has been little public education and awareness about freight issues and concerns, there is inadequate support for, and often adversarial attitudes towards, the freight industry as it modernizes and expands its operations.

This complexity of players, needs, and perspectives creates problems for the intermodal freight industry. Issues such as inadequate infrastructure, insufficient information sharing, congestion, and institutional barriers cause "bottlenecks" for intermodal freight movement. These bottlenecks impede the safe and efficient movement of intermodal freight and challenge the Nation's ability to remain competitive in the international marketplace.

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<sup>4</sup> Association of American Railroads web site, [www.aar.org](http://www.aar.org).

<sup>5</sup> Intermodal fleet consists of containers, trailers, and RoadRailers.

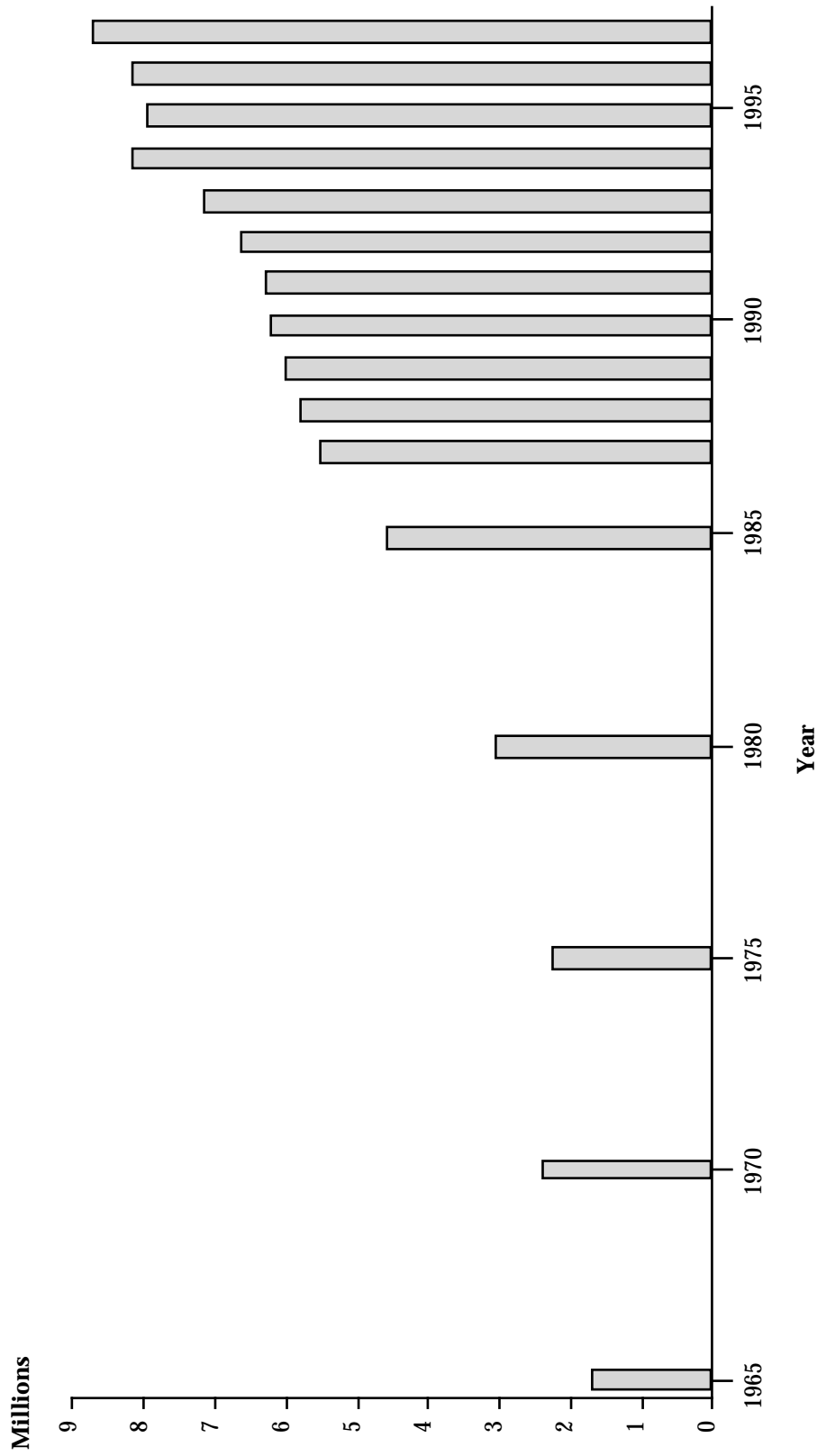
<sup>6</sup> Intermodal Association of North America, "The Intermodal Network," ca. 1998.

<sup>7</sup> DRI, quoted by Eugene Pentimonti, American Trucking Associations, I-95 Intermodal Leadership Summit, Princeton, New Jersey, October, 1998.

<sup>8</sup> Journal of Commerce, "House hearing set on U.S. port capacity," July 22, 1998.

<sup>9</sup> International trade is expected grow between three and five-percent annually between 1996 and 2006 according to the DRI report, "U.S. Freight Transportation Forecast...to 2006" quoted by the America Trucking Associations' web site, [www.truckline.com](http://www.truckline.com), in a press release dated December 18, 1997.





Source: Association of American Railroads.

**Figure 2. Total Domestic Intermodal Rail Traffic**  
Number of Originated Containers and Trailers

## APPLICATION OF INTELLIGENT TRANSPORTATION SYSTEMS

The rapid growth of information technology and intelligent transportation systems (ITS) technologies creates an opportunity for the intermodal industry. Intelligent transportation systems apply advanced and emerging technology in areas such as information processing, communications, control systems, and electronics to meet transportation needs. ITS are being applied to freight transportation, intermodal facilities, and intermodal operations to streamline administrative procedures, improve productivity, better coordinate the transfer of freight across modes, minimize costs, improve customer service, and respond to the growth in intermodal freight movement worldwide. These ITS applications can be grouped by their role in the intermodal movement, as follows:

- **Gate and terminal management** – the management of intermodal terminal gates and transfer sites, such as terminals, seaports, and airports;
- **Route and fleet management** – the management of intermodal equipment and the tracking of cargo and conveyances while in-transit, including the asset management of trucks, trains, and vessels; and
- **Shipment tracing and management** – the management of the information flows associated with the movement of shipments, and use of information to enhance the productivity, efficiency, and the secure movement of goods.

## DEVELOPMENT OF A NATIONAL ITS/INTERMODAL FREIGHT PROGRAM

The U.S. Department of Transportation (U.S. DOT) recognizes the importance of safe and efficient intermodal freight movement and the potential to increase the safety and productivity of its activities through the accelerated application of ITS. The Federal Highway Administration (FHWA), with organizational support from the Secretary's Office of Intermodalism and the ITS/Joint Program Office (JPO), is sponsoring the development of a national program to apply ITS technologies to intermodal freight activities.

This study was commissioned by the FHWA as an initial step toward a National ITS/Intermodal Freight Program. This study addresses the following questions:

- What are the issues and impediments associated with the intermodal movement of freight?
- What are the ITS opportunities to apply and accelerate the application of ITS to intermodal freight movement?
- What are appropriate Federal activities in the application of ITS to intermodal freight?

This report, *National ITS/Intermodal Freight Program Requirements*, outlines the requirements for the program and recommends projects and activities. Previous research on this topic serves as a foundation for the information documented here. The study's first technical memorandum, *Intermodal Freight Movement Issues*, addressed the trends, issues, and impediments in inter-

modal freight movement. The study's second technical memorandum, *ITS Opportunities in Intermodal Freight Movement*, addressed ITS opportunities and appropriate U.S. DOT activities in a National ITS/Intermodal Freight Program.

## OBJECTIVES AND ORGANIZATION OF THIS REPORT

This report identifies ITS opportunities for intermodal freight movement, specific ITS/intermodal projects, and an overall ITS/intermodal program. The objectives of this report are the following:

- Profile the intermodal freight industry;
- Describe key issues and trends in the intermodal industry;
- Identify the impediments that could be addressed by the application of information and advanced technologies;
- Recommend high-priority initiatives and opportunities to apply ITS to intermodal freight movement; and
- Outline the recommended Federal activities in a National ITS/Intermodal Freight Program.

This report is organized as follows:

- Section 2 covers the methodology used for the project.
- Section 3 profiles the intermodal freight system, describing the major elements of the intermodal system and industry segments.
- Section 4 presents the key intermodal issues and trends.
- Section 5 describes the key impediments in intermodal freight movement.
- Section 6 presents the major requirements for the national U.S. DOT ITS/intermodal program.
- Appendix A lists the literature that was used as reference to this study and serves as a resource for more detailed information on intermodal freight transport.
- Appendix B lists the current membership of the U.S. DOT ITS/Intermodal Freight Steering Group.
- Appendix C provides “road maps” to different types of intermodal freight flows and the information flows that accompany them.
- Appendix D describes U.S. DOT's outreach efforts, studies, and program initiatives in the area of ITS intermodal freight transportation.
- Appendix E describes several intermodal operational tests that have already been initiated by other programs and working groups.
- Appendix F is a glossary of terms.

## 2. Methodology

The recommendations of this report were developed with advice from the U.S. DOT ITS/Joint Program Office (JPO), the Federal Highway Administration (FHWA), and the Volpe National Transportation Systems Center (VNTSC). Anne Aylward, from VNTSC, served as a senior advisor to the project. The primary tasks included conducting a literature review, obtaining public and private stakeholder input through interviews and listening sessions, and performing and documenting the data analysis. These tasks are described in more detail below.

### CONDUCT LITERATURE REVIEW

A broad scan of transportation literature was conducted covering freight, intermodalism, and ITS. The literature included recent reports and studies on intermodalism, ITS, and freight; documentation of existing freight, intermodal, and ITS projects and initiatives; trade journals; industry newspapers; and information collected from the Internet. A list of ITS and intermodal literature is included in Appendix A.

### OBTAIN INPUT FROM INTERMODAL STAKEHOLDERS

Intermodal stakeholders were interviewed for the ITS/Intermodal Freight Program and took part in six regional listening sessions. In total, 140 stakeholders from both the public and private sectors participated in the interviews and sessions.

#### Interview Key Public and Private Stakeholders

Interviews with key public and private sector intermodal freight stakeholders provided personal and institutional perspectives to this study. The interviews were conducted in-person or by telephone. Industry perspectives presented at the Intermodal Freight Identification Technology Workshop, other intermodal conferences and meetings, and informal discussions served to supplement the results of the interviews.

The interviews covered intermodal issues, interests, and perspectives. The stakeholders discussed intermodal freight movement issues and impediments, potential ITS solutions, key stakeholders, and potential Federal actions and projects. A summary of the interview guide is provided in Technical Memorandum One.

Public sector interviews focused on agency research and projects in the area of intermodal freight transportation, perceived bottlenecks, productive applications of ITS to intermodal freight movement, and potential Federal actions in an ITS/Intermodal Freight Program.

Private sector interviews focused on the technologies that organizations were using to improve freight operations, perceived bottlenecks, and potential applications of ITS to intermodal transport. Suggestions for potential Federal actions were solicited as well.

The research for this project also included interviews and discussions with Federal, State, and local transportation program administrators; freight industry representatives; and technical experts involved in ITS and intermodal issues and programs. A list of the agencies, companies, and organizations that participated in the interviews is included in Technical Memorandum One.

## **Conduct Listening Sessions**

In a separately funded, but parallel effort, listening sessions were held in six cities as input for the ITS/Intermodal Freight Program. The first objective was to assess the market for the ITS/Intermodal Freight Program, including documenting impediments to intermodal freight movement, identifying current information technology and ITS applications to intermodal freight operations, and locating opportunities for public-private cooperation to accelerate the application of ITS to intermodal freight operations. The second objective was to discuss the anticipated benefits, outline participant roles and responsibilities, and review the request for applications (RFA) submission and selection process. The listening sessions were held in Seattle, Washington; Norfolk, Virginia; Chicago, Illinois; Los Angeles, California; Houston, Texas; and New York City, New York.

## **Perform and Document Data Analysis**

### ***Segment the Intermodal Industry***

The intermodal freight industry was segmented and summarized. The information was collected during the literature review and by contacting industry associations. Each of the major components of the intermodal industry (e.g., air, ocean, rail, trucking) was described in brief to understand its role and importance in the overall logistics system.

### ***Scan ITS-Related Freight Initiatives and Applications***

The second step in the analysis was to review current freight-related information technologies in use by the private and public sectors. This analysis helped to identify:

- ITS-related technologies that are used frequently by the intermodal industry;
- Initiatives that can be leveraged in developing and implementing a national ITS/intermodal program; and
- Impediments to intermodal freight operations that lend themselves to ITS solutions and merit attention by the U.S. DOT.

### ***Identify Key Issues and Impediments***

Based on the information collected through the interviews and the literature review, the major issues and impediments related to intermodal freight movement were summarized. The issues and impediments were evaluated with respect to their scope and impact on international trade

and national security. In addition, they were evaluated for the potential benefits that could be derived from the application of ITS technologies. The information collected on the intermodal industry, major issues, information and freight flows, key impediments, market segments, and conclusions was documented in Technical Memoranda One and Two and summarized in this report.

### ***Identify Potential U.S. DOT Activities***

Potential activities for the U.S. DOT in implementing a national ITS/intermodal program were developed by reviewing current and recent Federal intermodal and ITS initiatives, and Federal transportation legislation. These recommendations were developed in the context of changing regulatory functions of the U.S. DOT and the increasing level of cooperation among the public and private sectors in the areas of freight and intermodalism.

### ***Develop ITS/Intermodal Freight Program***

A list of high-priority, high-visibility opportunities and program areas that could be addressed in a Federal ITS/intermodal program were drafted. Initial project ideas were prepared for discussion by participants at the Intermodal Freight Identification Technology Workshop. The program areas and project ideas were refined based on the input and perspectives from intermodal stakeholder forums; current intermodal literature; discussions with intermodal stakeholders; consultation with the ITS/Intermodal Freight Steering Group<sup>1</sup> and the Intermodal Freight Technology Working Group<sup>2</sup>; and the research conducted for this study.

### ***Solicit Input and Review by the Steering Group***

Summaries of the preliminary findings were presented to the members of the U.S. DOT ITS/Intermodal Freight Steering Group for their review and comment. A draft version of this report was reviewed by selected members of the Steering Group. This final report which includes findings of the research and analysis reflects the changes requested by members of the Steering Group.

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<sup>1</sup> The U.S. DOT ITS/Intermodal Freight Steering Group reaches across multiple modal administrations and currently serves in an ad hoc basis to oversee the development of the ITS/Intermodal Freight Program. Currently, the Steering Group is chaired by the Office of Intermodalism; members include FHWA, FRA, MARAD, ITS/JPO, RSPA, and VNTSC. Representatives of the member agencies and modal administrations are included in Appendix B.

<sup>2</sup> The Intermodal Freight Technology Working Group, sponsored by ITS America, was formed as a result of the Reston Intermodal Freight Identification Technologies Workshop. It is a collaboration of people from private and public sector seeking to promote greater interaction between the private and public sector and encourage the application of ITS to intermodal freight transportation.

### 3. Profile of Intermodal Freight System

This section profiles the intermodal freight system and describes:

- The elements of the intermodal system; and
- The market segments in the intermodal industry.

#### ELEMENTS OF THE INTERMODAL SYSTEM

The major elements of the intermodal system include carriers, means of conveyance (e.g., trucks and trains), terminals, and infrastructure for the four major transportation modes: air, rail, ocean, and highway (trucking). The key modal elements of the intermodal transportation system are listed in table 1.

**Table 1. Elements of the Intermodal System**

	<b>Air</b>	<b>Rail</b>	<b>Water</b>	<b>Road</b>
Carriers*	Air cargo carriers	Railroads	Shipping lines	Motor carriers
Conveyance	Airplanes	Trains	Ships and barges	Trucks
Terminal	Airports	Rail terminals	Ports	Truck terminals
Infrastructure	Airways	Railways	Sea and inland waterways	Roadways

\* For this table, the term “carriers” includes: companies that transport goods, third-party logistics providers, and other non-asset owning operating businesses.

#### INDUSTRY SEGMENTS

This section describes each of the major segments of the intermodal industry: air, ocean, rail, and trucking. It also includes a brief description of third-party logistics providers.

##### **Air**

Air cargo, which is intermodal in nearly every case, consists primarily of high-value commodities and time-sensitive deliveries. This segment of the freight industry is growing rapidly. In 1996, all-cargo airlines transported 5.1 million metric tons of cargo, representing an annual increase of

10.5 percent since 1991. In addition, 13 million tons of cargo were carried by passenger aircraft in 1996, representing an 8.8 percent annual increase over the same time period.<sup>1</sup>

This growth is expected to continue as more high-value commodities, including electrical equipment, food products, and textiles travel by air.<sup>2</sup> From 1996 to 2006, U.S. revenues for air freight shipments are expected to more than double (from \$13.3 billion to \$29.4 billion). Some areas of the country expect intense freight growth. For example, in Southern California, planners estimate air cargo volumes will triple between 1998 and the year 2016.<sup>3</sup> The growth in air cargo movement is attributed to increased reliance on just-in-time delivery, greater space availability due to increasing numbers of cargo-carrying aircraft, and changing cost tradeoffs for inventories and transportation.<sup>4</sup>

A list of the top 10 air cargo airlines ranked by ton-kilometers of freight carried can be found in table 2. By this measure, Federal Express and UPS are the largest air freight carriers.

**Table 2. Top U.S. Airlines by Freight Ton-Kilometers in 1996**

Rank <sup>1</sup>	Scheduled Service	Passenger and Cargo	All Cargo	Freight Ton-Kilometers (000's)
1	Federal Express		X	8,615,371
2	United Parcel Service <sup>2</sup>		X	5,392,959
3	Northwest Airlines	X		3,074,872
4	United Airlines	X		2,873,822
5	American Airlines	X		2,641,138
6	Delta Airlines	X		1,609,514
7	Emery Worldwide <sup>2</sup>		X	1,553,304
8	Polar Air		X	1,238,102
9	Evergreen International Airlines <sup>2</sup>		X	726,193
10	Continental Airlines	X		577,967

Source: Air Transport Association web site, [www.air-transport.org](http://www.air-transport.org).

<sup>1</sup> Rank of all carriers certified under Section 401, Federal Aviation Act.

<sup>2</sup> Includes non-scheduled service.

Figure 3 shows the top domestic air cargo hubs in the United States by volume. Memphis, Tennessee is the clear leader reflecting the high volumes carried through the site by FedEx.

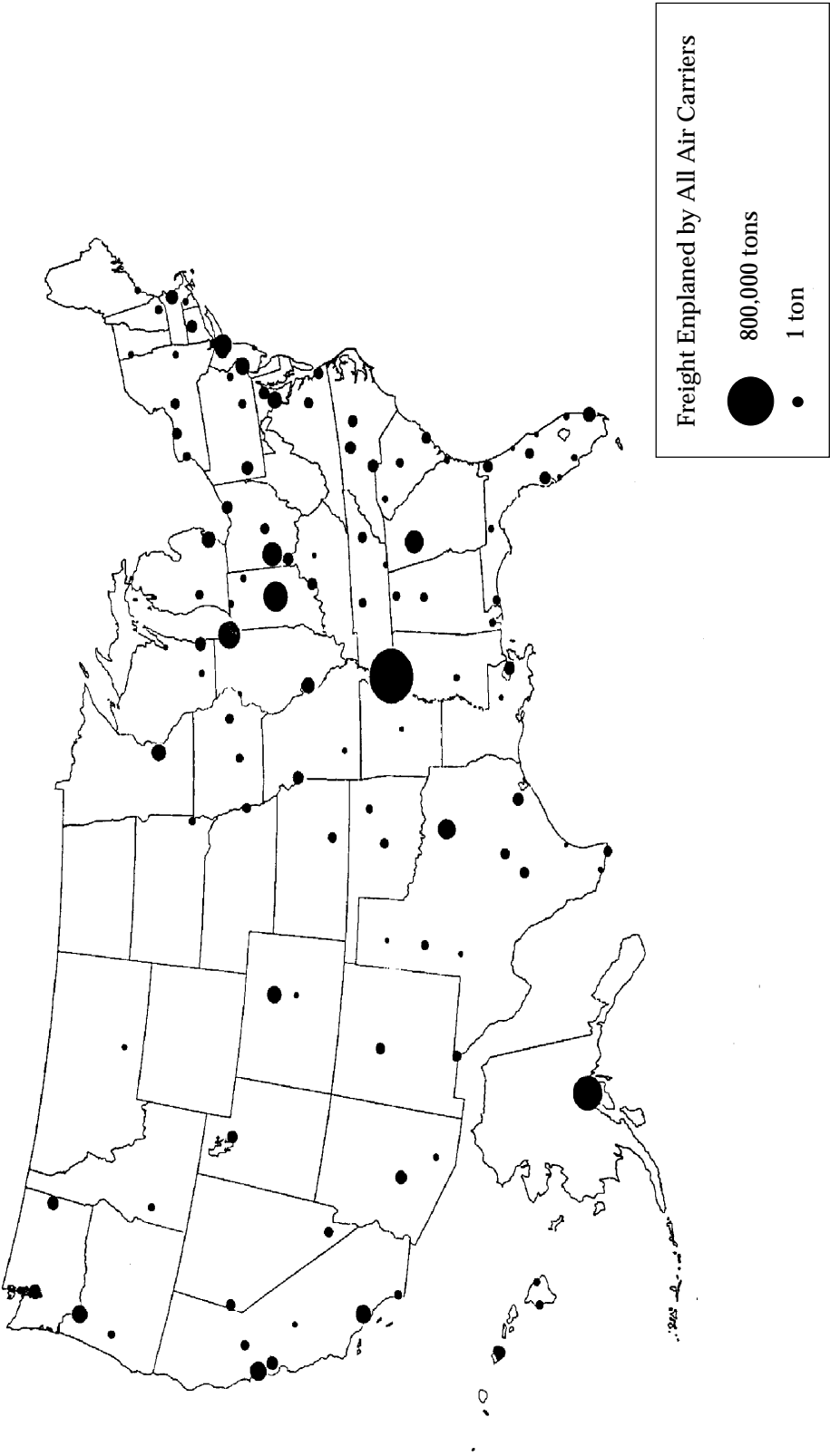
<sup>1</sup> International Air Transport Association, quoted in the Journal of Commerce, "More Shippers Moving Bulk Cargoes by Air," May 26, 1998.

<sup>2</sup> From the DRI report, "U.S. Freight Transportation Forecast...to 2006" by DRI, quoted by the America Trucking Association web site, [www.truckline.com](http://www.truckline.com), press release dated December 18, 1997.

<sup>3</sup> Journal of Commerce, "LAX Planning in Los Angeles," August 11, 1998.

<sup>4</sup> Journal of Commerce, "More Shippers Moving Bulk Cargoes by Air," May 26, 1998.





Source: Federal Aviation Administration. Airport Activity Statistics of Certified Route Carriers, 12 Months Ending December 31, 1993.  
U.S. Department of Transportation, Washington, DC, 1994.

**Figure 3. Air Cargo Volumes at U.S. Domestic Air Hubs**

In the near term, it is anticipated that air cargo movement will be segmented more clearly by the time-sensitivity of the delivery. According to Jim Hartigan, Vice President of United Airlines Cargo and chairman of Cargo 2000, an industry group that has set standards for bar coding of air cargo and electronic data systems:

“The air cargo business is splitting into two paths over the next five years: those who deliver non-time-sensitive, commodity products who need delivery in less than six days but not as fast as 72 hours; and those who need it in 72 hours or less. The first group will serve those shippers looking for no-frills transportation. The second will cater to those who need not only transportation but other services such as bonded warehousing or Customs clearance.”<sup>5</sup>

## Ocean

Cargo moved by ocean carriers, similar to air cargo, is intermodal in nearly all cases.<sup>6</sup> It is estimated that the volume of international maritime trade will increase by three times to as much as 13 billion metric tons annually within 20 years as the globalization of manufacturing continues to grow.<sup>7</sup> To meet these expected increases in demand, an additional 550 container ships were on order as of November 1996 to supplement the world fleet's total of more than 6,000.<sup>8</sup>

The larger ocean carriers are often referred to as global carriers due to their extensive international network and global coverage. In addition, all of the top ocean carriers have extensive intermodal rail operations in North America.<sup>9</sup> However, as a result of deregulation that took effect May 1, 1999 ocean carriers are increasing their focus on port-to-port freight movement and may decide to leave the rail industry. For example, Neptune Orient Lines, the parent company of APL Ltd. is seeking to sell APL's stack-train operations.<sup>10</sup>

Table 3 lists the top 10 ocean container carriers by TEUs<sup>11</sup> imported and exported. Due to the international nature of their activities, this list is not limited to U.S.-flag carriers. Sea-Land Service, Evergreen, and Maersk Line lead the list. These three lines are the only carriers with

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<sup>5</sup> Estimated by The Colography Group and quoted in the Journal of Commerce, “Up for Grabs,” April 13, 1998.

<sup>6</sup> The ocean carrier industry is comprised of: traditional ocean carriers, also known as vessel-operating common carriers (VOCCs) and non-vessel-operating common carriers (NVOCCs). The distinction between the two is now blurred due to the recently passed Ocean Shipping Reform Act deregulating the maritime industry, according to the Journal of Commerce, “Ocean Carriers Rethink Rail Links,” October 20, 1998 and Journal of Commerce, “Problematic Ocean Carrier Issues,” April 21, 1998.

<sup>7</sup> According to Admiral James M. Loy, commandant of the Coast Guard in the Journal of Commerce, “Maritime Traffic Jam?,” August 10, 1998.

<sup>8</sup> VZM/TranSystems presentation materials on containerization, 1997.

<sup>9</sup> Journal of Commerce, “Top 100 Container Carriers: A Journal of Commerce Special Report on the State of Ocean Shipping,” October 23, 1998.

<sup>10</sup> Journal of Commerce, “Ocean Carriers Rethink Rail Links,” October 20, 1998.

<sup>11</sup> A TEU is a 20-foot equivalent unit that is a standard measure in the ocean shipping industry.

extensive services in both the trans-Pacific and trans-Atlantic trades.<sup>12</sup> The larger carriers also tend to have more sophisticated computer systems and offer more automated services like handling of shipping documentation, cargo tracking, booking, and issuing of bills of lading than the smaller carriers.<sup>13</sup> Changes in the annual ranking of ocean carriers depend on acquisitions, service expansions, or a change in fleet size.<sup>14</sup>

**Table 3. Top Ocean Container Carriers by TEUs**

Rank 1997	Ship Line	Imports (TEUs)		Exports (TEUs)	
		1992	1997	1992	1997
1	Sea-Land Service	518,844	729,046	326,915	626,080
2	Evergreen Line	451,125	638,167	391,423	606,567
3	Maersk Line	397,254	617,802	330,586	463,648
4	Hanjin Shipping Co.	279,685	461,361	200,228	366,230
5	Hyundai Merchant Marine	171,540	375,930	136,099	300,843
6	American President Line	403,124	439,825	223,642	216,359
7	Orient Overseas Container Line	228,502	282,362	161,556	236,411
8	China Ocean Shipping	181,746	266,489	143,902	247,109
9	Yangming Marine Line	189,829	286,580	132,549	204,776
10	Nippon Yusen Kaisha	235,188	281,609	228,922	188,785

Source: Journal of Commerce, "Top 100 Container Carriers, A Journal of Commerce Special Report on the State of Ocean Shipping" October 23, 1998. TEUs are 20-foot Equivalent Units.

The top U.S. ports by the value of goods imported and exported are shown in figure 4. The ports of New York, Los Angeles, and Long Beach sites rank significantly higher in import value than other domestic ports. The ports of New York, Long Beach, and Houston are the leading ports by value of goods exported.

<sup>12</sup> Journal of Commerce, "Top 100 Container Carriers, A Journal of Commerce Special Report on the State of Ocean Shipping" October 23, 1998.

<sup>13</sup> Journal of Commerce, "Ocean Carriers Rethink Rail Links," October 20, 1998.

<sup>14</sup> Journal of Commerce, "Strategy, Market Nudge Subtle Changes in Rank," September 23, 1998.

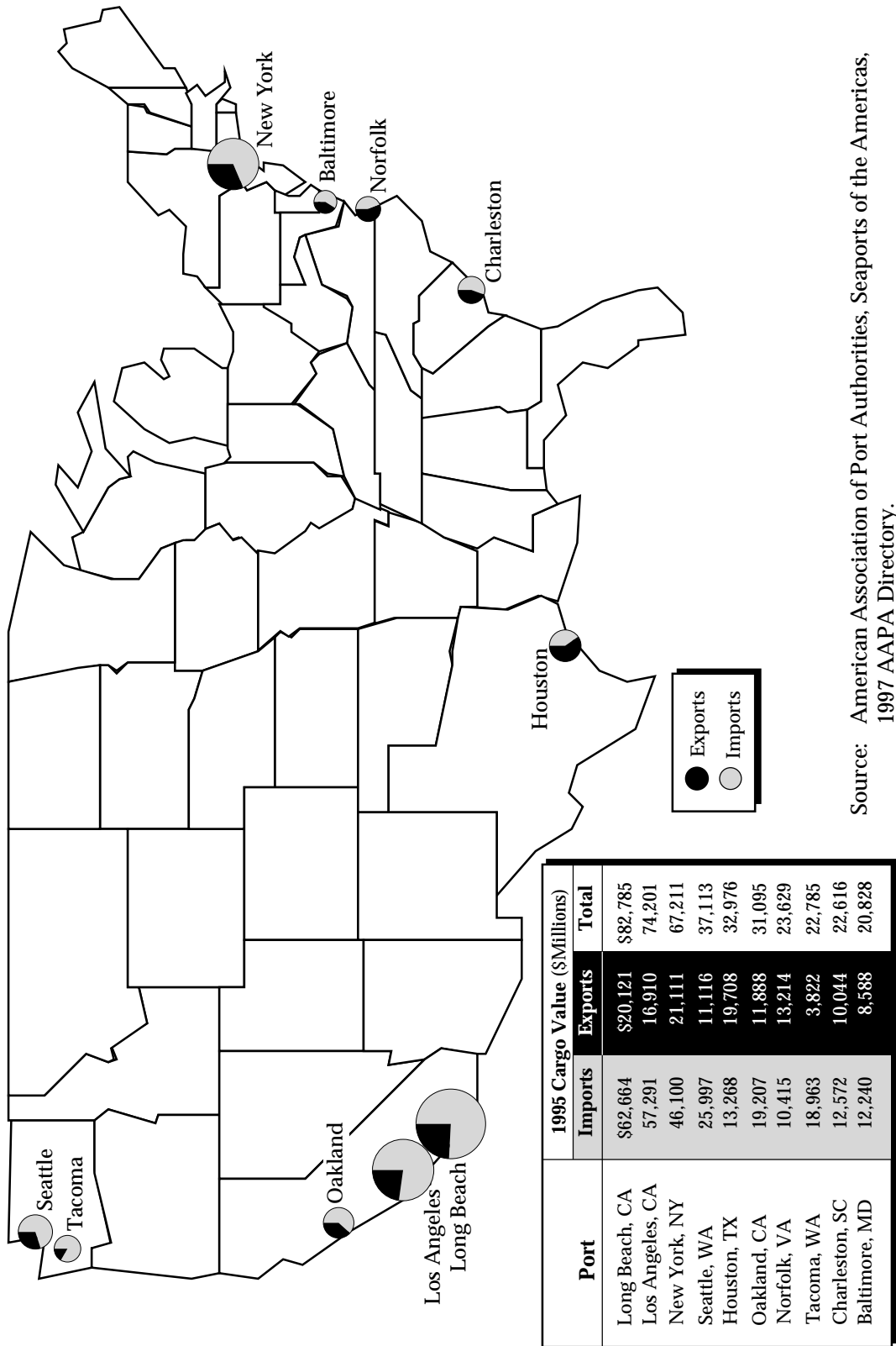


Figure 4. U.S. Port Rankings by Total Cargo Value

## Rail

Historically, intermodal movements have represented a small portion of the railroads' business and profit margin. The Association of American Railroads estimates that the intermodal portion of rail revenue was 18 percent in 1997.<sup>15</sup> The relative importance of intermodal revenue varies among carriers. For example, intermodal revenue accounts for almost 10 percent of revenues for CSX Transportation and slightly more than 20 percent of the revenue for Conrail (pre-merger).<sup>16</sup>

However, intermodal freight transport has been increasing in importance to railroad operations in recent years. The eight million intermodal trailers and containers now moving by rail represent a 32 percent increase since 1990 and are almost three times the volume moved in 1980.<sup>17</sup>

Figure 5 shows the growth of intermodal freight revenues for the top seven U.S. railroads. Union Pacific's intermodal revenues increased by 95 percent between 1995 and 1997. Other railroads experienced more moderate growth in their intermodal revenues: 17 percent for Burlington Northern Santa Fe; 15 percent for Norfolk Southern; and 11 percent for Kansas City Southern.

Revenues for rail intermodal shipments are projected to increase by more than 50 percent (from \$5.6 billion to \$8.7 billion) between 1996 and 2006 (see table 4).<sup>18</sup> Some experts believe that the number of intermodal loads moved by CSX and Norfolk Southern through the Port of New York and New Jersey will increase by at least 300 percent (from 750,000 currently moved by Conrail to three to four million over the next 10 years).<sup>19</sup> Growth in intermodal rail revenues can be attributed primarily to the growing number of high-value commodities traveling by rail.

**Table 4. Rail Intermodal Freight Forecast – 1996 to 2006**

Rail	Intermodal Traffic (Millions of Metric Tonnes)			Intermodal Revenue (Millions of \$)		
	1996	2001	2006	1996	2001	2006
Bulk	3	4	4	\$ 108	\$ 126	\$ 159
General Freight	134	160	210	5,451	6,482	8,559
Total	137	164	214	\$5,559	\$6,608	\$8,716

Source: American Trucking Associations, "U.S. Freight Transportation Forecast...to 2006," 1997.

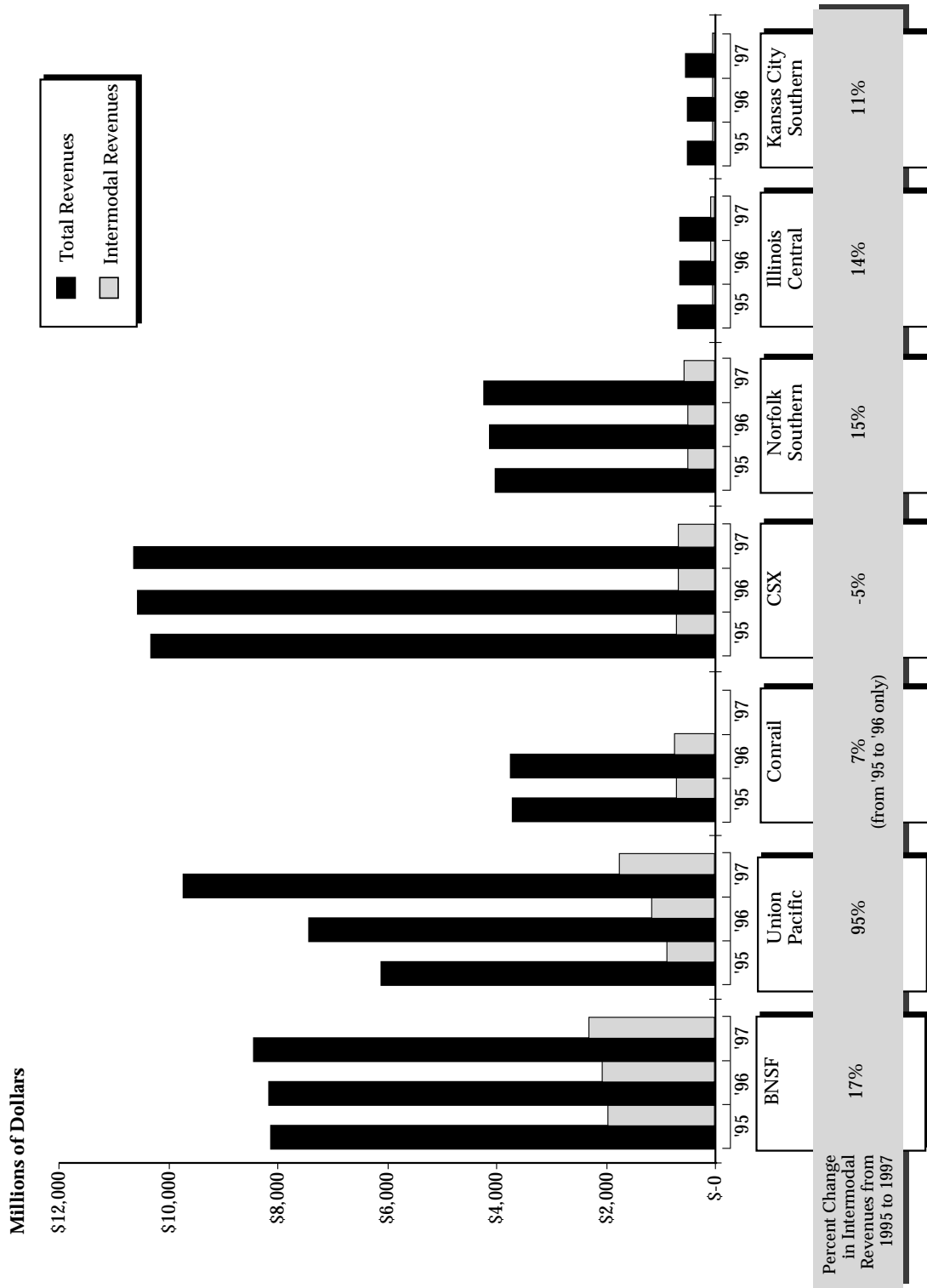
<sup>15</sup> Association of American Railroads, telephone conversation on November 18, 1998.

<sup>16</sup> Journal of Commerce, "Service Quality at Expo Forefront," May 6, 1998.

<sup>17</sup> Journal of Commerce, "What's in a Name?" June 15, 1998.

<sup>18</sup> From the DRI report, "U.S. Freight Transportation Forecast...to 2006" by DRI, quoted by the America Trucking Association web site, [www.truckline.com](http://www.truckline.com), press release dated December 18, 1997.

<sup>19</sup> Journal of Commerce, "What's in a Name?" June 15, 1998.



**Figure 5. Total and Intermodal Revenues of Major Class 1 Railroads, Ranked by Intermodal Revenues**

Railroad mergers and acquisitions since 1995 have changed the face of the rail industry by reducing the absolute number of rail competitors.<sup>20</sup> For example, CSX and Norfolk Southern acquired Conrail's assets, and the Union Pacific and Southern Pacific have merged operations. The top nine rail carriers by intermodal units for the years 1997 and 1998 are shown in table 5. Each of the top two carriers, Burlington Northern Santa Fe and Union Pacific, carried twice the number of units of the third highest rail carrier, Norfolk Southern. Today, 90 percent of the Nation's total rail freight revenue is accounted for by CSX and Norfolk Southern in the East, and Burlington Northern Santa Fe and Union Pacific in the West.<sup>21</sup>

**Table 5. Top Railroads by Intermodal Units  
Originated and Received**

Rank	Railroad	1997 (January 1 to October 3)	1998 (January 1 to October 3)	1997-1998 Percent Change
1	Burlington Northern Santa Fe	2,156,508	2,400,107	11.3
2	Union Pacific	2,337,189	2,054,889	-12.1
3	Norfolk Southern	1,103,534	1,093,176	-0.9
4	CSXT	699,394	717,620	2.6
5	Canadian Pacific Railway	522,620	550,159	5.3
6	Canadian National Railway	528,206	539,834	2.2
7	Conrail	1,329,111	401,037	5.4
8	Kansas City Southern	113,385	137,541	21.3
9	Illinois Central	149,689	133,901	-10.5

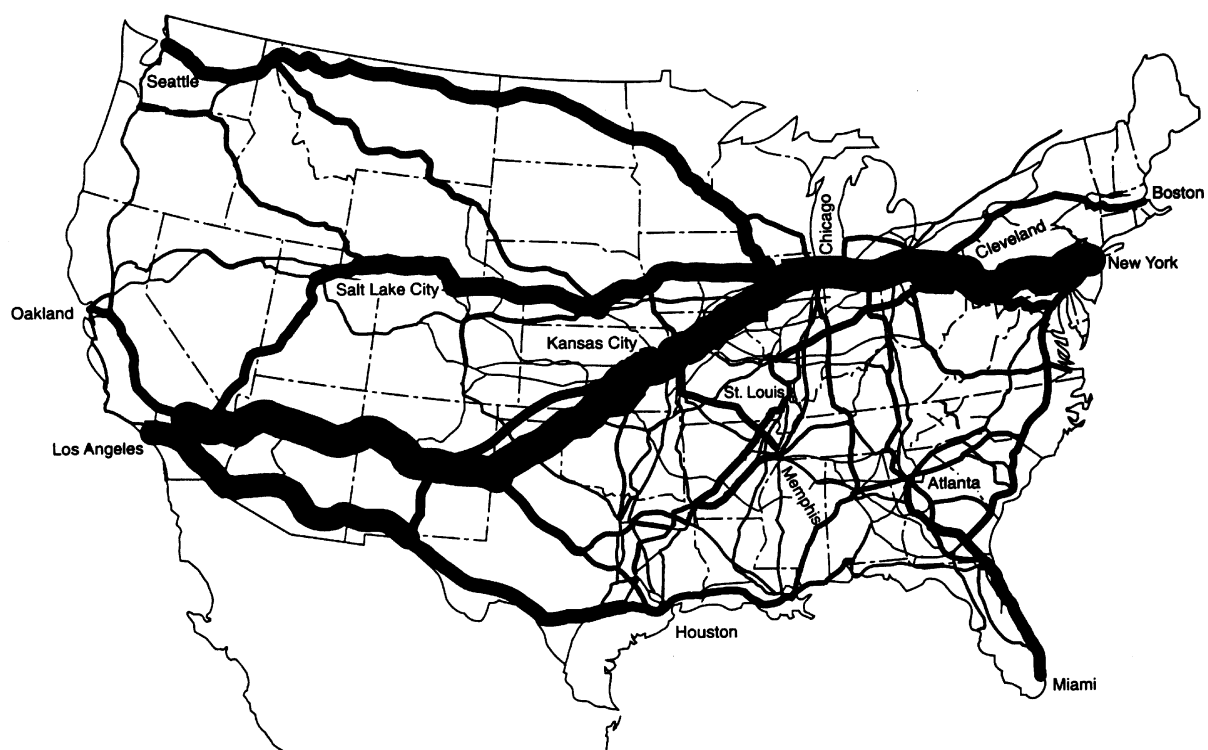
Source: Journal of Commerce, October 15, 1998.

Figures only cover from the beginning of the calendar year 1998 through October 3. Only nine rail carriers were cited in this information. Data for the complete calendar year is not available.

The railroad lanes highlighted in figure 6 carry the majority of intermodal freight in the United States. The east-west movement of intermodal freight dominates intermodal rail transport; the highest freight volume is carried on the New York-Chicago-Kansas City-Los Angeles lines.

<sup>20</sup>Journal of Commerce, "The Nafta Railroad," July 27, 1998, and "Down to Four," June 15, 1998.

<sup>21</sup>Journal of Commerce, "Down to Four," June 15, 1998.



Source: Double-Stack Container Systems: Implications for U.S. Railroads and Ports (Washington, D.C.: U.S. DOT, 1990).

Note: Line thickness corresponds to intermodal volume for the year 1987.

**Figure 6. Railroad Mainlines Showing Intermodal Volume**



## Trucking

Trucking is the dominant mode in intermodal freight transportation. Nearly every intermodal move in the United States involves transport by truck.<sup>22</sup> Intermodal movement involving trucks and trains is among the fastest growing sectors of intermodal transportation; trucks also continue to serve as the primary mode of access to U.S. ports.<sup>23</sup> However, no current and consistent data are available on the percentage of truck volumes or revenues associated with intermodal movements.<sup>24</sup>

Trucking is expected to continue its dominance in domestic freight transportation. According to a DRI study, intermodal trucking will continue to grow and support intermodal freight movement in the United States.<sup>25</sup> DRI predicts that trucking's share of domestic freight revenue will continue at over 80 percent between 1996 (\$346 billion in gross revenues) and 2006 (\$446 billion). However, this represents an increase of almost 30 percent in absolute revenue, as freight transportation as a whole is expected to grow. The share of the volume of freight carried by the trucking industry is expected to increase by more than 25 percent, from 6.6 billion metric tonnes in 1996 to 8.3 billion metric tonnes in 2006.<sup>26</sup>

Figure 7 depicts the truck volumes on the national interstate highway system. The highest volumes are concentrated in the west coast, northeast, mid-Atlantic, and southern states, in contrast to the highest rail volumes running between the east and west coasts.

Dray carriers are responsible for two types of local freight movement: between a point of origin (or destination) and an intermodal transfer facility; and between modes at an intermodal transfer facility. Drayage costs usually represent 15 to 20 percent of the total cost for intermodal transportation.<sup>27</sup> Some dray carriers, like J.B. Hunt Transport, Inc. and Schneider National, Inc., are large trucking firms that have successfully integrated advanced communication and information systems into their daily operations. However, the vast majority of drayage companies are small, owner-operated businesses that have not invested in advanced information systems or other sophisticated technologies. The smaller dray firms are a weak link in the intermodal information system, as they are unable to transmit the same level of information on shipment location and condition as larger trucking firms and other modal carriers.

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<sup>22</sup> Journal of Commerce, "Further Tales of the Drayman," October 15, 1998.

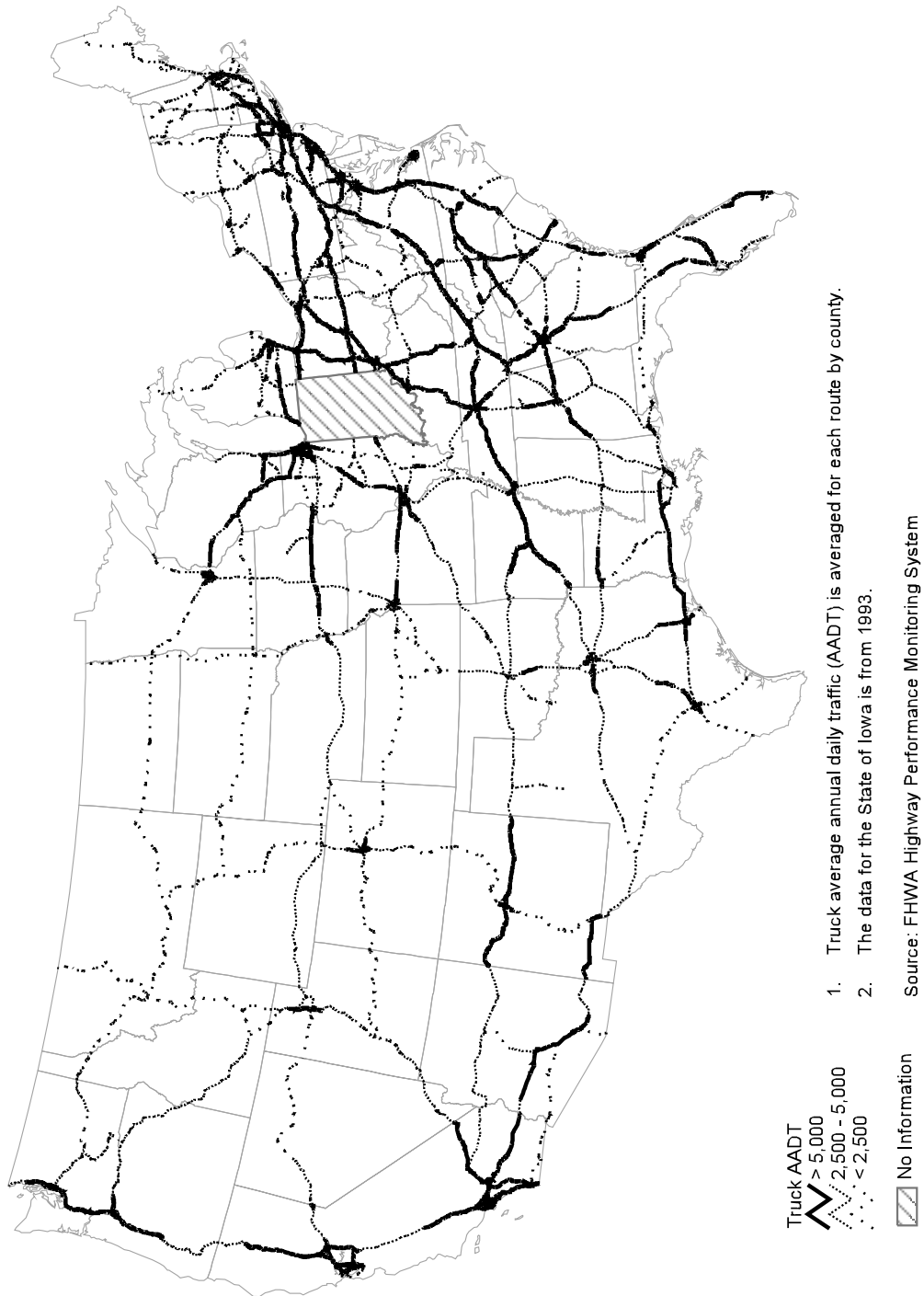
<sup>23</sup> Eugene Pentimonti, American Trucking Associations, I-95 Intermodal Leadership Summit, Princeton, New Jersey, October 1998.

<sup>24</sup> America Trucking Associations, "U.S. Freight Transportation Forecast...to 2006," December 1997.

<sup>25</sup> Trucking's share of primary shipment volumes is expected to increase from 60 percent in 1996 to 63 percent in 2006. A primary move is the first movement of freight from an origin to a destination. Secondary movements are the additional hauls that are part of the intermodal movement. Since the majority of all secondary freight movements are carried by truck, it is likely that the data underestimates the portion that should be attributed to trucking. America Trucking Associations, "U.S. Freight Transportation Forecast...to 2006," December 1997.

<sup>26</sup> From the DRI report, "U.S. Freight Transportation Forecast...to 2006," quoted by the America Trucking Associations web site, [www.truckline.com](http://www.truckline.com), press release dated December 18, 1997.

<sup>27</sup> Gerhardt Muller, *Intermodal Freight Transportation*, 1995.



**Figure 7. Interstate Highways with Major Truck Volumes, 1994**

Due to drayage's local orientation and the frequency of small-sized firms, reliable data for dray carriers are not available.

### **Third-Party Logistics Providers**

In the last decade there has been significant growth in the involvement of third-party logistics providers in the warehousing, transportation, and distribution functions of shippers and receivers. Third-party logistics firms do not have their own goods to ship or even own their own assets, in some cases. However, they oversee various logistics management functions, including matching loads with carriers, managing the flow of goods to clients, and overseeing shipment informational requirements. Intermodal marketing companies (IMC) are more technologically advanced third-party providers, and will allow shippers to outsource their logistics operations; IMCs are responsible for handling at least 60 percent to 70 percent of domestic intermodal freight distribution.<sup>28</sup> As a result they have a significant influence over the changing patterns of intermodal freight movement.

### **SUMMARY**

The intermodal freight industry has four major segments: air, ocean, rail, and trucking. The key points discussed in this section are summarized below:

#### **Air**

- Air cargo transportation is intermodal in nearly every case.
- Intermodal air cargo transportation:
  - Consists primarily of high-value commodities and time-sensitive deliveries; and
  - Is expected to grow as more high-value commodities travel by air.
- U.S. revenues for air freight shipments are expected to more than double between 1996 and 2006.

#### **Ocean**

- Cargo moved by ocean carriers, similar to air cargo, is intermodal in nearly all cases.
- The volume of international maritime trade is expected to increase by three times within 20 years.
- The larger ocean carriers have extensive international networks and global coverage.
- Deregulation will trigger restructuring and repricing of ocean freight services.

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<sup>28</sup> Journal of Commerce, "Truck loads pick up amid rails' woes," May 6, 1998.

## **Rail**

- Intermodal movements represent less than 20 percent of the railroads' business and profit margin.
- Intermodal freight transport has been increasing in importance to railroad operations in recent years. The number of intermodal trailers and containers now moving by rail is approximately three times the volume of 1980.
- Revenues for rail intermodal shipments are projected to increase by over 50 percent between 1996 and 2006. Growth in intermodal rail revenues can be attributed primarily to the growing number of high-value commodities traveling by rail.
- Railroad mergers and acquisitions have changed the face of the rail industry by reducing the number of rail competitors.

## **Trucking**

- Trucking is the dominant mode in intermodal freight transportation. Nearly every intermodal move in the United States involves transport by truck at some point.
- Intermodal movement involving trucks and trains is among the fastest growing sectors of intermodal transportation.
- Drayage costs usually represent 15 to 20 percent of the total cost for intermodal transportation.
- The vast majority of drayage companies are small, owner-operated businesses that have not invested in advanced information systems or other sophisticated technologies and represent a weaker link in the intermodal system.

## 4. Key Intermodal Freight Issues and Trends

This section provides an overview of major trends and critical issues in intermodal freight transportation. The trends and issues include the following:

- Rapid trade growth;
- Increasing competitive pressures;
- Growing customer demands for service and information;
- Increasing use of electronic information exchange and evolving information technologies; and
- Increasing coordination of military and commercial systems.

### RAPID TRADE GROWTH

International freight movement both contributes to and is a product of reduced barriers to trade, travel, communication, and information transfer. The increase in international trade has meant an explosion in international freight and containerized cargo movement. This explosion is attributed to trade liberalization, economic growth, increased multinational business investment, lower tariffs and trade barriers, and the globalization of national economies.

Domestic container cargo is expected to more than double over the next 12 years and to increase seven times over the next 50 years.<sup>1</sup> Increasing domestic trade will continue to fuel the demand for freight movement and may be attributed to such factors as strong domestic economic growth and changing business practices. The growth in trade is anticipated to heighten the stress on the Nation's port, rail, and highway infrastructure, which many believe is operating already at or near capacity.<sup>2</sup>

### INCREASING COMPETITIVE PRESSURES

Competitive pressures are increasing for freight operators, both domestically and internationally. Conditions in the United States, such as highway and port congestion, constraints on automation imposed by labor contracts, and duplicative paperwork required for Government regulation, reduce the efficiency of intermodal freight operations. These constraints raise the cost of goods movement by U.S. carriers and reduce the Nation's economic competitiveness in the global marketplace.

In the United States, as every business involved in freight movement struggles to cope with the competitive changes, new patterns of strategic partnering, as well as numerous mergers and

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<sup>1</sup> Journal of Commerce, "Rebuilding U.S. infrastructure to cost billions," March 11, 1998.

<sup>2</sup> Journal of Commerce, "Rebuilding U.S. infrastructure to cost billions," March 11, 1998.

acquisitions, are occurring. These include the consolidation of Burlington Northern and the Santa Fe in 1995; the merger of Union Pacific and Southern Pacific in 1996; and the acquisition of Conrail by CSX and Norfolk Southern in 1998.<sup>3</sup>

The changing competitive climate also affects intermodal facility operators as carriers demand that the facilities become more responsive to their needs. Marine carriers that control a greater portion of the market share can demand that ports become more responsive to their needs. Carriers currently operating in the Port of New York and New Jersey are frustrated by inadequate port infrastructure and channel depths. Sea-Land and Maersk have requested that several ports on the Eastern seaboard make proposals on how the ports may be able to better service the carriers through increased channel depth and other requirements.<sup>4</sup> The Port of Seattle is preparing to spend almost \$50 million rebuilding its main roll-on/roll-off pier to handle more cargo, increase market share, and respond to carrier requirements.<sup>5</sup>

## GROWING CUSTOMER DEMANDS FOR SERVICE AND INFORMATION

Shippers and freight forwarders are demanding that carriers respond to freight ordering and delivery requests more quickly and within shorter timeframes. They also want the carriers and terminal operators to provide them with better and more timely information related to the movement of their freight. Additionally, these improvements are expected without cost increases to the customer. Transportation service providers also are trying to stay competitive by making accurate, detailed, up-to-date electronic information on rates, schedules, and other services available to shippers and forwarders.

Just-in-time (JIT) delivery is increasing because the cost of storing freight as inventory in warehouses is becoming prohibitive. According to some estimates, 50 percent of all firms will be operating JIT systems by the year 2000.<sup>6</sup> Consequently, the transportation system increasingly is becoming an inventory system. Goods are ordered with less lead time and must arrive at destinations within smaller windows of time; also, the number of last-minute requests and changes to meet changing customer needs is rising.

Also increasing is the use of just-in-case response, which requires that two or more duplicate shipments of a load be sent to a receiver when delivery failure due to congestion, accidents, and weather, or other uncontrollable factors is unacceptable. However, by exacerbating existing congestion, this may have the unintended result of increasing delays and decreasing customer responsiveness.

Meeting increasing customer requests for information and for resolving problems in a timely manner is another major trend affecting current business practices. It is no longer sufficient to

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<sup>3</sup> Journal of Commerce, "Conrail goes out of business tomorrow," August 21, 1998 and "Down to Four," June 15, 1998.

<sup>4</sup> Journal of Commerce, "Port: If we build it, will you stay?" July 1, 1998.

<sup>5</sup> Journal of Commerce, "Seattle prepares to handle more cargo," Feb 17, 1999.

<sup>6</sup> Urban Transportation Monitor, July 3, 1998, p. 4.

simply inform forwarders and shippers of a shipment's arrival. Forwarders and shippers want problems to be addressed as they arise to minimize any delay suffered by the shipment. Shippers also want to be able to change shipment destinations as the need arises. Traditionally, location information and shipment status have not been available to the customer. FedEx and UPS led the development of customer-friendly shipment information and tracking systems; now, tracking and status information increasingly is available through Internet web sites as well as through specialized software that can be operated by shippers and carriers.

## INCREASING USE OF ELECTRONIC INFORMATION EXCHANGE

Information and advanced technologies are rapidly changing the way that business operates in the United States and around the globe. A number of technological solutions are being developed to address intermodal problems and needs. Electronic systems are continually being modified and updated to keep up with changing technologies, as well as with the increasing customer demands.

Many intermodal stakeholders, primarily those in the private sector, are shifting from paper-based systems to electronic systems for data storage and for information exchange. As a rule, these technologies are intended for use within individual modes, rather than among modes. The most frequently used information technologies in the intermodal industry are Electronic Data Interchange (EDI) and the Internet.<sup>7</sup> EDI involves the exchange of data directly between the computers of different organizations; it reduces the costs of data reentry and allows for the tracking of entire shipping process.<sup>8</sup>

The Internet is an essential element of business operations today. For communications, customer service, data exchange and information processing, use of the Internet helps to cut costs and improve productivity and efficiency.<sup>9</sup> However, despite significant improvements in information security, concerns remain among shippers about sharing proprietary data over a public network such as the Internet.<sup>10</sup>

Although electronic systems can respond quickly to routine requests, customers often require personal assistance for exceptional problems, as well as to build trust when working with new service providers.<sup>11</sup> Despite the many advances in automated technologies, many people continue to be suspicious of and uncomfortable with these technologies. Consequently, it is likely that the Internet and other advanced technologies will never completely replace human contact for customer service and problem solving.

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<sup>7</sup> Other widely used technologies include satellite location systems, bar codes and readers, dedicated short-range communications (DSRC), weigh-in-motion, and smart card technologies.

<sup>8</sup> Journal of Commerce, "Caught in a Web," May 22, 1998.

<sup>9</sup> Journal of Commerce, "Web puts new spin..." May 27, 1998 and "Techtalk," May 8, 1998.

<sup>10</sup> Journal of Commerce, "New technology, regulation may increase 'comfort level'," May 27, 1998.

<sup>11</sup> Journal of Commerce, "Service with a smile, not a Web browser," May 27, 1998.

As another indication of the trend to substitute electronic exchange for paper-based information, it is anticipated that some types of shipments will be replaced to a significant extent with electronic movements. For example, according to UPS, approximately 40 percent of the letter and document traffic will move electronically by the year 2000.<sup>12</sup>

## **INCREASING COORDINATION OF MILITARY AND COMMERCIAL SYSTEMS**

Increasingly, the military relies upon the use of commercial freight services. Commercial carriers already transport all domestic military shipments. The U.S. Department of Defense (DoD) is increasing its reliance on commercial carriers for the intermodal movement of goods, equipment, and weapons to international locations, as well. The DoD has recognized the need to improve its systems to transport, trace, and manage the flow of intermodal freight. During Desert Storm, for example, some critical freight shipments were sent to the wrong locations, were poorly identified, or lacked critical information required for the movement to be completed.

Because the military often requires the use of commercial fleets during military operations, there is a growing consensus that the DoD must ensure the compatibility of its information and identification systems with commercial systems. Compatibility not only helps to avoid duplicative initiatives, but also leverages the benefits of existing private sector systems, ensures the efficient coordination of defense and commercial systems during national emergencies, and reduces duplicative research and development efforts.

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<sup>12</sup> Journal of Commerce, "Express companies flock," May 19, 1998.



## 5. Key Impediments to Efficient Intermodal Movements

This section discusses the key impediments associated with intermodal freight transportation. The discussion focuses on areas where ITS technologies can be used to address the problems. The impediments described here can best be understood within the framework presented in figure 8. The first level, business strategy, addresses impediments on the organizational and institutional levels. The second level, information technology, describes problems related to data exchange, technologies, and standards. The third level, intermodal operations, focuses on operational problems with the intermodal move at gates and terminals, in-transit, and information for shipment tracing and management.

Only those impediments that would significantly benefit from the application of ITS technologies are addressed in this section. Problems that require major infrastructure investments are noted in passing, but not addressed for solution; for example, inadequate channel depth for the new generation of container ships and insufficient tunnel clearances for double-stack trains.

### BUSINESS STRATEGY

#### Industry: Complex and Fragmented

The intermodal industry by nature is fragmented and depends upon the cooperation of a large number of widely diverse stakeholders across multiple modes.<sup>1</sup> The relationships among intermodal industry stakeholders are shifting constantly, as are their roles and responsibilities. In addition to the stakeholders identified in table 1, Elements of the Intermodal System, other key private-sector participants in the intermodal movement of freight include: shippers and receivers; logistics providers<sup>2</sup> (e.g., intermodal marketing companies<sup>3</sup>, brokers, third-party service providers); associations and authorities (e.g., intermodal associations; toll road authorities); and unions (e.g., labor unions).

The stakeholders also include numerous public agencies, including the Federal and State DOTs, MPOs, the U.S. Customs Service, and the U.S. Department of Defense.

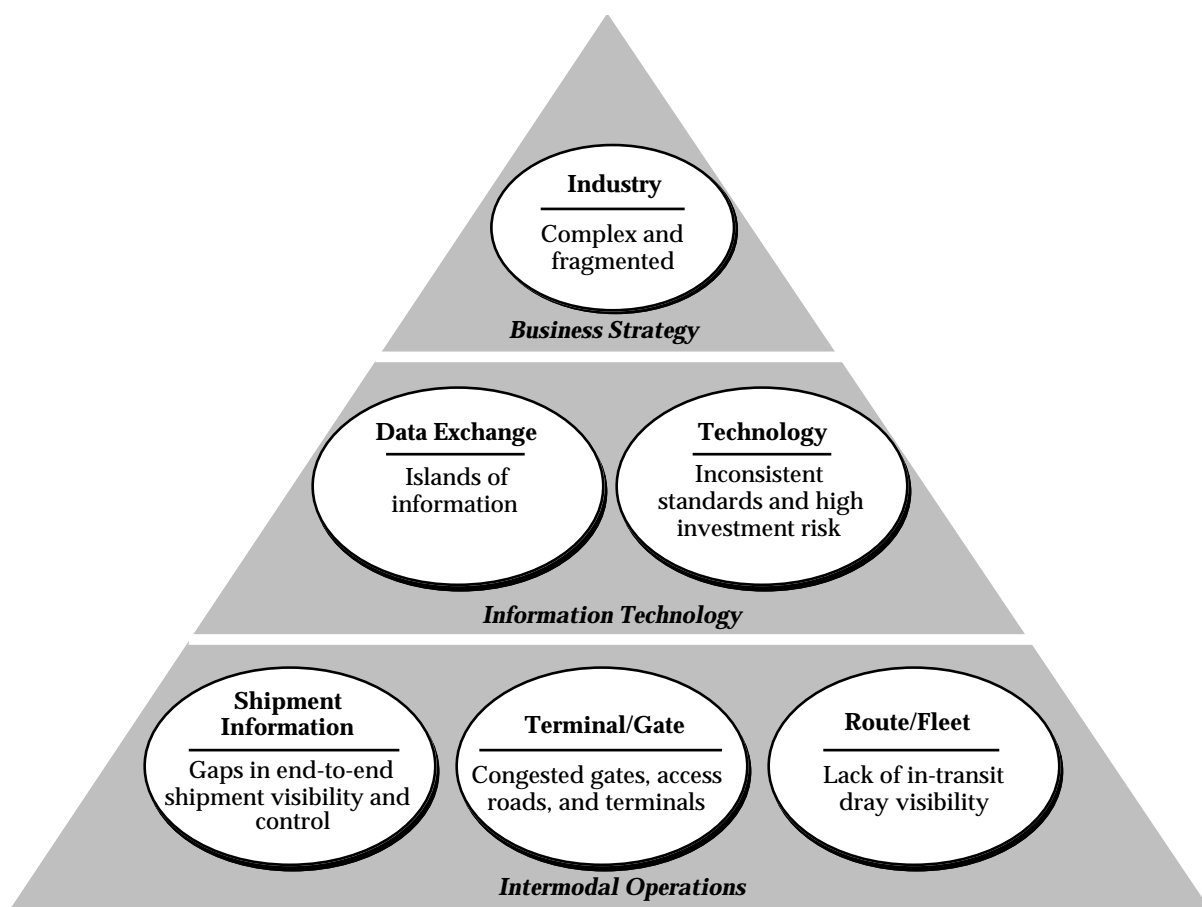
The sheer complexity of this industry is a major impediment to resolving problems related to the inefficient movement of intermodal freight. This complexity affects the relationships

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<sup>1</sup> For more detail and an explanation of the fact that there is no single intermodal system, see *Intelligent Transportation Systems and Intermodal Freight Transportation*.

<sup>2</sup> Logistics, as defined by the Council of Logistics Management, is “the process of planning, implementing, and controlling the efficient, effective flow and storage of goods, services, and related information from point of origin to point of consumption for the purpose of conforming to customer requirements.” (Council of Logistics Management web site, [www.clm1.org](http://www.clm1.org)) Logistics providers are commercial firms that provide logistics services to its customers.

<sup>3</sup> For example, the Hub Group Inc., Chicago, is the largest IMC in the industry. *Journal of Commerce*, “NS, CSX hope to lure cargo from trucks,” May 6, 1998.



**Figure 8. Intermodal Issues and Impediments**

among private sector companies, among public sector organizations, and between public and private stakeholders.

### ***Impediments Within the Private Sector***

Due to intense market competition, it is difficult for the intermodal industry to promote coordination and cooperation among the private sector stakeholders, despite the fact that working together may generate significant benefits for all parties involved. The industry's traditional orientation is toward individual modes; there are relatively few integrated intermodal companies. Each mode has its own unique business philosophy, culture, and historic basis of operation. Because each carrier is concerned primarily about its own movement and transfer points, there is little effort made to optimize freight movement across modes within an intermodal move. The lack of a common vision, common goals, and common operating procedures among multiple transportation modes serves to hinder cargo movement in ways that do not apply when goods are transported by a single mode.

### ***Impediments with Public/Private Sector Relationships***

The limited degree of public-private cooperation impedes problem-solving and progress related to intermodal goods movement. With regard to relationships between public and private sector intermodal stakeholders, significant impediments are created by the complex nature of the regulatory environment. Additional impediments are created by the differences in the planning horizons and technological priorities of public and private sector organizations.

### **Regulatory Environment**

Plans, legislation, and policies affecting goods movement are developed at the Federal, State, and metropolitan levels. Despite the good intentions of these activities, the effect often is to impede the efficient movement of intermodal freight.

At the Federal level, the traditional mandate of the U.S. DOT has been to ensure transportation safety, and to provide funding for projects and initiatives of national interest related to security and trade. From an organizational perspective, the U.S. DOT traditionally has focused on individual modes; however, actions are being taken to address this focus through U.S. DOT's ONE DOT initiative and other actions which are intended to increase collaboration and cooperation among the modal administrations.<sup>4</sup>

Each state establishes modal regulations independently. Consequently, carriers who operate in multiple states must comply with various rules and regulations that can be duplicative or conflicting. The burden of compliance may impede goods movement efficiency without necessarily increasing public safety.

### **Planning Horizons**

The problems associated with enhancing cooperation between the public and private sectors are illustrated by the differences in their planning horizons and technological priorities. Public

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<sup>4</sup> U.S. DOT web site, [www.usdot.gov/onedot](http://www.usdot.gov/onedot).

sector agencies look several years ahead when planning for infrastructure projects. This lead time enables them to acquire funding, obtain all necessary approvals, and secure community support before a project gets underway. In contrast, many private sector players focus intently on the near term, with planning horizons that may extend no further than the current week's payroll or the quarter's financial return.

### **Investment Priorities**

The public and private sectors do agree on some investment priorities for freight technology. For example, in a recent survey that included both public and private sector intermodal stakeholders, the system characteristics identified as desirable for freight identification technologies by both sides include reliability, functionality, and cost.<sup>5</sup> There also is a trend toward increasing integration among customers as well as transportation providers.<sup>6</sup>

Nonetheless, as the missions of the public and private sector differ substantially, so do their investment priorities. From the perspective of the private sector, freight technologies must aid in meeting customer demand, increasing shipping productivity, responding to competitive pressures, retaining or increasing market share, and reducing costs. In contrast, the public sector insists that intermodal freight technologies must help to address matters of national defense, promote the economic competitiveness of the United States in the global marketplace, and enhance the safety of the nations' transportation systems. This lack of congruence makes it difficult for the parties to reach agreement on how resources should be allocated and invested over time to increase the efficiency of freight movements.

### ***Impediments Within the Public Sector***

Federal and State regulations and policies related to the movement of intermodal freight are often complex, inconsistent, and duplicative. It also should be noted that in addition to the complexities of the U.S. environment, multimodal movement and international trade by their nature cause stakeholders to face a series of regulations that usually vary by mode, country, language, and culture.

Within the United States, coordination among government agencies varies greatly. Historically there has been only a moderate degree of cooperation among Federal agencies responsible for trade movement and clearance. Further, there has been only a moderate degree of cooperation among state agencies within the same state that are involved with the regulation of freight movements; each agency has its own perspective and objectives. Although ITS provide the means to expedite freight movement and regulation, differing missions among agencies and modes constrain approvals and clearances. In addition, states generally do not cooperate with each other in setting standardized modal regulations. Consequently, most state regulations are developed independently, without regard for policies set by other states; this often results in unnecessary redundancy and wasted effort.

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<sup>5</sup> These priorities were identified in a survey of participants of the Intermodal Freight Identification Technology Workshop held in June 1998.

<sup>6</sup> Journal of Commerce, "FMC weighing rules for forwarders," June 23, 1998.

Efforts are being made to overcome the lack of intrastate and interstate coordination. For example, Federal interest in the development of state and regional ITS/CVO business plans brought together state departments of transportation, revenue, motor vehicles, commerce, and public safety, often for the first time, to discuss carrier regulation and enforcement.

At the metropolitan level, the Federal Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 legislation mandated that MPOs oversee local freight planning. Unfortunately, due in part to a lack of resources, these agencies have found it difficult to meet the growing freight planning expectations. Few MPOs have sufficient freight expertise to perform the kinds of detailed freight planning suggested by the ISTEA; in many cases, these organizations also lack sufficient influence to bring the numerous stakeholders to the table. The amount of integrated freight planning being performed is severely limited, possibly exacerbating situations that already are problematic as the growth of freight movement continues.

In addition, educating the public about freight and intermodal issues and requirements has not been a high priority for public agencies. As a result, there often is a lack of public support for addressing the needs of freight movement and planning.

## **INFORMATION TECHNOLOGY**

### **Data Exchange: Islands of Information**

Lack of information on freight movements results in cargo delays and damage. Delays occur when shipments and containers are lost or misplaced at an intermodal terminal facility; cargo also can become damaged if timely and appropriate handling conditions are not maintained. Finally, cargo movements can be delayed when truckers get lost while attempting to navigate unfamiliar access routes and terminals.

Information gaps are all too common, as intermodal data and information are scattered across the logistics chain. The lack of shared, timely information about cargo movement, status, and contents results in “islands” of information that are not shared among stakeholders and impair decision-making by all. Currently, there are few common identifiers for container shipments, no systematic advance notification of shipment arrivals at intermodal facilities, and no common standards for providing carriers with intermodal terminal layouts and directions.

Variations in technology investment and in the level of technological sophistication across modes inhibit the effective flow of information on freight. Air cargo carriers, railroads, truckers, and forwarders are all investing in technology as their resources permit. However, smaller-sized dray carriers remain a weak link in the intermodal information and technology chain. This is because most smaller dray carriers are not convinced that the benefits outweigh the relative costs for a small firm to invest in computer technologies; nor have small dray carriers been urged by forwarders and shippers to meet an industry-wide technology standard.

To date, the markets for technologies generally are mode-specific. For example, a variety of fleet management systems are available for motor carriers, including automatic vehicle location systems, onboard computers, mobile communication systems, and routing and dispatching

systems.<sup>7</sup> Air cargo carriers can use a shipping information system called FreightNet, which will link freight forwarders to Customs, other modal carriers, and shippers.<sup>8</sup>

Although some steps are being taken to link multiple modal carriers into a unified and consistent information system, the systems that extend across the multiple modes are used predominantly by integrated carriers. Integrated express delivery companies use multiple modes, such as motor carriers and air cargo, because of the time-sensitive nature of the deliveries. The information systems of these companies generally use scanning technologies and internal software to track and locate packages anywhere in their system, regardless of mode.<sup>9</sup>

### **Technology: Inconsistent Standards and High-Investment Risk**

Due to the fact that there is no single “intermodal industry,” numerous organizations are involved in setting standards that apply to only a portion of the industry. Rapidly changing technologies contribute to the multitude of industry standards and make it more difficult to maintain compatibility across and within modes. In addition, international standards fall within the purview of multiple agencies and organizations. Because standards are continuously evolving, private firms are reluctant to invest in technologies for carrier conditions and freight identification, location, and status that are either not compatible or interoperable with existing technologies already or may not conform with the industry standard in the near future. Consequently, the industry suffers as incompatibilities arise among the technologies and standards of the modal carriers. This complicates the flow of data across modes.

Current ITS standards efforts that will impact intermodal freight transportation include:

- Dedicated Short-Range Communication (DSRC), led by the American Society for Test and Materials (ASTM) and the Institute of Electrical and Electronics Engineers, Inc. (IEEE);
- CVO safety and credentials, led by the American National Standard Institute (ANSI);
- Automatic vehicle identification, video camera control, and weigh-in-motion, led by American Association of State Highway and Transportation Officials (AASHTO);
- Advanced traveler information systems and navigable map databases, led by the Society of Automotive Engineers (SAE);
- Automatic equipment identification system based on radio frequency identification (RFID) tags, led by the International Standards Organization (ISO) and the Association of American Railroads (AAR) for Class I U.S. railroads;

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<sup>7</sup> These systems are documented in U.S. DOT FHWA report, *ITS Fleet Management Technology Resource Guide*, May 1997.

<sup>8</sup> Journal of Commerce, “FreightNet connects all links in air cargo distribution chain,” February 24, 1998.

<sup>9</sup> See Technical Memorandum Two for more specific descriptions of information and advanced technologies for freight.

- Electronic Data Interchange (EDI) for computer to computer communication, led by two different standards organizations, ANSI X12 and United Nations Electronic Data Interchange for Accounting, Commerce, and Transport (UNEDIFACT); and
- International Trade Data System (ITDS), a system which standardizes international trade data requirements for several Federal agencies under the direction of the U.S. Department of Treasury, has been developed to meet UNEDIFACT standards.

New and emerging technologies promise to increase customer responsiveness, improve safety, and enhance productivity. A number of technological solutions are being developed specifically to address intermodal problems and needs. However, most of the best technologies are not in common use. It is difficult to keep pace with the hardware and software options that are available, to identify the solutions likely to yield the greatest benefit for each organization, or to be certain that the capital investment and training costs associated with a particular system or technology will be cost-effective.

The capital costs of new technologies are an obvious impediment to their application to intermodal freight movement. Each agency, organization, and company struggles to find the best way to allocate their limited resources among competing demands. Today, the need for continuous investment in computer technologies generally is accepted as a high-priority concern. Many of these systems are expensive, requiring substantial up-front investments, as well as ongoing investments in staff training and technology maintenance. However, technologies vary greatly with respect to their functional complexity, capacity, and ability to interface with existing systems. As a result, even a large capital investment may not address an organization's outstanding requirements. In addition, technology changes so fast that even an expensive, state-of-the-art system can be outdated before it has been paid off.

The example of how the mission of Electronic Data Interchange (EDI) is changing illustrates the risks associated with some technology investments. EDI has provided many opportunities in recent years to increase and improve the exchange of information and data among the members of the supply chain. For most organizations, EDI represents a major investment. However, many view traditional EDI as expensive, time-consuming, cumbersome and often ineffective, particularly when compared with the Internet, which is able to perform many of the same functions with respect to the exchange of confidential, data-intensive information.<sup>10</sup> Thus, the future role and competitive advantage of investing in EDI are unclear.

## **INTERMODAL OPERATIONS**

### **Shipment Information: Gaps In End-to-End Shipment Visibility and Control**

Shipment tracing and management information systems affect the end-to-end visibility of freight moving between shippers and receivers. Weak oversight of cargo, security lapses, and operational inefficiencies result from information gaps.

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<sup>10</sup> Journal of Commerce, "Caught in a Web," May 22, 1998.

### **Information Gaps**

The costs of a single organization's performance in the supply chain cannot be quantified easily in a multimodal movement. Building systems that would carry information consistently through the intermodal movement is complicated by the need for all of the stakeholders to share roles, responsibilities, and costs. Given the fragmented nature of the industry, the use of shipment information management systems by multiple firms can be institutionally and cost prohibitive. Currently, the primary users of logistics management systems are integrated carriers, especially those using two modes; for example, FedEx uses both trucks and airplanes to deliver their cargo.

### **Security Problems**

Despite measures by the private sector to improve security, cargo theft continues to mount in frequency and value, and remains a major constraint to the efficient and safe movement of goods. Increasing levels of cargo theft actually runs counter to the current downward trend in U.S. crime. The National Cargo Security Council attributes the rise in cargo crime to five factors:

- The modern cargo criminal is more sophisticated and operates on a larger scale than before (previously one bottle would be taken; now an entire container is stolen);
- Cargo theft has become one element of a larger criminal operation, including drug smuggling, arms smuggling, money laundering, or alien smuggling;
- International crime has risen due to the extensive changes in politics and administration of former Soviet Bloc and communist countries;
- There is a reluctance to prosecute cargo crime domestically; and
- Rapid technological changes are occurring that facilitate stealing. Thieves can more easily identify profitable cargo from databases and other information systems.<sup>11</sup>

Cargo theft may involve either insiders or outsiders. One frequently occurring type of theft is known as "cargo leakage." In such cases, a thief is tipped off by a dispatcher or another insider about the type of cargo being hauled, location information, and the operations of the facility.<sup>12</sup>

Theft results in the loss of goods, delays in meeting customer needs, and increasing insurance costs. This is a problem for all modes, but it is becoming increasingly problematic for air cargo because of the high value of goods that are shipped by air, particularly computer chips and other high-tech equipment.<sup>13</sup> Although theft has occurred most often at transfer points and terminals, theft also takes place while freight is in transit.

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<sup>11</sup> Edward Badolato, Chair, National Cargo Security Council, telephone conversation, January 11, 1999.

<sup>12</sup> Edward Badolato, Chair, National Cargo Security Council, telephone conversation, January 11, 1999, and Journal of Commerce, "Call the cops," May 14, 1998.

<sup>13</sup> Journal of Commerce, "JFK's volume is growing, but the flow could improve," July 8, 1998.



Cargo theft has become so prevalent that some shippers are taking dramatic steps to minimize its effects. For example, one shoe manufacturer has chosen to move left and right shoes in separate shipments, despite the cost penalty that this imposes.<sup>14</sup> In addition, some shippers and receivers are calling in private investigators who specialize in freight theft and transport crime to try to recover their cargo.<sup>15</sup>

To address security problems, Customs is conducting a test of minimum security standards at the Port of Jacksonville for possible implementation nationwide. Such standards include restricting general access to freight, restricting terminal access by private vehicles, conducting spot security checks to avoid predictable security routines, and introducing x-ray technology that can detect hidden drugs. In addition, many coordinated measures are being promoted by the National Cargo Security Council, including developing cargo theft task forces, sharing industry best practices, instituting a nationwide theft information system, increasing cargo theft penalties, training local law enforcement on cargo security, and focusing greater research and development efforts on cargo theft prevention.

### ***Operational Inefficiencies***

Operational problems affecting individual modes, facilities, or geographic areas also can create delivery problems when they impede the efficiency and cost-effectiveness of intermodal movements. For example, in Southern California during the summer of 1998, short-haul drayage companies were operating near capacity at the beginning of the peak Asian import season. This created uncertainty for shippers, modal carriers, and receivers regarding their ability to meet their customer commitments. At the same time, importer concerns about service problems on Union Pacific Railroad and their intermodal yards in Southern California resulted in loads being shifted to motor carriers to ensure that merchandise would reach receivers in a timely manner.<sup>16</sup>

### **Gate and Terminal: Congested Gates, Access Roads, and Terminals**

Congestion remains the most significant operational impediment experienced by intermodal operators. Two-thirds of the 25 container ports surveyed by the American Association of Port Authorities classified traffic congestion on major truck routes to their ports as a major concern.<sup>17</sup> Traffic jams can turn a three-mile trip to the airport into a 30-minute drive.<sup>18</sup> The FHWA's ongoing National Highway System (NHS) connectors project is attempting to identify missing links in the NHS that are critical to intermodal movement, and to provide funding as necessary to complete the missing connections.<sup>19</sup> The congestion experienced in the vicinity of intermodal terminals can be attributed to inadequate infrastructure, inefficient operating procedures, and institutional constraints.

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<sup>14</sup> Journal of Commerce, "Taking steps to trip cargo thieves," April 3, 1998.

<sup>15</sup> Journal of Commerce, "Shippers turn to private cops to find stolen goods," September 1, 1998.

<sup>16</sup> Journal of Commerce, "Truckers scrambling," July 27, 1998.

<sup>17</sup> Journal of Commerce, "Rebuilding U.S. infrastructure to cost billions," March 11, 1998.

<sup>18</sup> Journal of Commerce, "JFK's volume is growing, but the flow could improve," July 8, 1998.

<sup>19</sup> U.S. DOT web site, [www.fhwa.dot.gov](http://www.fhwa.dot.gov).

Congestion is experienced within intermodal terminals and gates as well. Inadequate landside access and port facilities that are unable to handle larger vessels rank among the major challenges facing carriers transferring freight from ships to trucks or on-dock trains. Larger vessels will allow for more goods to be transported with greater efficiency, but this is not possible when they are being unloaded at facilities that are already operating at capacity.

Inefficient gate clearance procedures result in congestion at port and terminal facilities. Due to a lack of information and pre-planning, unnecessary unloading and movement of cargo occurs within the intermodal facility. Cargo may need to be stored to accommodate schedule changes; further delays may occur because of the lack of real-time information on those changes. Some of the containers and cargo must be moved within the facility to accommodate other, more timely shipments. Delayed cargo and additional movements exacerbate the congestion within the terminal or port.

Facility congestion is exacerbated by factors such as poor coordination of intermodal transfers, scheduling constraints, and the need to accommodate passenger traffic at shared facilities. The efficient flow of goods also is inhibited by requirements that complex paperwork must be reviewed when carriers are entering terminals; and that exiting vehicles must present their documentation to officials at facility offices, instead of at the gate.

For example, the Customs clearance process imposes unique information handling requirements on the freight movement industry at one of its bottlenecks, the terminal gate. Many carriers perceive the Customs process as slow, burdensome, costly, time-consuming, and inconsistent at international gateways. The cost of complying with Customs-filing requirements is calculated to be four to six percent of the value of each shipment; it is estimated that simplifying these procedures may reduce this cost burden by up to 50 percent.<sup>20</sup>

The current, automated Customs systems include the Automated Commercial System and the Automated Export System,<sup>21</sup> which allow for the electronic filing of export documents as well as the clearing and release of international cargo shipments.<sup>22</sup> These systems are considered to be inadequate to meet the current and increasing demands being placed on them by many in the intermodal freight business.

Improvements to Customs procedures that reduce unnecessary hardship for carriers while continuing to meet policy objectives are critically needed. The Customs Service's recently launched National Customs Automation Program (NCAP) eventually will be installed at land border crossings, seaports, and airports, and will cover the electronic clearing and release of import shipments, cargo examinations, payment of duties and reconciliation of Customs entries.<sup>23</sup> NCAP is the prototype for the development of a new and more extensive automated Customs system – the Automated Commercial Environment (ACE). However, funding of the \$1 billion

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<sup>20</sup> Journal of Commerce, "Compromise revamps export filing procedure," July 10, 1998.

<sup>21</sup> Journal of Commerce, "Paying for upgrade," May 8, 1998.

<sup>22</sup> Journal of Commerce, "Electronic export filings," April 20, 1998.

<sup>23</sup> Journal of Commerce, "Customs newest document," May 20, 1998.

ACE system has been delayed due to disagreements concerning public and private sector contributions and insufficient congressional appropriations to complete the multi-year project.<sup>24</sup>

Simultaneously, the U.S. Treasury Department is leading a multi-agency effort to develop the International Trade Data System (ITDS). The ITDS allows for a single electronic filing of import and export documentation that responds to over 100 Federal agencies' information requirements.<sup>25</sup> Although there is significant support for the ITDS among the trade community, concerns have been expressed that funding the \$256 million system will divert limited Federal resources from the ACE system.

### **Route and Fleet: Lack of In-Transit Dray Visibility**

Tracking and tracing systems allow cargo and vehicle movements to be visible at all times and at all points along the logistics chain. However, information systems generally are oriented toward individual carriers, modes, or terminals. When any single link in the logistics chain – for example, a carrier or mode – does not use these systems, the load is virtually “lost”; no information can be obtained on status, conditions, or direction of the shipments movement.

Most major carriers for all modes maintain some form of tracking.<sup>26</sup> However, few of the small carriers, and hardly any dray carriers, have invested in this type of technology. This lack of continuous cargo visibility significantly weakens the ability of the entire logistics chain to respond to changes and problems as they arise.

### **Summary**

This section has reviewed the key impediments to intermodal freight movement in the areas of business strategy, information technology, and intermodal operations. The impediments discussed here could be addressed by the application of ITS technologies. Opportunities for the U.S. DOT to apply ITS technologies to intermodal freight movement are delineated in Section 6.

The issues and impediments are summarized below in the three areas: business strategy, information technology, and intermodal operations.

### **Business Strategy**

The first area, business strategy, addresses issues and impediments on organizational and institutional levels.

- **Complex and fragmented industry.** The intermodal industry is fragmented. It is a complex industry composed of a large number of diverse stakeholders across multiple modes in

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<sup>24</sup> Journal of Commerce, “Customs mobilizes for system breakdown,” January 13, 1999.

<sup>25</sup> ITDS web site, [itds.treas.gov](http://itds.treas.gov), and Journal of Commerce, “Customs mobilizes for system breakdown.”

<sup>26</sup> See *ITS Fleet Management Resource Guide*, May 1997, for more specific descriptions of motor carrier routing and fleet technologies.

different geographical locations. Although intense competition and tremendous growth in the intermodal industry have forced some level of cooperation among industry segments in recent years, collaboration and institutional isolation remain significant issues. Effective daily management and long-term planning suffer because the modes and stakeholders are operating independently of one another. There are few clearly understood benefits of and incentives for technology interoperability, institutional collaboration, and timely information sharing by stakeholders. These benefits and incentives must be identified and communicated clearly to industry and government stakeholders to promote a new approach to intermodal planning.

In addition, government regulations can be complex, duplicative, and inconsistent across administrations and agencies, Federal and State governments, and countries in the case of Customs clearance. Intermodal freight transport would benefit significantly if regulatory requirements were simplified, streamlined, and made consistent.

## Information Technology

The second area, information technology, describes problems related to data exchange, technologies, and standards.

- **Inefficient data exchange.** Paper-based systems of data exchange impede the flow of information related to intermodal freight transport. Such systems are slow, inefficient, prone to easy introduction of error, and unable to respond quickly and easily to changes. With the rapid improvement in information technology it is possible to secure and exchange documents within a completely electronic environment. Current business practices, such as just-in-time (JIT), demand immediate action and response. Therefore, regulatory requirements, enforcement, invoicing, credit, inventory, customer response, scheduling, routing, and staffing must change to keep pace with today's increasingly electronic business environment.
- **Inconsistent technologies standards.** Technologies are changing rapidly. Given the lack of a unified intermodal industry standard, their rapid development makes linkages and interoperability more difficult. Standards for intermodal technology would encourage interoperability throughout the intermodal system and facilitate gains in long-term efficiency and productivity for all participants.
- **High-investment risk.** There is uneven investment in information and advanced technologies by different businesses in the logistics system (e.g., shippers, carriers, third-party logistics brokers, and terminal operators). The degree of investment risk and the financial limitations of some dray carriers and less technologically advanced carriers prevent uniform and sophisticated response by carriers and terminal operators to shippers, freight forwarders, and other business partners.

## Intermodal Operations

The third area, intermodal operations, focuses on operational problems at gates, terminals, and en route, and the overall tracing and management of shipments.

- **Shipment information.** Shipment tracing and management information systems affect the end-to-end visibility of freight moving between shippers and receivers. Weak oversight of cargo, security lapses, and operational inefficiencies result from information gaps.
- **Congestion at gates and terminals.** Congestion is a major impediment in intermodal freight movement for all modes. Congestion and capacity constraints exist at intermodal terminals, gates, and ports. The means must be found to better manage the movement of freight across existing transportation facilities, or to increase capacity of the transportation facilities themselves.
- **Lack of in-transit or en route visibility.** Tracking and tracing systems allow cargo and vehicle movements to be visible at all times and at all points in the logistics system. Few small carriers and dray carriers have invested in these types of technologies. This lack of continuous cargo visibility significantly weakens the ability to respond to changes and problems as they arise.

## 6. Recommendations for a National ITS/Intermodal Freight Program

### PURPOSE OF THIS SECTION

This section recommends a program of activities and initiatives to address intermodal freight issues and impediments. The activities and initiatives focus on issues and impediments that can be addressed by an ITS program. These activities are the foundation of a National ITS/Intermodal Freight Program for the U.S. DOT.

The activities are organized into three areas as illustrated in figure 9:

- **Business Strategy.** The objective of these activities is to increase cooperation and collaboration among the private and public sector on intermodal issues.
- **Information Technology.** The objective of these activities is to improve intermodal freight operations through the development of data-exchange standards and interoperable freight-identification technologies.
- **Intermodal Operations.** The objective of these strategies is to improve shipment tracing and management, reduce congestion at gates and terminals, and improve route and fleet management through a series of operational tests that apply information technology and ITS to intermodal freight problems.

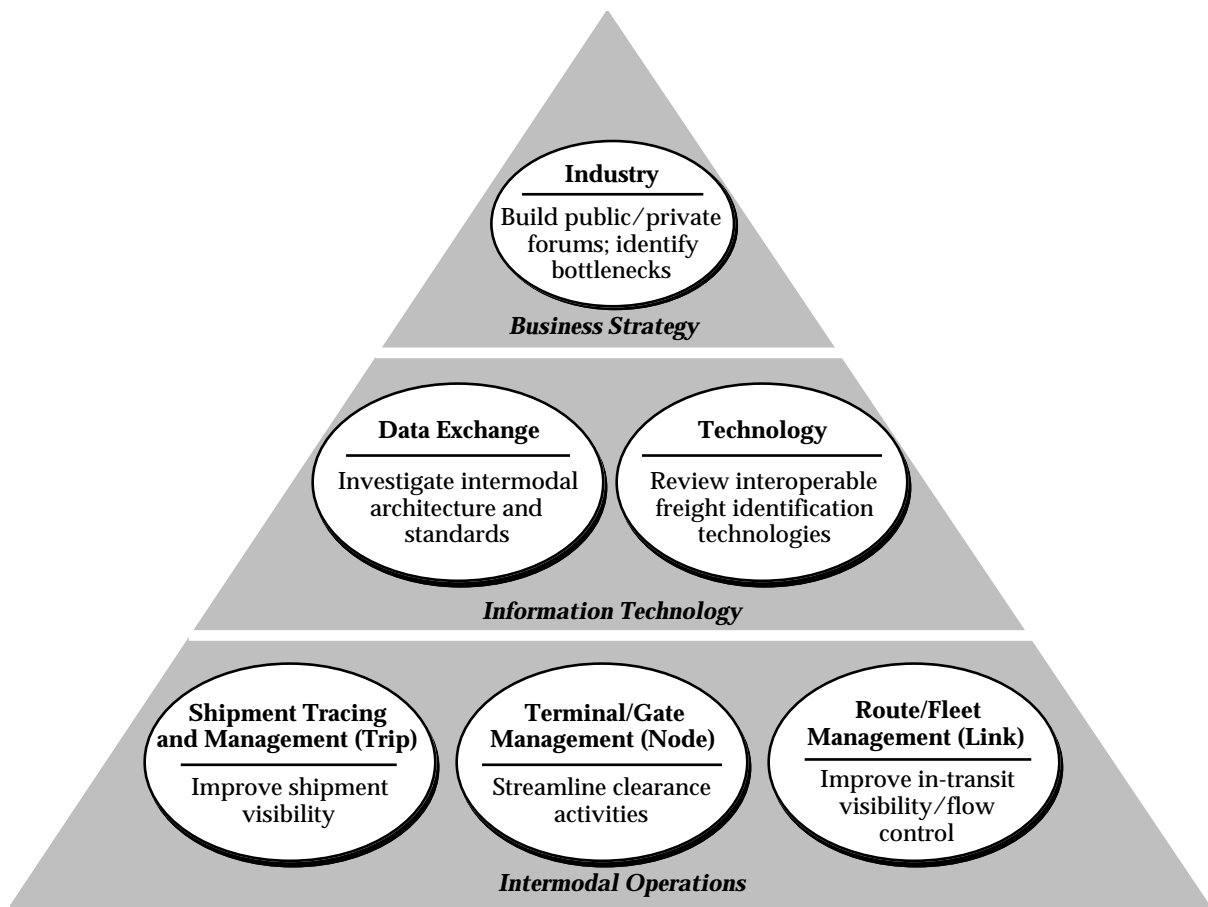
The recommendations proposed in this section will support the mission of the ITS/Intermodal Freight Program to promote a safe, reliable, efficient intermodal freight transportation system for the Nation through the application of ITS technology. The program will support the Federal goals of safety, mobility, economic growth, and trade; protecting and enhancing human and natural resources; and ensuring the Nation's security and stability.

### Business Strategy

#### Overview

Within the context of the ITS/Intermodal Freight Program, the area of business strategy emphasizes a strategy of cooperation and collaboration among private businesses and government agencies to improve intermodal freight operations.

As discussed in Section 5, the intermodal arena is inherently fragmented and complex, has numerous stakeholders, and has diverse priorities. As a result, the intermodal system lacks systematic, meaningful strategies that are generated and supported by a range of public and private stakeholders. Only by effecting collaboration among the diverse stakeholders can sound action plans be developed and successfully implemented. Without the support of both public and private sector participants, the major institutional issues will continue or worsen, turning poor situations into unmanageable ones.



**Figure 9. Opportunities for ITS/Intermodal Initiatives**

Sound business cases must be developed before the public and private sectors will make significant investments in ITS intermodal applications. Until intermodal stakeholders and decision-makers believe that ITS provides cost-effective solutions to the impediments involved in intermodal freight operations, they will not commit the financial resources that are required to support long-term technological solutions, thereby hindering improvements in intermodal freight operations. Reasons to invest in ITS will arise as intermodal freight growth continues and ITS applications are used increasingly by international competitors.

Collaborative planning and decision-making by public and private sector interests facilitates the identification of critical issues and problems on local, national, and international levels and encourages resolution. The intermodal business will profit from an environment in which issues are brought forth openly; impediments of all kinds – institutional, infrastructural, operational, and technological – are reviewed; stakeholders’ opinions are expressed; and coordinated and mutually agreeable solutions can be found, supported, and successfully implemented. Increasing interaction and dialogue among the private sector stakeholders and between the public and private sectors will promote greater integration of this highly fragmented industry.

It is important for the U.S. DOT to be a catalyst for business strategy solutions. The U.S. DOT has demonstrated its ability to bring diverse stakeholders together as evidenced by the development of the National ITS Architecture, the Intermodal Freight Identification Technology Workshop, and the megaships regional conferences. The U.S. DOT can serve effectively as both a convener and as a participant in such forums. In addition, the U.S. DOT can commit resources to initiatives that support national priorities including enhancing the environment (e.g., reducing landside congestion), increasing productivity, stimulating the Nation’s economy, increasing the Nation’s competitiveness internationally, and preserving national security. The U.S. DOT also can facilitate the dissemination of information on initiatives through day-to-day interactions with other Federal administrations and State agencies.

Elements of the business strategy program area should include:

- Improved coordination of Federal intermodal freight-related activities;
- Support for emerging public-private partnerships, intermodal freight technology forums, and technical working groups; and
- Development of educational and training initiatives focused on the application of ITS to intermodal freight operations.

These initiatives are explained in greater detail below.

## ***Recommendations***

### **Improve Coordination of Federal Intermodal Freight-Related Activities**

Consistent with the U.S. DOT Secretary’s ONE DOT initiative, the DOT should continue to strengthen coordination among Federal agencies and administrations for intermodal freight activities and initiatives.

**Empower the U.S. DOT ITS/Intermodal Freight Steering Group.** The U.S. DOT should empower the existing ITS/Intermodal Freight Steering Group to address the issues and



problems of intermodal freight transportation in a unified and collective manner. Many of the institutional complexities and modally-oriented initiatives of the intermodal industry have been replicated within the U.S. DOT. The U.S. DOT must incorporate ITS/intermodal issues and initiatives systematically into existing U.S. DOT freight, ITS, and intermodal activities and discussions. Unless these internal issues are addressed, the success of the U.S. DOT in interacting with private sector representatives will be compromised.

The U.S. DOT should expand the membership of the Steering Group, establish a clear mission, and task the Steering Group with overseeing the implementation of the U.S. DOT ITS/Intermodal Freight Program. The Steering Group reaches across multiple modal administrations and currently serves in an ad hoc basis to oversee the development of the ITS/Intermodal Freight Program. The current agency representation consists of Office of Intermodalism, FHWA, FRA, MARAD, ITS/JPO, RSPA, and VNTSC, and should be supplemented by representatives from the Federal Aviation Administration (FAA), the Coast Guard, and the U.S. Department of Defense (DoD). (See figure 10.) The Steering Group is chaired by the Office of Intermodalism and currently meets approximately once every month and a half. This organizational approach is consistent with the U.S. DOT's ONE DOT management strategy to increase collaboration and cooperation among the modal administrations and DOT functional areas and solve problems of common concern more effectively.

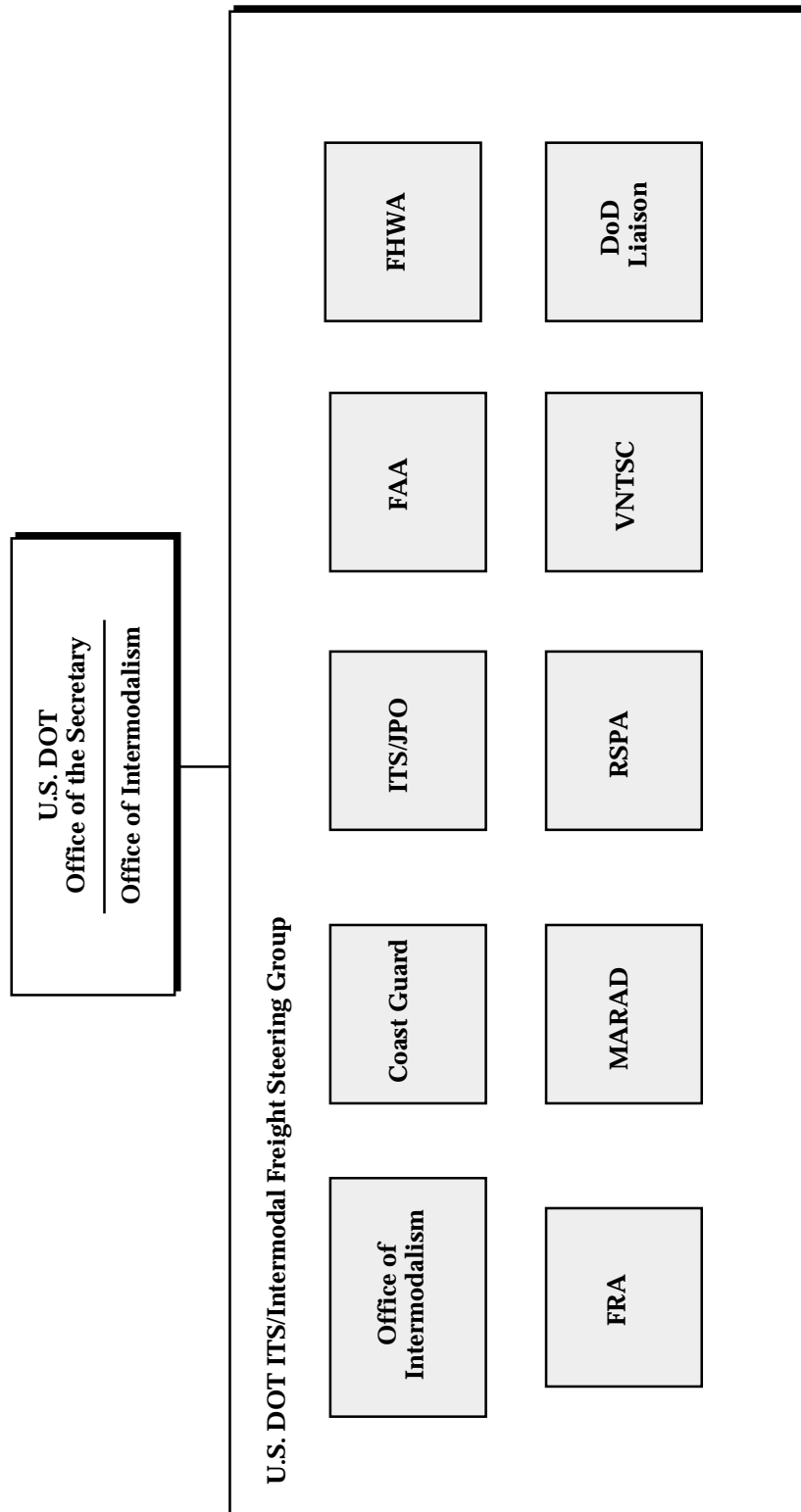
The ITS/Intermodal Freight Steering Group should focus on:

- Helping to implement the ITS/Intermodal Freight Program by providing assistance in the selection of candidate operational tests, project deployment, and project evaluation;
- Guiding the internal coordination of U.S. DOT ITS intermodal activities; and
- Exploring opportunities to partner and share resources across modal administrations for ITS/intermodal initiatives.

**Support work of U.S. International Trade Commission to streamline regulatory requirements.** The U.S. DOT should work with the U.S. International Trade Commission to streamline trade regulations affecting international freight movement. The U.S. International Trade Commission was tasked by Congress to simplify regulatory requirements and apply information technologies to ensure data accuracy, reduce duplicative requests for information, and speed the submission of regulatory transactions. The mandate of the Commission includes streamlining regulatory requirements and simplifying the categories of duties on which imported products are assessed. The U.S. DOT can contribute its expertise to facilitate and expedite this process for international goods movement.

### **Support Emerging Public-Private Partnerships, ITS/Intermodal Freight Forums, and Technical Working Groups**

The U.S. DOT should support public and private forums and working groups that can identify intermodal freight issues and promising ITS applications. The U.S. DOT should work with forums and groups at the international, national, regional, and local levels. These partnerships, forums, and working groups are discussed below.



**Figure 10. U.S. DOT ITS/Intermodal Freight Steering Group**

### *National Level*

**Promote national-level national forums for insight and technical guidance.** The U.S. DOT should promote national-level forums to gain insight and obtain technical guidance for the Federal Government on intermodal freight programming and project development. Representation should include a broad selection of intermodal policy-level personnel from both private and public sectors. Private sector representatives should be well versed in their problems and direction of their mode and represent their industry, not their company. Membership should be balanced geographically as well as functionally. Public sector representatives should be able to make commitments on behalf of their agency. Such forums allow for private sector outreach and can provide advice to the U.S. DOT about implementing the National ITS/Intermodal Freight Program, policy, and Federal initiatives and activities. Specific Federal initiatives will be more likely to succeed as they will be refined by the perspectives of the private sector, and be more supported subsequently as private sector concerns and perspectives have been included and addressed.

Efforts should be made to support and build upon the Intermodal Freight Technology Working Group, which was recommended at the Intermodal Freight Identification Technology Workshop in Reston. The working group was established in the Fall of 1998 to suggest improvements to intermodal operations and advise on the deployment of intermodal freight technologies. The membership of Intermodal Freight Technology Working Group is drawn primarily from the private sector, but is co-chaired by representatives from the public sector and the private sector. ITS America hosts the working group. The Intermodal Freight Technology Working Group is operations-oriented. Its mandate includes: promoting ongoing dialogue between the private and public sector, encouraging the application of ITS to intermodal freight transportation, promoting interoperability among industry stakeholders, and improving communication and technology transfer between the U.S. DoD and commercial freight applications.

**Support conferences and workshops.** The U.S. DOT should support conferences and workshops that focus on specific aspects of intermodal freight technology or operations. These conferences can be effective in drawing new people and perspectives into intermodal program development and implementation. The Intermodal Freight Identification Technology Workshop, which focused on intermodal freight identification technologies, served effectively to develop new contacts and collaboration between the U.S. DOT and the private sector, provided an open forum to present a range of perspectives, and assessed the level of support and interest by stakeholders for various suggestions and initiatives. In addition, it improved communication between the private and public sectors by proposing and initiating the previously mentioned Intermodal Freight Technology Working Group.

### *Regional Level*

Regional level activities address initiatives for a group of states. They should be centered around a major trade corridor or several key intermodal facilities.

**Host regional meetings to develop support for ITS/intermodal freight initiatives.** The U.S. DOT, in collaboration with FHWA, MARAD, and FAA regional resource centers, should host regional discussions on intermodal technology issues that are either topic- or site-specific to develop support and interest for ITS/intermodal freight initiatives. The regional meetings

hosted by MARAD in 1997 to address the increasing use of megaships at U.S. ports was timely, significant to stakeholders, and required the perspectives of both the public and private sectors. Regional meetings and “listening sessions” facilitate participation, yet permit discussions of issues of more local interest. Such meetings, when appropriate, can leverage the success of the listening sessions hosted by the U.S. DOT held in recent years, including those of MARAD and the FAA. In addition, the Office of Intermodalism hosted a series of listening sessions in the fall of 1998 as part of the study, *Challenges and Opportunities for an ITS/Intermodal Freight Program* that provided a strong basis for future discussions on intermodal freight-related issues.

#### *Local Level*

**Promote the development of local public-private sector intermodal freight advisory groups.** The U.S. DOT should promote the development of local freight advisory groups that draw from the private and public sectors. Many issues and bottlenecks in intermodal freight movement occur at local transfer points (e.g., rail terminals, ports) and inspection sites (e.g., international border crossings, state borders, international airports). Although issues relating to Customs are national issues, metropolitan planning organizations (MPOs) should lead local efforts to identify intermodal impediments and find ways to correct them. For example, freight advisory groups sponsored by MPOs, including the Chicago Area Transportation Study freight advisory group and the Puget Sound Regional Council’s Seattle Freight Mobility Roundtable, have a range of intermodal specialties and stakeholder interests represented, and can be highly successful means to encourage public and private sector discussions, facilitate collaboration, and develop realistic action plans to address local problems. The U.S. DOT can encourage local and regional discussions of issues as an extension of the efforts of the National Freight Partnerships, and provide information on working with the private sector, success stories from other localities, and current national initiatives.

#### *International Level*

**Represent U.S. interests in ITS/intermodal freight movement in international forums.** The U.S. DOT should support ITS applications, intermodal technology standards development, and international ITS/intermodal programs in international forums. Foreign trade continues to increase; globalization pervades all aspects of production, transport, and trade; and ITS applications are being used increasingly by international competitors. Important trade and freight transportation forums at which the United States is represented and should promote the development of international policies and technology standards for intermodal freight include the North American Free Trade Agreement (NAFTA), the Asia-Pacific Economic Cooperation (APEC), Organization for Economic Cooperation and Development (OCED), International Border Crossings, and a range of international standards organizations.

### **Develop Education and Training Initiatives Focused on the Application of ITS to Intermodal Operations**

**Educate the intermodal industry on the costs and benefits of interoperability.** The U.S. DOT should take steps to educate intermodal stakeholders about the benefits and costs of ITS technology for intermodal freight operations. First, the U.S. DOT should collect and disseminate existing data on the costs and benefits of interoperable intermodal technologies to industry stakeholders. Second, the DOT should seek to develop a better understanding of the private sector’s costs and benefits and develop a shared vision with private-sector participants on the

costs and benefits of technical interoperability through interactive forums and scanning tours of multimodal operations. Lastly, the DOT should sponsor research studies to expand upon the information and studies performed to date. As expressed at the Intermodal Freight Identification Technology Workshop and the Intermodal Freight Technology Working Group's initial meeting, there is a great need for information by industry representatives on the costs and benefits of interoperability of intermodal technologies. However, because the operating conditions of intermodal stakeholders vary greatly, it is not easy to draw relevant conclusions on the costs and benefits of interoperability for the intermodal industry as a whole. As a result, there are little data that can be summarized accurately on the costs and benefits of interoperability for all players, and there is insufficient information for individual modes on their costs and benefits of intermodal interoperability.

**Develop a clearinghouse of ITS/Intermodal projects, best practices, and lessons learned.** The ITS America web site should serve as a clearinghouse for ITS/intermodal projects. The content of the site should include existing information from the U.S. DOT's ITS web site, which describes ITS projects by state; and the ITS Cooperative Deployment Network (ICDN) web site, which is planned to include ITS interviews, case studies, and reports.<sup>1</sup> The ITS America web site would best serve this function as ITS America already is a mutually acceptable forum to represent private and public sector interests. The recent deployment and evaluation of freight and intermodal ITS technologies have generated valuable information and lessons learned from which future initiatives will benefit. However, no central clearinghouse exists to collect and disseminate best practices and lessons learned. Information on the planning and evaluation of intermodal and ITS initiatives is scattered among the U.S. DOT, state DOTs, ITS America, and individual project teams. Some of this documentation has been posted on web sites, but there is no central site where interested parties can review a list of relevant ITS/intermodal activities, read project scopes and status, and review project evaluations and lessons learned before pursuing their own ITS/intermodal applications.

**Expand the ITS professional capacity building program to the ITS/intermodal area.** The U.S. DOT should expand its ITS Professional Capacity Building (PCB) Program to include training courses related to the application of ITS to intermodal freight. The mandate of the ITS Professional Capacity Building Program is to train transportation professionals and future professionals in ITS technologies and applications, increase awareness among public-sector decision-makers and industry representatives of the potential offered by ITS, and raise public awareness about ITS. Extending the ITS PCB program to the intermodal freight area would help intermodal professionals realize the benefits of applying ITS technologies to their current operations, and to facilitate and expedite the deployment of intermodal technologies nationwide.

**Encourage collaboration for education and training initiatives.** The U.S. DOT should encourage collaboration among university, government, and industry sectors to promote training and education in the area of intermodal freight. Promoting training and education to students, professionals, and public sector policy makers in intermodal freight operations, policy, and technologies will provide benefits far beyond the education of individuals; it will have a positive impact on ITS/intermodal planning efforts on regional, national, and international levels.

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<sup>1</sup> U.S. DOT ITS web site, [www.its.fhwa.dot.gov](http://www.its.fhwa.dot.gov); U.S. DOT ITS Cooperative Deployment Network, [www.fhwa.dot.gov/hst/icdn.htm](http://www.fhwa.dot.gov/hst/icdn.htm); ITS America web site, [www.itsa.org](http://www.itsa.org).

Successful collaboration among university and industry segments to promote training and educational opportunities in intermodalism and technology applications is occurring, but should be broadened. A jointly sponsored initiative by the U.S. Merchant Marine Academy and Sea-Land has proven beneficial for both parties. These organizations have been developing case studies in intermodal freight movement for Sea-Land senior-level staff and intermodal freight courses for university students to train both groups in current intermodal practices and the use of advanced technologies. The U.S. DOT can complement educational and training initiatives by explaining U.S. DOT strategies and priorities, such as global competitiveness and safety; and ITS/intermodal activities like the ITS/Intermodal Freight Program.

The Federal government should encourage the development of certificate programs in universities for ITS and freight to institutionalize the field. In addition, the U.S. DOT can provide or encourage opportunities for remote learning and certification on intermodalism and technology applications through the U.S. DOT web site, other Internet links, CD-ROMs, and other channels.

**Educate MPOs and the public on freight and intermodalism.** The U.S. DOT should accelerate its efforts to educate MPOs and the general public about the importance of intermodal freight transportation and the issues surrounding it. The 1991 Federal ISTEA legislation mandated that MPOs oversee local freight planning. Some MPOs have been able to meet the challenge, realize the global implications of the freight activities in their regions, and increase public awareness of critical intermodal issues. However, due in part to a lack of resources, many agencies have found it difficult to meet growing expectations for freight planning, including education of the public about freight and intermodal concerns. As a result, there is frequently a lack of public support for the needs of freight transport and planning. The U.S. DOT can assist these agencies by providing guidelines and materials about intermodal freight issues and opportunities to MPOs for use in their public education efforts. This support can be provided as an extension of the National Freight Partnership's development of freight advisory councils through the MPOs.

## ***Information Technology***

### **Overview**

These recommendations address the strategies that the U.S. DOT can undertake to improve intermodal freight operations through the development of data-exchange standards and interoperable freight-identification technologies.

Since there is no single "intermodal industry," numerous organizations are involved in setting technology standards that apply to only a portion of those firms and organizations in intermodal transportation or that apply to only a portion of their business. Rapidly changing technologies contribute to the multitude of industry standards and make it difficult to maintain compatibility across and within modes. In addition, international standards fall within the purview of multiple agencies and organizations. Because standards are continuously evolving, private firms are reluctant to invest in freight technologies that are not compatible with existing technologies or may not conform with the industry standard in the near future. Consequently, the industry suffers as incompatibilities arise among the technologies and standards of the modal carriers. This impedes the flow of data across modes, and leads to further problems, including lack of timely shipment information, duplicative informational requirements and

efforts, delays in cargo shipments, damaged or misplaced cargo, poor responsiveness to customers, less safe operating conditions, and reduced productivity.

Efforts in the area of information technology can greatly improve efficiency, safety and productivity. Intermodal standards and protocols would allow for greater compatibility and interconnectedness among technologies. Interoperable technologies will facilitate the flow of data, reduce duplicative data efforts and errors, speed the movement of cargo, increase efficiency through reduced manual response and enhanced functionality, increase the safety and security of operators and cargo, increase responsiveness to customers, and increase the productivity of intermodal operations overall.

The U.S. DOT has established its ability in effecting information technology (IT) solutions to problems of national interest and should continue this function in the area of intermodal freight. The Federal government already has committed itself to technology solutions as part of the strategies developed by the National Partnership for Reinventing Government led by Vice President Al Gore. The U.S. DOT has demonstrated its ability to convene technical experts; influence planning issues; build upon existing technical, standards, and policy work; serve as a clearinghouse of information; and provide funding. The U.S. DOT is unique in that it can perform these roles simultaneously, reinforcing both the functions and the results, and should continue to do so in the area of intermodal freight transportation as well (See Appendix D for a list of recent U.S. DOT outreach efforts, studies, and program initiatives in the area of ITS intermodal freight transportation).

Elements of the IT program area in the ITS/Intermodal Freight Program include:

- Developing intermodal architecture and standards; and
- Developing interoperable technologies.

### **Recommendations**

**Assess the need for and determine the scope of an intermodal freight ITS architecture and ITS standards.** The U.S. DOT, as the primary sponsor and supporter of the National ITS Architecture, should help the private sector explore the need for and scope of an ITS intermodal freight architecture and ITS intermodal standards. Participants at the Intermodal Freight Identification Technology Workshop and other industry forums have recommended developing an ITS architecture user service to improve intermodal freight operations. The U.S. DOT should help and support industry representatives and other private sector stakeholders to explore the need for and determine the scope of an intermodal freight user service in the National ITS Architecture and intermodal freight standards. The National ITS Architecture provides the structure to design an ITS system by defining the “building blocks” that allow different ITS services and technologies to work together. It allows for a variety of design approaches that can meet site-specific needs, ensure technical consistency within a broader geographic or functional context, allow for interoperability with existing technologies, and provide for further development and interoperability with new technologies. The ITS Architecture would allow for an intermodal freight system to operate compatibly with a different intermodal freight system in the next geographic region or to operate compatibly with an incident management system in the same geographic location.

The National ITS Architecture is the overarching framework for an interoperable, nationwide system that will allow for a range of ITS services to develop. It will assist stakeholders by:

- Providing a framework for integrating technologies, ensuring compatibility, and coordinating actions and responses;
- Facilitating planning and reducing the time and resources required to develop a regional ITS framework;
- Helping stakeholders to communicate complex ideas through a common language;
- Identifying where standards should be used to develop interfaces that multiple vendors can support; and
- Eliminating the incidence of conflicting technologies, which can render some technologies inoperable.

In addition, the Architecture identifies the potential benefits that are achieved through the integration of ITS infrastructure components. Development of the National ITS Architecture is an ongoing process over time. The initial version of the National Architecture was begun in 1993 and completed in 1998, and includes six areas of user services:

- Travel and transportation management;
- Public transportation operations;
- Electronic payment;
- Commercial vehicle operations;
- Emergency management; and
- Advanced vehicle control and safety systems.

Of these six areas, commercial vehicle operations is the only one that directly addresses the movement of freight, and it is limited to motor carrier regulatory operations. Development of a new intermodal freight user service would address this shortcoming in the National ITS Architecture.

As part of the architecture development process, it also will be necessary to define the ITS standards critical for an intermodal freight user service. Standards and protocols, collectively referred to as “standards,” define how the components of a system interconnect and interact within the framework of the National ITS Architecture.<sup>2</sup> The architecture and standards should address linkages across modes for such services as cargo identification, tagging, and tracking.

ITS standards are being developed in many areas which will influence intermodal freight movement. These efforts are being led by a range of standards organizations. Current ITS

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<sup>2</sup> For more information on the National ITS Architecture, refer to the U.S. DOT Overview of the National Architecture, [www.its.fhwa.dot.gov/architecture/overview.html](http://www.its.fhwa.dot.gov/architecture/overview.html).



standards efforts that will impact standards for intermodal freight transportation include: DSRC, CVO safety and credentials, automatic vehicle identification, weigh-in-motion, advanced traveler information systems, automatic equipment identification, EDI, and the International Trade Data System.

The need for and scope of an intermodal freight user service for the ITS architecture relies upon the lessons learned from intermodal freight operational tests, the coordination and input of a broad range of intermodal specialists, and the previous experience of ITS Architecture development. It is important to ensure the architecture remains open and is compatible with multiple technologies. The operational tests suggested in the report, *Challenges and Opportunities for an ITS/Intermodal Freight Program*, will provide input to the functional requirements required for an intermodal freight user service. In addition, the experience gained from the Commercial Vehicle Information Systems and Networks (CVISN) development process, because of its freight focus, also will add valuable insight in developing an intermodal freight user service for the National ITS Architecture.

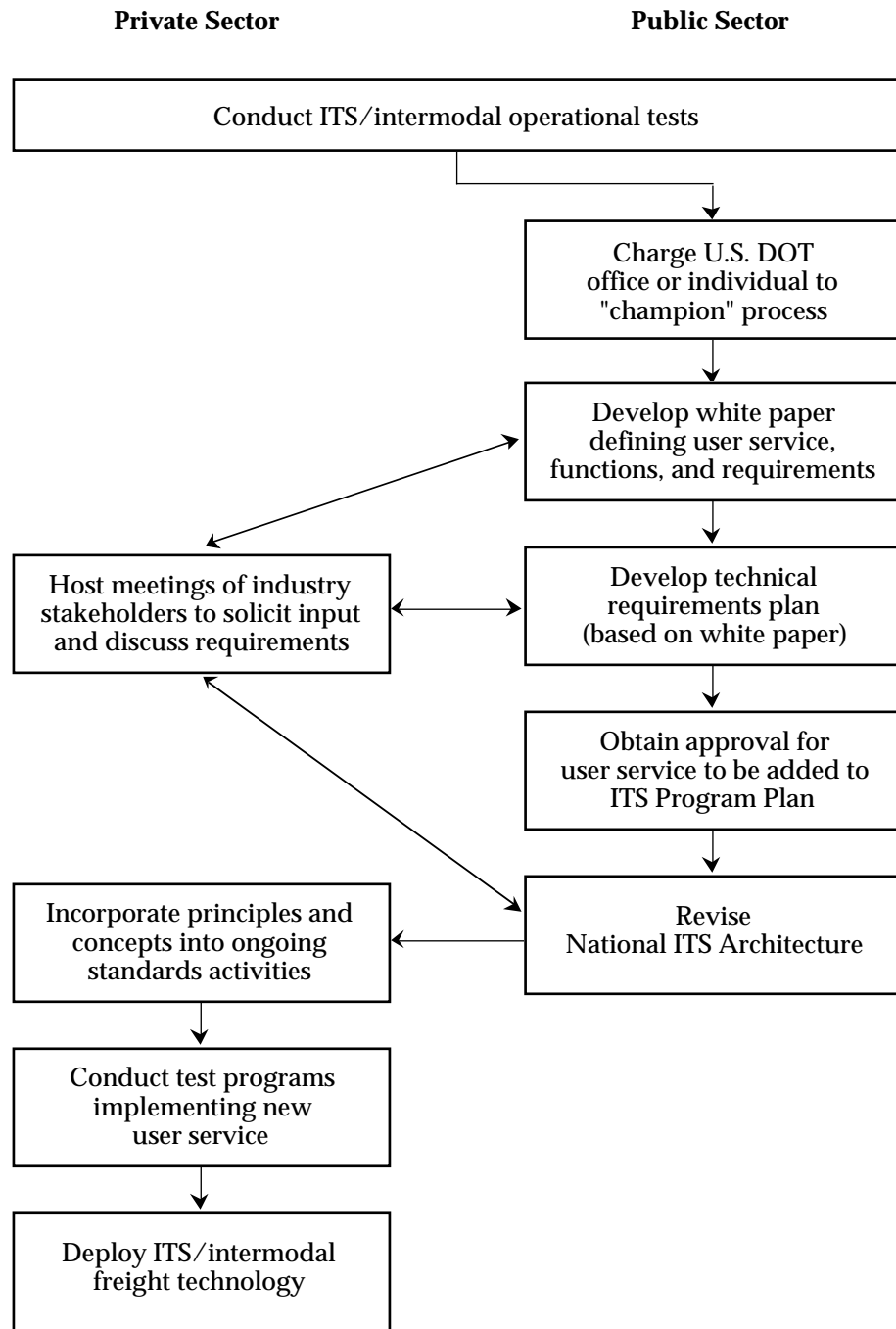
Figure 11 provides a schematic of the architecture development process for an intermodal freight user service. This effort beginning with the ITS/intermodal operational tests, leading to an intermodal freight architecture, followed by a system prototype which uses the new architecture, followed by full deployment, standards development and common usage of the architecture and standards in the intermodal industry.

**Promote the use of interoperable technologies.** As an intermodal freight user service for the National ITS architecture is still in the future, the U.S. DOT should take immediate steps to promote interoperability of intermodal freight technology through demonstration projects, the development of compatible intermodal technologies, and leveraging of existing public and private sector applications of freight and vehicle identification technologies. Identification and tracking technologies for intermodal cargo, containers, and conveyance constitute the core aspects of IT applications to intermodal freight transportation. Recent intermodal events, including the Intermodal Freight Identification Technology Workshop and the listening sessions for the study, *Challenges and Opportunities for an ITS/Intermodal Freight Program*, have indicated the interest in interoperability intermodal freight identification technologies by government agencies and by the private sector. There are agencies and consortia conducting freight demonstration projects, including the Cargo Handling Cooperative Program (CHCP) and the Intermodal Freight Technology Working Group (See Appendix E for more detail). In addition, there are several identification technologies in development and current use whose functionality can be advanced and extended to intermodal freight movement.

The steps required to promote interoperability of intermodal freight technology include:

- Disseminate existing information;
- Partner with the private sector and provide financial assistance;
- Support industry “champions”; and
- Coordinate efforts and initiatives.

**Disseminate existing information.** A first step is to disseminate available materials to a broader range of intermodal stakeholders on:



**Figure 11. Architecture Development Process for an Intermodal Freight User Service**

- Achieving interoperability and its benefits;
- Developing and using ITS architecture and standards; and
- Existing technologies of relevance to the intermodal industry, such as optical character readers (OCR), radio frequency identification (RFID), and satellite location systems.

Although some of this information is already being distributed through industry publications, forums, and the Internet, attention must be given to how to reach those intermodal representatives who are less likely to be informed through U.S. DOT's traditional means of communication. This information should be distributed through industry newsletters, "listservs," web sites postings, conferences, industry champions, related advisory groups, and other industry forums.

**Partner with the private sector and provide financial assistance.** The second step is for the U.S. DOT to promote standardization and interoperability of intermodal freight technologies through partnering with the private sector and providing financial assistance on operational tests. Public-private partnering requires understanding the other sector's perspectives and developing shared priorities. In this way, the U.S. DOT can encourage deployment and interoperability of intermodal technologies across localities, regions, and the Nation.

**Support industry "champions."** The third step is to identify and support industry representatives who serve as informal "champions" for interoperability within their industry or region. Champions are spokespeople from the industry who already recognize the value of interoperability, are able to speak to technical issues, and are willing to support and address the issue of interoperability at industry forums, at conferences, and through informal networking. Their role would be especially important at intermodal forums and working group meetings as discussed as part of the Business Strategy. Many informal champions already exist, such as the members of the Intermodal Technologies Working Group and its segment teams.

**Coordinate efforts and initiatives.** The last step in promoting interoperable technologies is to coordinate and leverage related initiatives. Many demonstration projects and operational tests are being initiated by different industry groups; the project managers and their organizations should actively investigate opportunities to coordinate and leverage phases and components of their projects with other initiatives, share the lessons learned from the projects, and identify stakeholders who are able to facilitate deployment in future initiatives or project phases. Coordination of initiatives should occur through the U.S. DOT with assistance from intermodal industry organizations, such as the Intermodal Association of North America (IANA).

## ***Intermodal Operations***

### **Overview**

These recommendations suggest a series of operational tests. The U.S. DOT should solicit and fund proposals for ITS/intermodal freight operational tests at terminals and gates, for routes and fleets, and for shipment information. Intermodal freight operations can be improved significantly by linking existing private sector shipment information and asset management systems with public sector traffic and safety management systems. In this way, terminal operators, freight carriers, and state and metropolitan traffic operations managers can share information to optimize flows and better utilize equipment and facilities. The operational tests

would benefit the intermodal industry, the businesses they serve, and the general public. The tests should be designed, staged, and evaluated in 24 months or less. These operational tests will improve intermodal freight operations by:

- Demonstrating how linkages across information systems and data sharing will improve intermodal operations by increasing efficiency and productivity;
- Increasing private-public collaboration and facilitate future cooperation;
- Building and strengthening networks and institutional links;
- Spurring innovation in technology, operations, and business procedures; and
- Assessing the need for and determining the scope of an ITS architecture and ITS standards.

Opportunities for intermodal operational tests fall into three areas:

- Gates and terminals (e.g., management of ports, terminals, gates, clearance sites);
- Routes and fleets (e.g., management of trips between terminals, ports, shippers, and receivers); and
- Shipment information (e.g., management of status and location information for shipments).

Figure 12 depicts the focus of each activity. The examples of operational tests described below span the three areas, and therefore are categorized by the launching or starting point of the operational test concept.

## Gate and Terminal Management

### *Definition*

Currently there is significant congestion at transfer points in the intermodal freight logistics chain. In addition, certain operational practices can impede the efficiency of the freight movement at these locations as well. Backups and congestion can occur inside the terminals and ports, at the gates, or approaching the site. Clearance sites, such as Customs clearance, weigh stations, and terminal gates often requires cargo movement to stop and various activities to take place before the cargo may continue to move or before the cargo can be transferred to the next carrier.

The U.S. DOT has the opportunity to accelerate ITS applications at intermodal terminals, gates, and clearance sites, thereby mitigating congestion at gates and terminals, accelerating Customs clearance activities at international borders and ports, and increasing productivity and efficiency. In addition, lessons learned from other private and public sector asset management and clearance activities (e.g., ITS/CVO, ITS/electronic toll collection, international land border clearance) should be applied to intermodal gate clearance systems and activities.

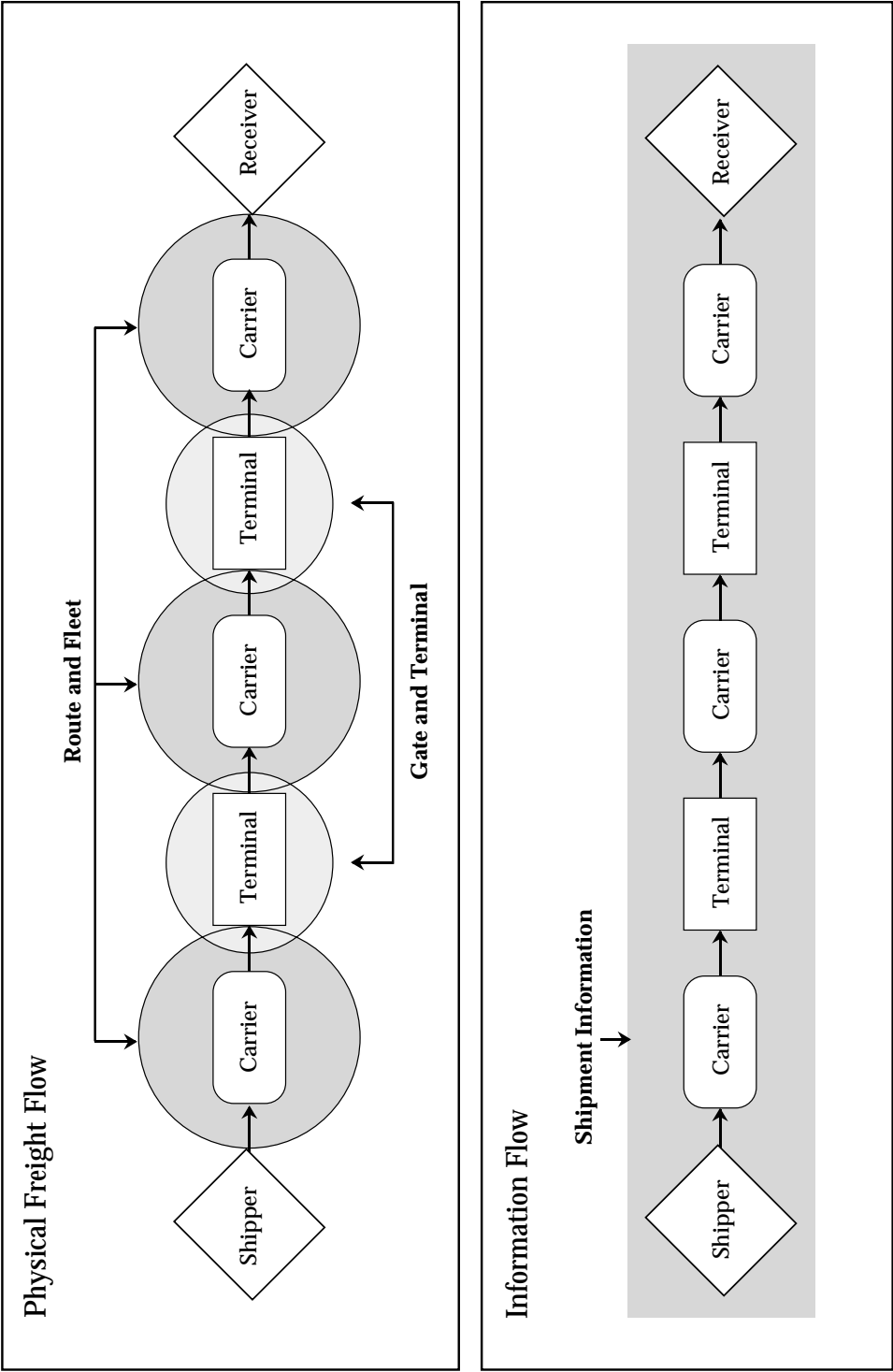


Figure 12. Elements of the Intermodal Operations Program Area

### Existing Systems

Currently there are many types of gate clearance, terminal inventory management systems, Customs clearance, and permitting systems in use for freight movement. Several examples are included in figure 13.

TERMINAL INVENTORY MANAGEMENT SYSTEMS	
<b>Function:</b>	Track and manage the movement of containers and trailers within port, rail, and truck terminals.
<b>Purpose:</b>	The systems are used to optimize the use of space in terminals, manage the stacking of containers of different lengths, make efficient use of labor and equipment, and schedule equipment repair and maintenance.
<b>Technology:</b>	The systems use computer models and optimization or expert systems software, RFID devices, GPS receivers for position identification, and mobile inventory vehicles for integrated inventory and equipment location identification. Systems typically are linked to booking and gate clearance systems.
<b>Examples:</b>	NAVIS; OASIS; APL Seattle Terminal System; Matson Hawaii Terminal System; August Design GRAIL robotic container-handling facility for Sea-Land Service, Inc.; MTLT Container Terminal Management System; Maher Terminals Marine Terminal Automated Management System; APL integrated Port Management and Vessel Planning System at the Port of Los Angeles.

GATE CLEARANCE SYSTEMS	
<b>Function:</b>	Automate the verification and inspection of drivers, truck tractors, trailers, containers, and chassis moving into and out of marine, rail, air, and truck terminals.
<b>Purpose:</b>	The systems are used to verify bookings, maintain security, and establish liability for damage.
<b>Technology:</b>	The systems use automatic vehicle identification (AVI) technology, e.g., GPS, RFID transponders, optical character recognition (OCR) linked to computerized databases. Systems typically are linked to booking and terminal management systems.
<b>Examples:</b>	Maher Terminals OCR Gate System; Southern Pacific/Santa Fe Los Angeles Terminal OCR System; Port Authority of New York and New Jersey (PANYNJ) Sea-Link card system; APL automated gate clearance system in Los Angeles; Port of Portland electronic shipyard planning system; LA King gate systems.

**Figure 13. Existing Terminal and Gate Management Systems and ITS Applications**

CUSTOMS CLEARANCE SYSTEMS	
<b>Function:</b>	Automate the filing, processing, review, and issuance of documents for import and export of goods.
<b>Purpose:</b>	The systems are used to automate transactions, improve Customs control, and minimize delays for shippers and receivers.
<b>Technology:</b>	The systems use transaction processing software and communications technology.
<b>Examples:</b>	U.S. Customs Automated Commercial System, Automated Manifest System, Automated Export Reporting System, Automated Export System, and International Trade Data System; Syntra Global Logistics System.

OVERSIZE/OVERWEIGHT PERMITTING SYSTEMS	
<b>Function:</b>	Automate the filing, review, payment, and issuance of state and local government permits to motor carriers to haul oversize or overweight (OS/OW) loads on highways.
<b>Purpose:</b>	The systems are used to facilitate and expedite the processing of OS/OW permits issued by state officials to motor carriers.
<b>Technology:</b>	The systems use electronic data interchange (EDI) and/or Internet communications, transaction processing software, and sometimes GIS and automated routing capabilities. The systems often are linked to bridge load-rating systems.
<b>Examples:</b>	Cambridge Systematics, Inc.; Geopak; American Management Systems; and KPMG.

**Figure 13. Existing Terminal and Gate Management Systems and ITS Applications (continued)**

#### *Support Operational Tests*

There are many opportunities for operational tests to improve or leverage terminal and gate systems and to link them to other elements of the intermodal system. The concepts suggested in this section are a sampling of a range of potential operational tests; they include the following:

- Intermodal outbound flow management;
- Pre-trip safety and weight screening; and
- Motor carrier credentials at terminals.

These potential operational tests are described below.

#### Intermodal Outbound Flow Management

The objective of this operational test concept would be to improve the mobility of trucks exiting terminal gates by adjusting street traffic signals based on real-time conditions or optimized

signal timing plans. It would address problems of congestion, queuing, and delays for trucks approaching and exiting the terminal gate caused by traffic signals on terminal access and egress roads and corridors.

To implement the system, the terminal's gate clearance system would need to be linked with the traffic-responsive and -adaptive traffic signal systems that are part of a regional or corridor traffic management system. The functioning of these systems would include:

- Gate clearance system that automates the verification and inspection of drivers, trucks, and containers; and
- Traffic management system that regulates traffic signal timing and coordination in a corridor.

The gate clearance system provides information on volumes of trucks exiting the terminal, and potentially, information on their destinations, to the regional or corridor traffic management system. The traffic management system uses the information to adjust the timing of street traffic signals and freeway ramp meters to ensure efficient traffic flow and minimize queuing. Timing can be based on day and time of day patterns or real-time traffic conditions.

#### Pre-Trip Safety and Weight Screening

The objective of an operational test for pre-trip safety and weight screening would be to reduce the frequency and duration of stops at weigh stations and other inspection sites for safe and legal motor carriers. Weigh station stops, especially when there is congestion, and roadside inspections create a burden for the compliant motor carrier because the delays directly impact their ability to meet schedules and impact the carrier's costs and profitability. This test concept would complement the primary objective of the Commercial Vehicle Information Systems and Networks (CVISN) program, as well, which is to develop and deploy information systems to support new capabilities in: the exchange of safety information, administration of motor carrier credentials, and electronic screening.

The system would allow for drivers at the terminal gate to verify their credentials and safety status as terminal operators query the regulatory safety assurance or weigh station clearance system. The weigh station clearance system would clear the truck and allow it to bypass verification at the gate.

The pre-trip safety and weight screening system would link the terminal's gate clearance system with the regulatory safety assurance or weigh station clearance system. The functions of each system include:

- Gate clearance system that automates the verification and inspection of drivers, trucks, and containers;
- Safety assurance system that provides information on the safety history and performance of motor carriers and drivers; and
- Weigh station clearance system that provides links to databases containing carrier and driver credentials and safety information and enables commercial vehicles to avoid stops at weigh stations.



### **Motor Carrier Credentials at Terminals**

The objective of the motor carrier credentialing at terminals operational test concept would be to enable a motor carrier to obtain a permit at the terminal to transport an oversize or overweight load. Currently, a load can be delayed for hours or days because the motor carrier must obtain a permit from a public agency to transport the oversized load.

The new system would allow for drivers at the terminal to apply for and receive permits for transporting oversize/overweight loads in the state. Potentially, regional permits could be obtained from regional permitting systems. In addition, the state can conduct weight inspections at the terminal and certify vehicle weight, and potentially enable the truck to bypass static weighing at the weigh station.

The operational test would require linking the terminal's gate clearance system with the automated oversize/overweight permitting system. The functions of the linked systems would include:

- Gate clearance system that automates the verification and inspection of drivers, trucks, and containers; and
- Oversize/overweight permitting system that automates the issuance of permits.

### **Route and Fleet Management**

#### *Definition*

Route and fleet activities in an ITS/Intermodal Freight Program would include increasing the in-transit visibility of assets, improving the flow of traffic leading to and from intermodal transfer facilities, and improving load planning of vehicles and vessels. These activities affect the in-transit portion of the intermodal move.

In-transit visibility allows for an intermodal asset's location to be determined at any given time. This information can be supplemented with data on shipment status, time, and physical condition to provide a real-time update to customers, operators, and carriers. The use of transponders for tracking and managing assets such as rail cars, chassis, and truck cabs is already widespread. For example, Global Positioning Systems (GPS) are being used by long-haul motor carriers for tracking and in-transit visibility, emergency rescue operations are investigating GPS to improve tracking and routing, and railroads are investigating the use of satellite systems to improve train positioning. The assets used for intermodal moves currently include containers, trucks, vessels, chassis, and rail equipment. There are significant opportunities to improve and expand the uses of these transponders for intermodal asset and cargo management.

There are many opportunities to improve the traffic flows leading to intermodal terminals and ports through the use of ITS technologies. Leveraging and linking existing ITS technologies such as electronic toll collection and traffic monitoring systems will provide immediate benefits. For example, the use of toll transponders and roadside readers linked to shippers and terminal operators would improve the in-transit visibility of dray movements; assist shippers, receivers, and intermodal terminals in planning more effectively for and regulating the flow of

pick-ups and deliveries; and allow terminal operators to adjust scheduling and yard designs as changes arise.

Route and fleet activities include the load planning of aircraft, trucks, trains, and ships. Load planning is important, because when it is done improperly, it can result in unbalanced vessels and vehicles and create unsafe traveling conditions. A variety of software is available to design the optimal load plan for a vehicle or vessel, basing the ideal configuration of weight, size, and delivery factors.

### *Existing Systems*

There are many types of routing and fleet management systems in use by freight operators. Examples of some of the management systems relating to route and fleet operations focus on: asset location, electronic toll collection, hazmat response, incidents, motor carrier routing and dispatching, railcar routing and dispatching, railroad grade crossing, safety assurance, ship stowage, traffic, traveler information, and weigh station clearance. Specific examples are included in figure 14.

SHIP STOWAGE MANAGEMENT SYSTEMS	
<b>Function:</b>	Plan and track the location of containers aboard ships.
<b>Purpose:</b>	The systems are used to maximize stability, minimize handling during loading and off-loading, position refrigerated containers, and isolate hazardous cargo.
<b>Technology:</b>	The systems use computer models and optimization or expert-system software. Systems typically are linked to booking and terminal inventory management systems.
<b>Examples:</b>	NAVIS, MTLs Vessel Planning System; Realtime Business Solutions' TopX (Terminal Operation Package – Xwindow); August Design GRAIL robotic container-handling facility for Sea-Land Service, Inc.

RAILCAR PLANNING SYSTEMS	
<b>Function:</b>	Provide for the efficient configuration of loads and railcars at railyards for train service.
<b>Purpose:</b>	The systems are used to enhance rail terminal operations by optimizing the use of space; managing containers and equipment; and improving scheduling of loads and deliveries for rail operations
<b>Technology:</b>	The systems computer models and optimization or expert-system software; radio frequency identification devices; GPS receivers for position identification; and mobile inventory vehicles for integrated inventory and equipment location identification. Systems may be linked to booking and gate clearance systems.
<b>Examples:</b>	MTLS Rail Planning System; ALK Associates PC-Rail and locomotive management system; OASIS.

**Figure 14. Existing Route and Fleet Management Systems and ITS Applications**

### MOTOR CARRIER ROUTING AND DISPATCHING SYSTEMS

<b>Function:</b>	Automate the routing and dispatching of trucks.
<b>Purpose:</b>	The systems are used to match drivers, equipment, and loads to pickup and delivery windows; minimize travel time and cost; and schedule maintenance.
<b>Technology:</b>	The systems use scheduling algorithms, geographic information systems, and linear optimization software. The systems often are linked to vehicle location and management systems.
<b>Examples:</b>	ALK Associates PC-Miler (truckload carriers); Rand-McNally MileMaker (Household Goods Carriers' Bureau mileage guide); SABER (general trucking); Descart (local pickup/delivery operations); Emery computer-aided dispatch system; Prophecy LoadExpress Plus.

### ASSET LOCATION AND MANAGEMENT SYSTEMS (LMS)

<b>Function:</b>	Locate and track a vehicle or container.
<b>Purpose:</b>	The systems are used to estimate time of arrival, minimize out of route travel, optimize equipment use, and improve safety and security.
<b>Technology:</b>	Satellite LMS utilize the Global Positioning System (GPS), geostationary satellites, or lower-earth orbit satellites. Ground-based LMS utilize Loran and wireless radio transmitters; dead-reckoning/map-matching computers; or automated equipment identification (AEI) transponders. Some systems are coupled with onboard computers and sensors that monitor vehicle or cargo condition.
<b>Examples:</b>	<p><b>Ship LMS:</b> GPS; U.S. Coast Guard Vessel Traffic System (VTS); Electronic Chart Display and Information System (ECDIS); Portable Communication, Navigation, and Surveillance System (PCNS)</p> <p><b>Railcar LMS:</b> Locomotive ATCS, Amtech railcar AEI tags</p> <p><b>Truck LMS:</b> Qualcomm OmniTracs, HighwayMaster</p> <p><b>Container/Trailer LMS:</b> Orbcomm (untethered trailer system), Qualcomm TrailerTRANS, Savi WideTRAK™</p> <p><b>Chassis LMS:</b> Amtech, Hughes, Mark IV, etc., AEI tags</p>

**Figure 14. Existing Route and Fleet Management Systems and ITS Applications (continued)**

**TRAVELER INFORMATION SYSTEMS  
(ADVANCED TRAVELER INFORMATION SYSTEMS ATIS)**

<b>Function:</b>	Provide real-time information on highway congestion, incidents, construction, and road closures.
<b>Purpose:</b>	The systems are used to provide drivers with information to make trip, time, route choices.
<b>Technology:</b>	The systems use AM/FM radio, variable/changeable message signs, radio frequency probes, highway advisory radio, and Internet web sites. Systems often are linked to onboard location and management systems and motor carrier routing and dispatch systems. Systems typically are linked to traffic management systems.
<b>Examples:</b>	SmartRoutes SmarTraveler (Boston); I-95 Corridor Coalition FleetForward; TRANSCOM travel advisory for New York-New Jersey metropolitan region; Minneapolis-St. Paul Orion Project.

**TRAFFIC MANAGEMENT SYSTEMS (ADVANCED TRAFFIC MANAGEMENT SYSTEMS ATMS;  
FREEWAY TRAFFIC MANAGEMENT SYSTEMS FTMS) AND  
TRAFFIC OPERATIONS CENTERS (TOCs)**

<b>Function:</b>	Improve the management and operations of traffic on freeways, arterial roadways, and local streets.
<b>Purpose:</b>	The systems are used to improve the flow of traffic; reduce congestion; and improve the safety of the road operations.
<b>Technology:</b>	The systems use flow monitoring devices (e.g., vehicle detection loops, closed-circuit television cameras, AVI-equipped probe vehicles), traffic control devices (e.g., traffic-responsive and adaptive traffic signal systems, ramp meters, and transportation network models. Systems typically are linked to traveler information systems.)
<b>Examples:</b>	Montgomery County, MD Advanced Transportation Management System; Houston TranStar; Detroit ATMS/ATIS – Michigan ITS Center (MITSC); Oakland County, MI FAST-TRAC; Milwaukee MONITOR FTMS; Minnesota DOT; Minneapolis-St. Paul Traffic Management Center; Metropolitan Model Deployment Initiative (MMDI) integrated traffic operations and freeway management systems.

**Figure 14. Existing Route and Fleet Management Systems and  
ITS Applications (continued)**

### RAILROAD GRADE CROSSING MANAGEMENT SYSTEMS

<b>Function:</b>	Manage gates and warning systems at railroad grade crossings to improve safety and reduce delays.
<b>Purpose:</b>	The systems are used to provide notice to drivers when a train is approaching and early warning to locomotive engineers when vehicles are blocking a crossing.
<b>Technology:</b>	The systems integrate radar, sound detectors, traffic detector loops, dynamic message signs, and railroad signal control systems. The systems typically are linked to rail and highway traffic operations centers, and can be linked to onboard navigation systems.
<b>Examples:</b>	Connecticut DOT/Amtrak four-quadrant gate system; San Antonio AWARD; Long Island Railroad, NY; Minnesota DOT; Illinois DOT.

### INCIDENT MANAGEMENT SYSTEMS

<b>Function:</b>	Enable transportation and safety officials to quickly and accurately identify a variety of incidents and implement a set of actions to reduce the impact of incidents on traffic.
<b>Purpose:</b>	The systems are used to improve incident detection, response, and clearance and to spread information about an incident to encourage drivers to seek alternate routes and reduce the traffic building in the queue.
<b>Technology:</b>	The systems vary in sophistication and may employ automatic detectors, closed-circuit television, highway advisory radio, variable message signs, computer-aided emergency dispatching, as well as special service patrols and cellular phones and road-side callboxes. The New York City and Houston systems use vehicles equipped with radio-frequency transponders (for electronic toll collection) as probes to measure the flow of traffic and identify congestion caused by incidents.
<b>Examples:</b>	Earliest incident management programs were in major cities such as Los Angeles and Chicago. Today, at least 15 states and 30 metropolitan areas have incident management programs.

**Figure 14. Existing Route and Fleet Management Systems and ITS Applications (continued)**

### HAZARDOUS MATERIALS (HAZMAT) RESPONSE SYSTEMS

<b>Function:</b>	Provide information to emergency response personnel at the scene of an accident about the contents of a hazmat load.
<b>Purpose:</b>	The systems are used to improve incident response for hazardous materials and reduce the impact of incidents involving hazardous materials on traffic flow and safe operating conditions.
<b>Technology:</b>	The systems include information systems and communications linkages, automatic equipment identification, automatic vehicle location, automated route guidance, and mayday signaling.
<b>Examples:</b>	Operation Respond; Tranzit Xpress; ALK Associates PC HazRoute.

### ELECTRONIC TOLL COLLECTION SYSTEMS

<b>Function:</b>	Enable the electronic payment of highway, bridge, and tunnel tolls.
<b>Purpose:</b>	The systems are used to expedite throughput, minimize queuing and delays, improve travel time and fuel consumption, and reduce congestion and the risk of accidents at toll barriers.
<b>Technology:</b>	The systems use radio-frequency identification transponders and transaction processing software.
<b>Examples:</b>	Metropolitan New York, New Jersey, and Pennsylvania EZ-Pass; Oklahoma PikePass; Massachusetts Turnpike FAST LANE; Florida Turnpike SunPass; Illinois Tri-State Tollway; Dallas North Tollway; San Francisco Golden Gate Bridge; New Orleans' Crescent City Connection and Lake Pontchartrain Causeway; private toll roads in California.

**Figure 14. Existing Route and Fleet Management Systems and ITS Applications (continued)**

WEIGH STATION CLEARANCE SYSTEMS	
<b>Function:</b>	Enable commercial vehicles to avoid stops at weigh stations.
<b>Purpose:</b>	The systems are used to increase throughput, minimize queuing and delays, focus enforcement resources on noncompliant motor carriers, and reduce safety hazards associated with queuing and trucks entering and exiting weigh stations.
<b>Technology:</b>	The systems use technologies including weigh-in-motion (WIM), dedicated short-range communications (DSRC), onboard or roadside electronic displays and/or optical character recognition (OCR), and locally maintained or networked information databases. WIM systems may weigh vehicles traveling at high speeds (installation on the mainline of the highway) or low speeds (installation on the approach ramp to the facility).
<b>Examples:</b>	Advantage CVO (formerly, Advantage I-75); HELP PrePass; Oregon Green Light; Multi-State Automated Preclearance System (MAPS); AVION System, Ontario, Canada.

SAFETY ASSURANCE SYSTEMS	
<b>Function:</b>	Provide information on the safety history and performance of motor carriers and drivers.
<b>Purpose:</b>	The systems are used to select vehicles and drivers for inspections with the result that resources are focussed on high-risk carriers and drivers, and to enhance enforcement's ability to monitor the en route safety status of the vehicle and driver.
<b>Technology:</b>	The systems use information management and communication technologies. The systems may be linked to weigh station clearance systems.
<b>Examples:</b>	U.S. DOT information systems SAFER (Safety and Fitness Electronic Records), MCMIS (Motor Carrier Management Information System), and CDLIS (Commercial Driver License Information System); and ASPEN software program for automated safety inspections.

**Figure 14. Existing Route and Fleet Management Systems and ITS Applications (continued)**

#### *Support Operational Tests*

There are many intermodal operational tests that would improve route and fleet activities and better link these activities to other events in the intermodal system. Some examples of potential operational tests include:

- Terminal inbound flow management;
- Incident avoidance;
- At-grade rail crossing advance notification; and
- Intermodal hazmat incident response.

#### Terminal Inbound Flow Management

The objective of this operational test concept is to improve the management of inbound truck and container traffic at terminals by using information on expected inbound volumes and arrival times to distribute the arrivals. The concept seeks to address the heavy inbound traffic at terminals that can exceed processing capacity, resulting in queues that may extend onto access roads, delays, and high peak-period operating costs for the terminal.

The test concept would operate in the following manner: regional electronic toll collection and weigh station clearance systems identify passing trucks and mark their location and time. The observation is forwarded on to terminal operators who use the information to anticipate truck arrivals, preplan gate activities, and communicate with motor carrier dispatchers to schedule arrival times. A third-party facilitator could manage the location data for the terminal operators.

To implement the system, operators would link electronic toll collection and weigh station clearance systems with the terminal gate clearance system and motor carrier routing and dispatching systems. The system could include several of the following components:

- Electronic toll collection system that enables the electronic payment of highway, bridge, and tunnel tolls;
- Weigh station clearance system that enables commercial vehicles to avoid stops at weigh stations;
- Gate clearance system that automates the verification and inspection of drivers, trucks, and containers; and
- Motor carrier routing and dispatching system that automates the routing and dispatching of trucks.

#### Incident Avoidance

The objective of the incident avoidance operational test is to provide motor carriers that transport intermodal loads with real-time information on incidents, congestion, construction, and other traffic conditions that will enable them to optimize their routing and dispatching to intermodal facilities and avoid incidents and other delays. This operational test seeks to address the substantial costs incurred by intermodal carriers as a result of delays due to problematic traffic conditions.

Regional or corridor incident management system and/or traffic management system has information on incidents, congestion, and other traffic conditions which the traveler information system passes to the motor carrier routing and dispatching system. The routing and dispatching system uses the information to select alternate routes or adjust dispatching to avoid incidents and other delays to intermodal traffic.



The approach suggested to implement this system is to link corridor incident management systems and/or traffic management systems and corridor traveler information systems with motor carrier routing and dispatching systems. An incident avoidance system should link the following systems:

- Incident management system that detects an incident and implements incident response and clearance;
- Traffic management system that detects and monitors traffic conditions;
- Traveler information system that provides real-time information on traffic conditions; and
- Motor carrier routing and dispatching system that automates the routing and dispatching of trucks and provides arrival and delivery notification to the additional intermodal carriers involved in the transport.

#### At-Grade Rail Crossing Advance Notification

The objective of the operational test concept for at-grade rail crossing advance notification is to enable vehicles to avoid delays at at-grade highway/railroad crossings to intermodal carriers by providing advance notification of train arrivals. It seeks to address the significant delays at railroad grade crossings that motor carriers experience which delay the expeditious movement of intermodal cargo.

Implementing the system would require linkages among three systems:

- Railroad grade crossing management system that detects an approaching train;
- Traveler information system that provides real-time information on traffic conditions; and
- Motor carrier routing and dispatching system that automates the routing and dispatching of trucks and provides arrival and delivery notification to the additional intermodal carriers involved in the transport.

A railroad grade crossing management system would provide information on an approaching train to the corridor traveler information system. The traveler information system passes the notification to the motor carrier routing and dispatching system for use in diverting trucks transporting intermodal freight to alternate routes and avoiding delays.

#### Intermodal Hazmat Incident Response

The objective of the operational test concept addressing intermodal hazardous material (hazmat) incident response is to improve the response to incidents which involve the intermodal shipment of hazardous materials. This operational test will address the need for a timely and effective hazmat incident response and the problems incurred by responders who cannot identify what is involved in a crash or spill.

Hazardous materials containers are identified and tracked end-to-end. Container identity, response instructions, contact phone numbers, and location information supplied to hazardous materials response and incident management systems would facilitate hazmat incident response and clearance. A system for posting hazmat information to a site in an electronic network where emergency responders can quickly access needed information has been demonstrated.

To implement this system, a ship stowage management system, terminal inventory management system, and location and management system with hazardous materials response and incident management systems would be linked in the following manner:

- Ship stowage management system that plans and tracks the location of containers aboard ships;
- Terminal inventory management system that tracks and manages the movement of containers within the terminal;
- Location and management system that locates and tracks a vehicle or container;
- Hazardous materials response system that provides identifying information on hazmat loads; and
- Incident management system that detects an incident and implements incident response and clearance.

## Shipment Tracing and Management

### *Definition*

These recommendations address the productivity and efficiency of shipment information and documentation moving from shipper to receiver. The opportunities to advance IT and ITS technologies in this area fall primarily within the domain of the private sector; however, the public sector should encourage and facilitate the application of IT and ITS to improve the use of shipment information. Opportunities to further improve the efficiency and security of shipment information rely upon improved cargo visibility, communications, and proper sharing of information about shipments and their movements across modes.

### *Existing Systems*

There are several types of shipment information systems and security systems being used by freight operators. Some examples are included in figure 15.

SHIPMENT INFORMATION SYSTEMS	
<b>Function:</b>	Manage the flow of materials and products from source to user.
<b>Purpose:</b>	The systems are used to optimize the visibility and control of goods (and their conveyances – containers, trucks, ships, etc.) through a logistics system. Integrated or extended supply chain systems may link suppliers, manufacturers, carriers, distributors, retailers/customers, and consumers/end users.
<b>Technology:</b>	The systems use information management and communications technologies.
<b>Examples:</b>	Ryder Integrated/Logistics i2 Technologies; Federal Express interNetShip; UPS on-line tracking system; Tie Logistics COMMAND®; ALK Associates E-tracker™; DHL Worldwide Package Tracking; Manna Freight's Freight Tracker.

**Figure 15. Existing Shipment Information Systems and ITS Applications**

SECURITY SYSTEMS	
<b>Function:</b>	Monitor the condition of vehicles, containers, and goods during shipment or in storage at terminals.
<b>Purpose:</b>	The systems are used to prevent theft and vandalism of trucks, chassis, containers, and freight.
<b>Technology:</b>	Most systems use sensors coupled to radio frequency transponders, onboard vehicle communication systems, or video surveillance systems. Systems typically are linked to vehicle location and management systems or terminal inventory management systems.
<b>Examples:</b>	Qualcomm TrailerTRACS®; Savi InsideTRAK™; Maher Terminals Logistics System, Inc. (MTLS) Electronic Security Processing System.

**Figure 15. Existing Shipment Information Systems and ITS Applications (continued)**

#### *Support Operational Tests*

The private sector will lead efforts to demonstrate the value of IT and ITS in the areas of shipment information and security systems. However, public support of an operational test in this area should focus on security because of the clear public interest in the security of commercial and military cargo.

#### Security of Intermodal Shipments and Assets

The objective of this operational test concept is to improve the security of goods and assets in-transit. This test seeks to address problems of theft and vandalism of vehicles, containers, and goods as theft and cargo crime have reached critical proportions.

A security system for intermodal shipments and assets would link onboard trailer and container security systems with terminal inventory management system, location and management system, and traffic management system/traffic operations center. The systems' functions include:

- Onboard trailer and container security systems that monitor the condition of vehicles and containers;
- Terminal inventory management system that tracks and manages the movement of containers within the terminal;
- Location and management system that locates and tracks a vehicle or container; and
- Traffic management system/traffic operations center that enables communication with law enforcement agencies (e.g., state police or highway patrol) for dispatching of emergency services.

The sensors on the containers monitor their condition. If a container is disturbed or vandalized in the terminal yard, the sensor system alerts the terminal operator. If a container is in-transit, the sensor sends a signal to the motor carrier location and management system, which notifies law enforcement agency dispatchers co-located or networked with the traffic management system/traffic operations center.

## SUMMARY

This section makes recommendations for the U.S. DOT National ITS/Intermodal Freight Program. The recommended program activities fall into the three areas: business strategy, information technology, and intermodal operations.

The business strategy recommendations include:

- Improving the coordination of Federal intermodal freight-related activities. Such initiatives include strengthening and empowering the U.S. DOT ITS/Intermodal Freight Steering Group and supporting the work of other Federal agencies to streamline trade regulations and processes;
- Supporting emerging public-private partnerships, intermodal freight technology forums, and technical working groups at local, regional, national, and international levels; and
- Developing educational and training initiatives focused on the application of ITS to intermodal freight operations.

The information technology recommendations include:

- Assisting the private sector in exploring the need for and determining the scope of an ITS intermodal architecture and ITS standards; and
- Promoting the use of interoperable technologies through demonstration projects, the development of compatible intermodal technologies, and leveraging of existing public and private sector applications of freight and vehicle identification technologies.

The intermodal operations recommendations propose conducting intermodal technology operational tests. The U.S. DOT should solicit and fund proposals for ITS/intermodal freight operational tests to improve shipment tracing and management, reduce congestion at gates and terminals, and improve route and fleet management.

## Appendix A

# ITS/Intermodal Freight Literature

### KEY PERIODICALS AND WEB SITES

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American Association of Railroads, [www.aar.org](http://www.aar.org)

American Shipper, [www.tradecompass.com](http://www.tradecompass.com)

American Trucking Associations, [www.truckline.com](http://www.truckline.com)

Fleet Owner, [www.fleetowner.com](http://www.fleetowner.com)

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Intermodal Association of North America, [www.intermodal.org](http://www.intermodal.org)

International Trade Data System, [www.itds.treas.gov](http://www.itds.treas.gov)

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## **Appendix B**

# **U.S. DOT ITS/Intermodal Steering Group Participants**

### **OFFICE OF INTERMODALISM**

Richard Biter, Deputy Director of the Office of Intermodalism, and Chair of the ITS/Intermodal Freight Steering Group

M.J. Fiocco, Transportation Specialist, Freight

Chip Wood, Associate Deputy Director

### **OTHER MEMBERSHIP**

#### **Federal Railroad Administration**

Steve Ditmeyer, Director, Office of Research and Development

Joel Palley, Industry Economist, Office of Policy and Program Development

#### **Federal Highway Administration**

Harry Caldwell, Senior Transportation Specialist, Office of Policy

Lee Chimini, Transportation Specialist, Office of Freight, Management, and Operations

Steve Crane, Chief, ITS/CVO Division, Office of Motor Carriers

Michael Curtis, Chief of the Information Division, Office of Motor Carrier Information Analysis

Michael Freitas, Chief, CVO and Rural ITS, ITS Research Division

Lee Jackson, International Border Crossing Manager, Office of Motor Carriers

Gary Maring, Director, Office of Freight, Management, and Operations

Stefan Natzke, Community Planner, Office of Environment and Planning

George Schoener, Division Chief, Intermodal and Statewide Programs, Office of Environment and Planning

Douglas McKelvey, CVISN Program Manager, ITS/CVO Division, Office of Motor Carriers

## **ITS/Joint Program Office**

Michael Onder, ITS Program Director, and original convener of the ITS/intermodal Freight Steering Group

Jeff Paniati, Deputy Director

## **Maritime Administration**

William Aird, Program Manager, Office of Ports and Domestic Shipping

Doris Bautch, Chief, Division of Ports, Office of Ports and Domestic Shipping

Maggie Blum, Associate Administrator for Port, Intermodal, and Environmental Activities

Robert Bouchard, Office of Intermodal Development

Kathleen Dunn, Program Manager, Office of Intermodal Development

Richard Walker, Director, Office of Intermodal Development

## **Research and Special Programs Administration**

Jennifer Antonielli, Physical Science Specialist, Office of Hazardous Materials Standards

Fenton Carey, Associate Administrator, Office of the Associate Administrator for Research, Technology and Analysis

Rita Freeman-Kelly, International Science and Technology Engineer

## **Volpe National Transportation Systems Center**

Anne Aylward, Senior Associate

Edith Boyden, Chief, Office of Plans

## Appendix C

# Intermodal Freight Flows

The purpose of this appendix is to:

- Map the movement of freight; and
- Show how intermodal freight movement is both dependent on and complicated by the information exchange accompanying it.

In Section 1, three examples of intermodal freight moving from shippers to receivers by multiple carriers through intermodal transfer points were presented. In the diagrams that follow in this section, figures C-1, C-3, and C-5, a portion of each trip is highlighted. The diagram that follows each intermodal movement describes the highlighted portion of the trip for both the physical movement of the freight, as well as the flow of information that accompanies the freight movement. These diagrams or “road maps” are meant to be illustrative of the complex information flows associated with intermodal movements and how the informational requirements can impede the efficient flow of intermodal freight. They are only illustrative, and cannot apply to all or even most intermodal moves as the level of technological sophistication and notification systems vary greatly by carrier.

The three examples include intermodal marine, intermodal rail, and intermodal air freight movements. The following sections describe these movements in detail.

### INTERMODAL MARINE

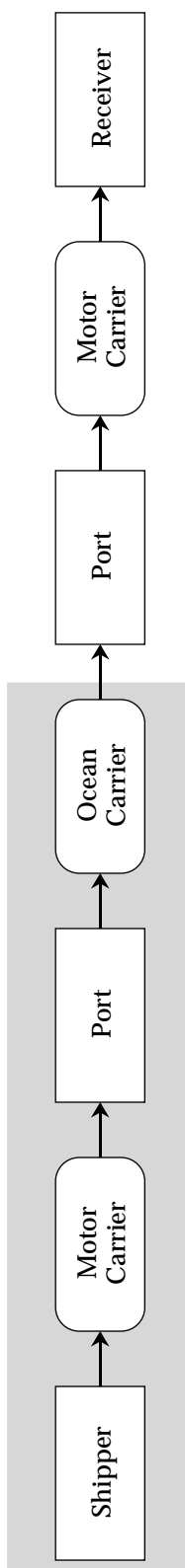
Figures C-1 and C-2 depict the intermodal movement of freight from a motor carrier to an ocean carrier. The left side of figure C-2 depicts the physical freight movement. The right side of the diagram depicts the information flows that occur in parallel with the physical movement of the cargo.

#### Physical Freight Flow

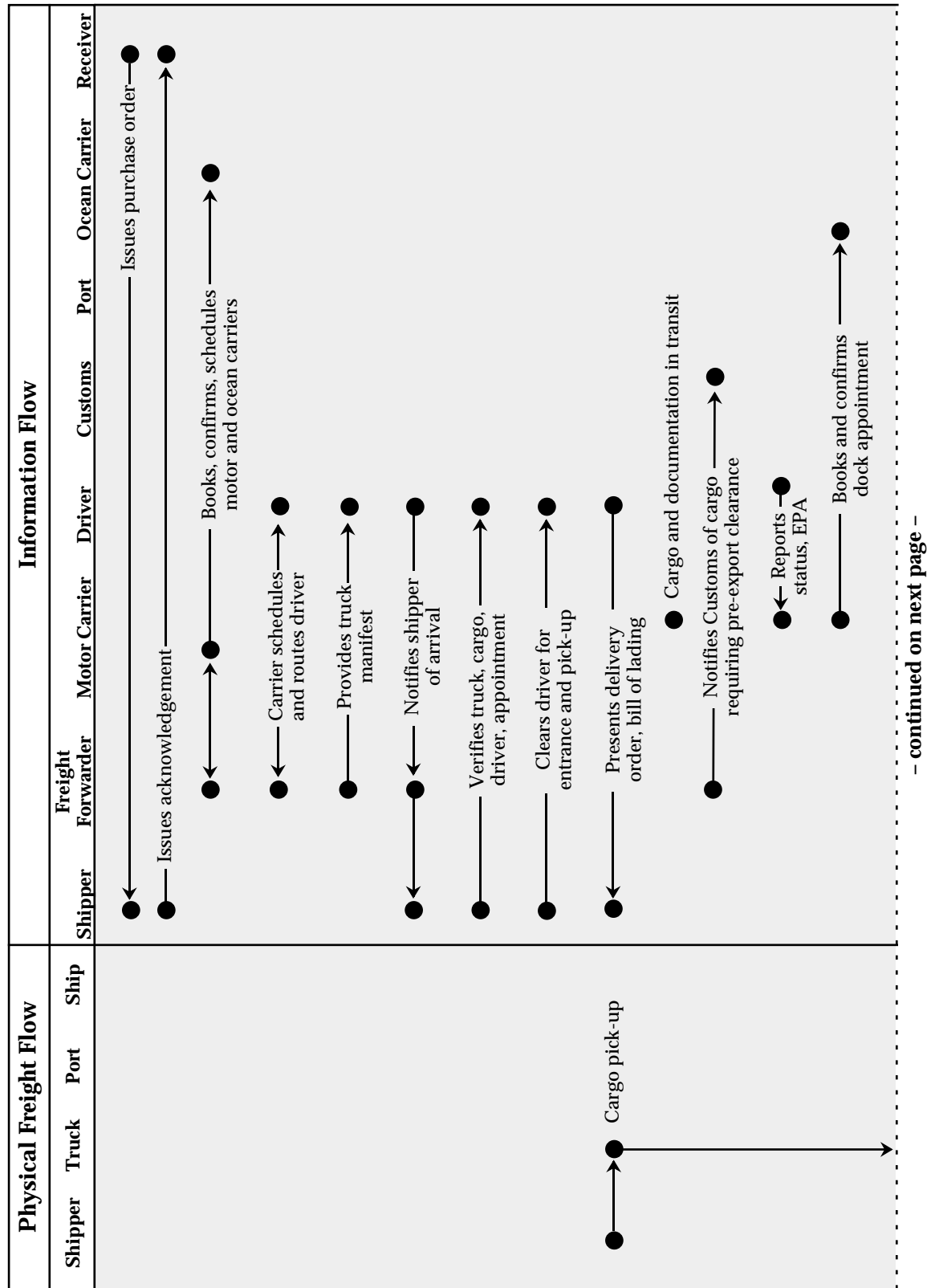
The intermodal movement begins with the shipper. A motor carrier picks up the cargo, and transports it to a seaport where it is unloaded. The cargo is transferred to the ocean carrier and is loaded onto a ship; the ship sails for an overseas port near to the shipment’s final destination.

#### Information Flow

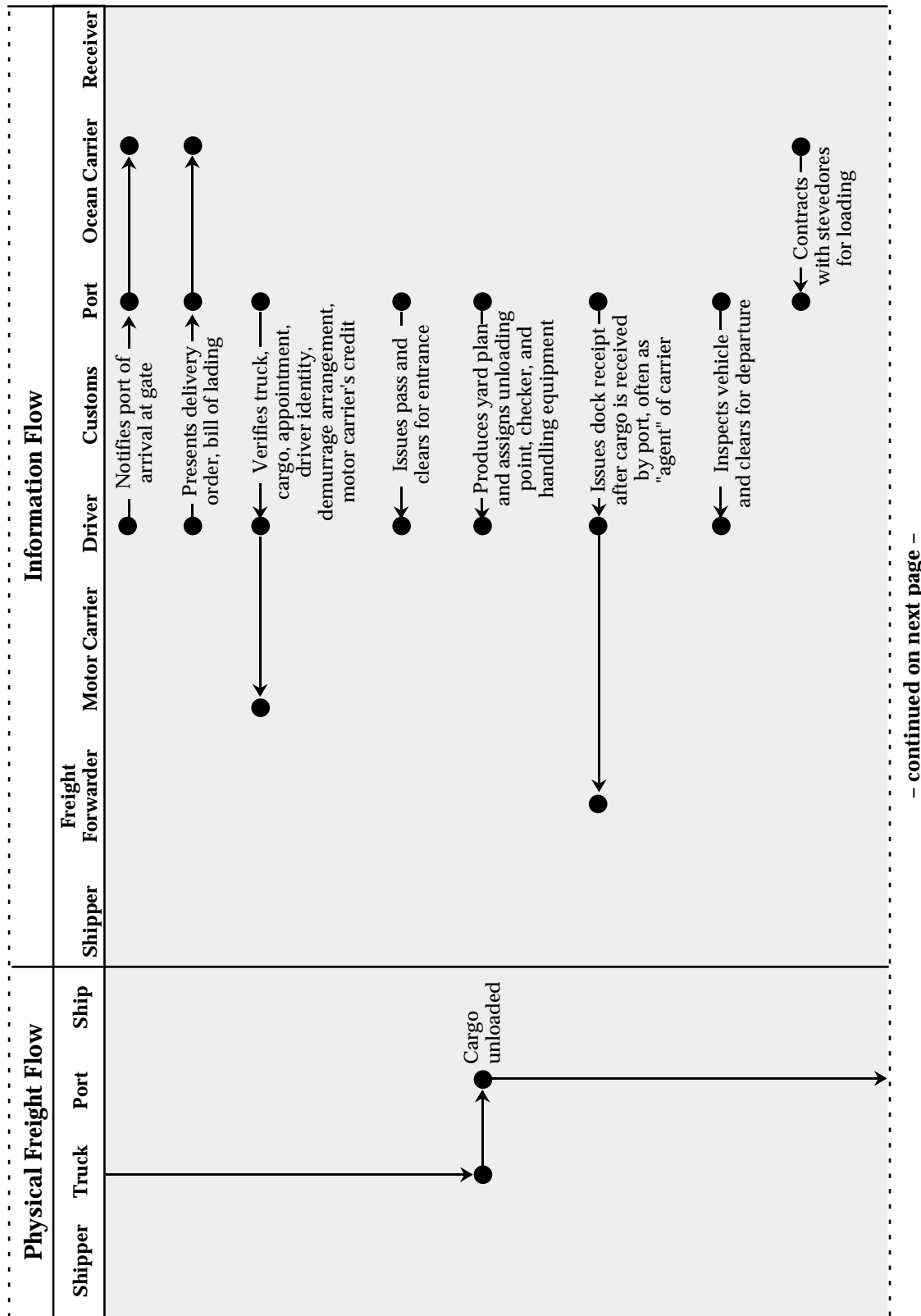
The receiver issues a purchase order for the cargo, and the receiver acknowledges it. The shipper books the motor and ocean carriers to transport the goods that were ordered. To make scheduling and routing decisions, the carriers must consider factors such as staff availability,



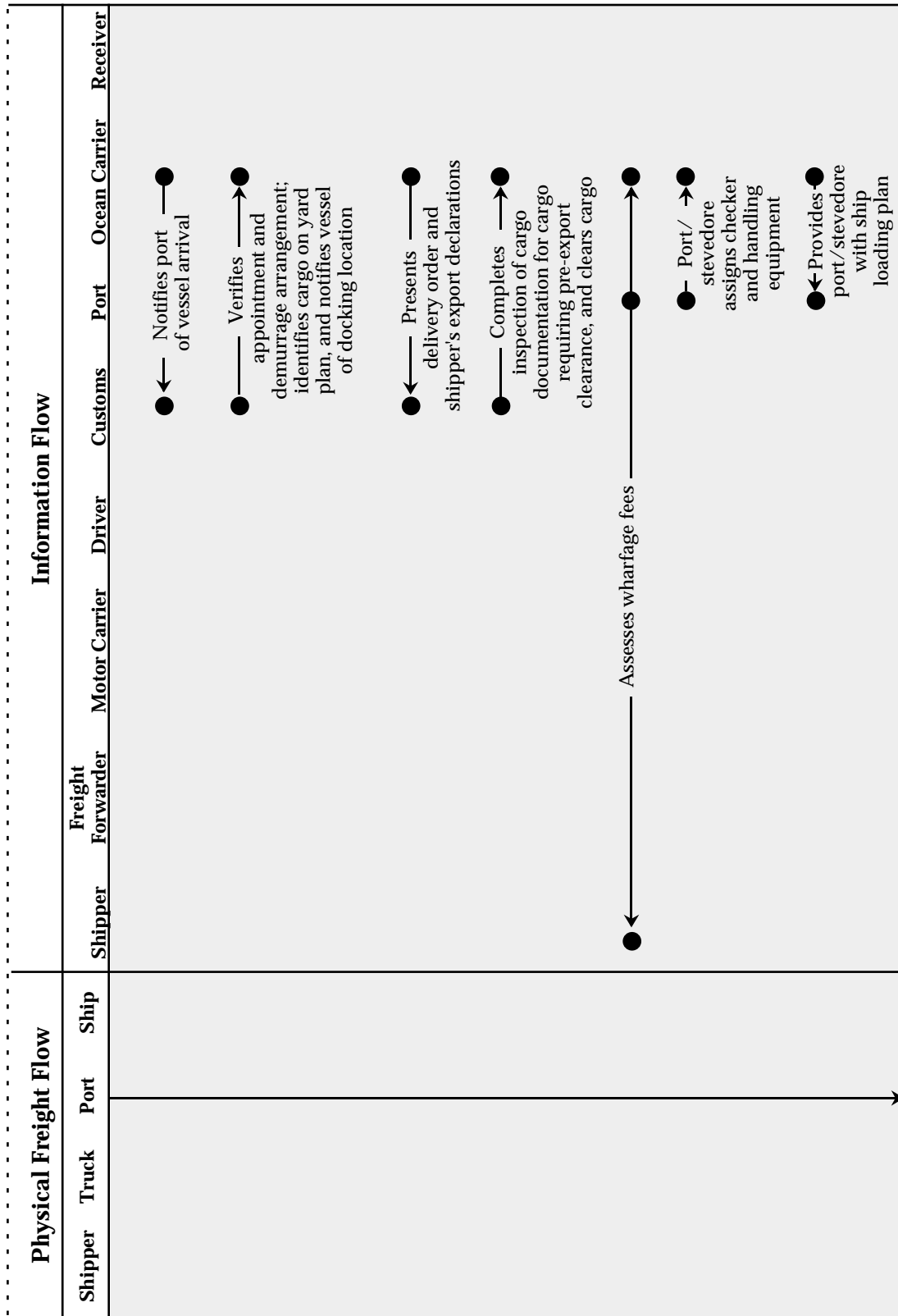
**Figure C-1. Typical International Truck-Marine Intermodal Movement**



### Figure C-2. Typical International Truck-Marine Intermodal Movement



**Figure C-2. Typical International Truck-Marine Intermodal Movement (continued)**



– continued on next page –

Figure C-2. Typical International Truck-Marine Intermodal Movement (continued)

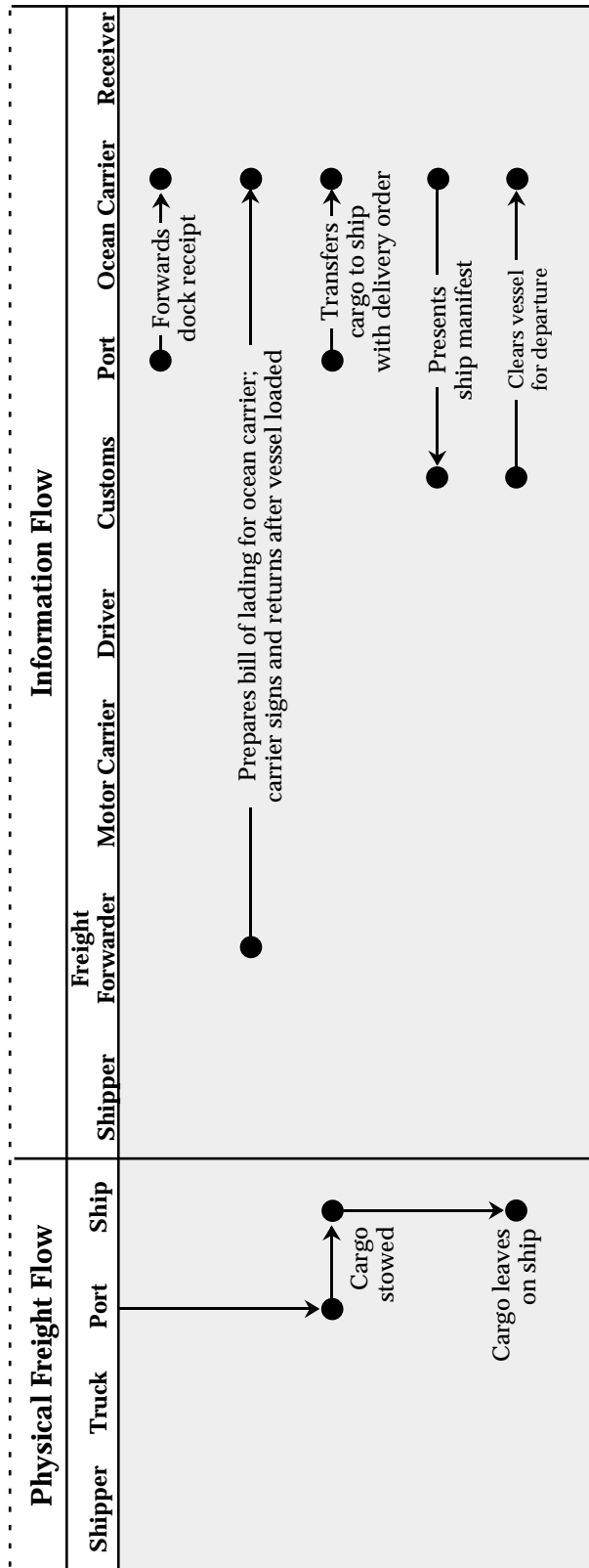


Figure C-2. Typical International Truck-Marine Intermodal Movement (continued)



road and ocean conditions, and weather. All these exchanges of information happen before any vehicle or vessel movement occurs.

On the day that the shipment's trip is scheduled to begin, the truck arrives at the shipper's warehouse to pick up the cargo. In some cases, there is no advance notification available to the shipper as to the time of day the truck will arrive, nor is there real-time information for cases of delays or changes. The truck driver presents documentation to the shipper, including the delivery order and identification to prove that the driver is the party responsible for transporting the goods to the port. The documentation usually is paper-based, but should be supplemented with some electronic information as well. The shipper verifies the information to the best of its ability. The driver is cleared for entrance and pick up of the cargo.

Most of the documentation is transported with the cargo to its next destination, the port. Notification of arrival usually occurs at the gate, with no advanced notification or real-time information available to help the port to prepare for the truck's arrival. Documents provided by the driver regarding the motor carrier, the cargo, and the delivery are presented at the gate for verification. In addition, the port also reviews the carrier's dock appointment and credit arrangement. The port reviews its yard plan, assigns an unloading point and equipment to the motor carrier, and clears the driver for entrance to the port. The cargo is unloaded and the documentation is passed on to the port or ocean carrier. The truck is inspected as it leaves, and is cleared to exit the port facility.

The ocean carrier has made arrangements in advance for docking the ship and loading the freight. The cargo is reloaded from the port facility onto the vessel according to the ocean carrier's ship loading plan. Documentation, often paper-based, includes the dock receipt, delivery order, and bill of lading, and is forwarded with the cargo to its next destination.

At the destination port, similar information exchanges and notifications occur to move the cargo to its final destination. Specific processes depend on the regulations and infrastructure that exist in the destination country.

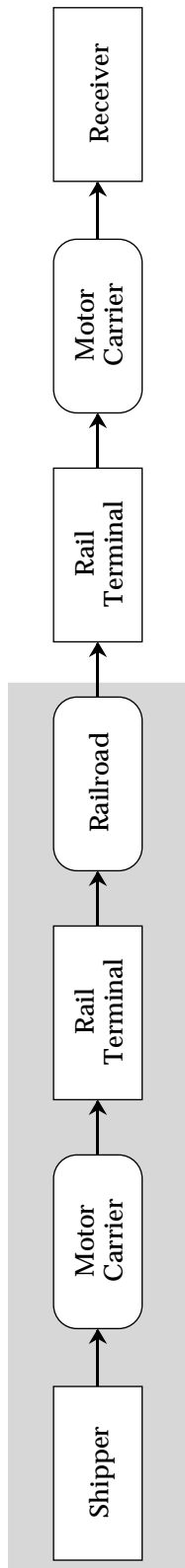
Invoicing and payment occur after the transportation services are complete and usually after the shipment has been delivered to the receiver. Invoicing of the freight forwarder or the receiver by carriers may be paper-based, can involve several carriers, and may occur long after the shipment has arrived at its final destination. Currently, few payments are made electronically.

## **INTERMODAL RAIL**

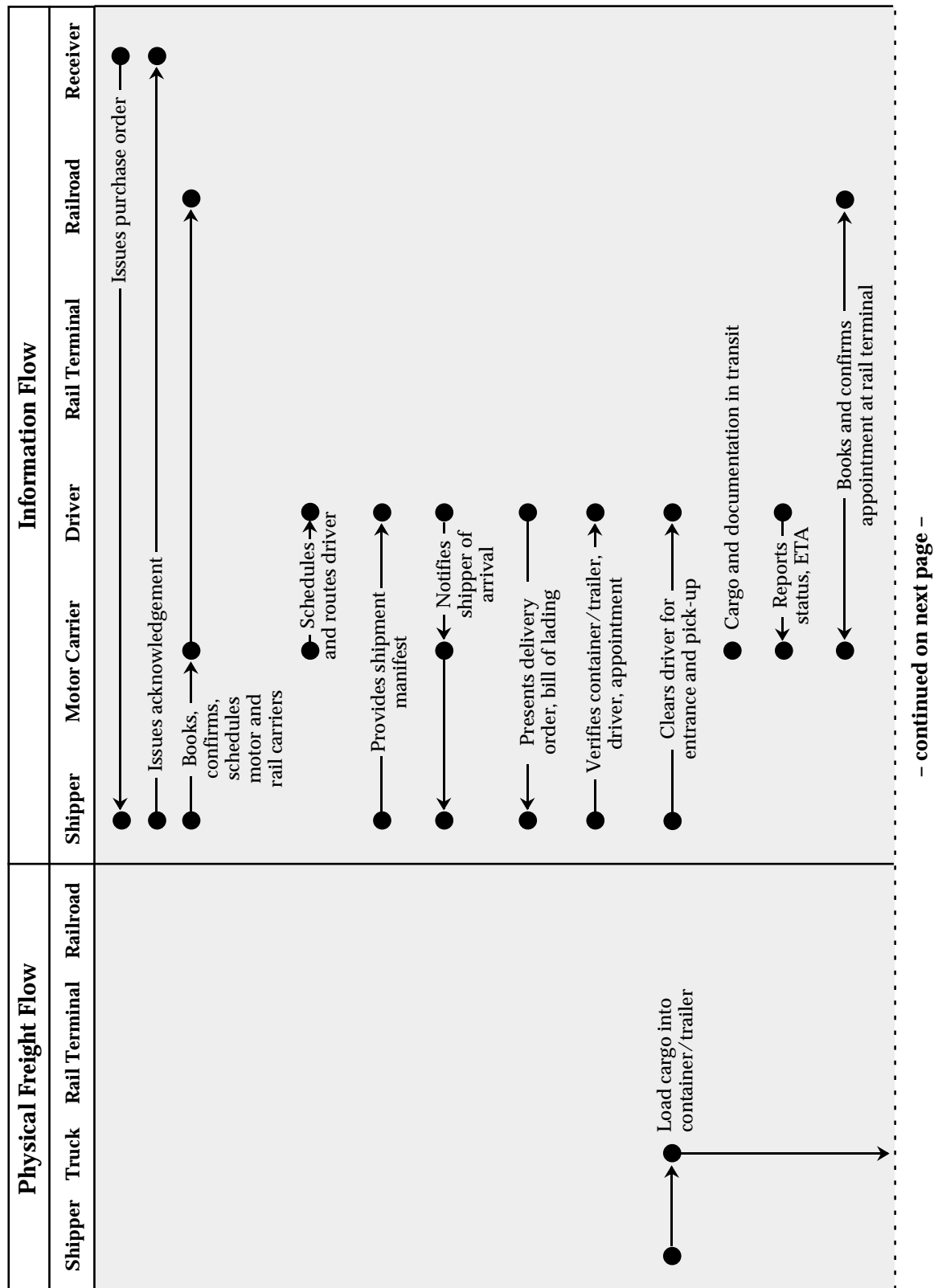
Figures C-3 and C-4 depict the intermodal movement of freight from a motor carrier to a railroad.

### **Physical Freight Flow**

The intermodal movement begins with the shipper. The motor carrier picks up the cargo and loads it into a container or chassis or trailer. The motor carrier transports it to a rail terminal where the cargo is transferred to the railroad terminal and stored until it is loaded onto a train for transport to a rail terminal near the shipment's final destination. The shipment is unloaded from the train at the rail terminal and is transported by a motor carrier to the receiver.



**Figure C-3. Typical Domestic Truck-Rail Intermodal Movement**



### Figure C-4. Typical Domestic Truck-Rail Intermodal Movement

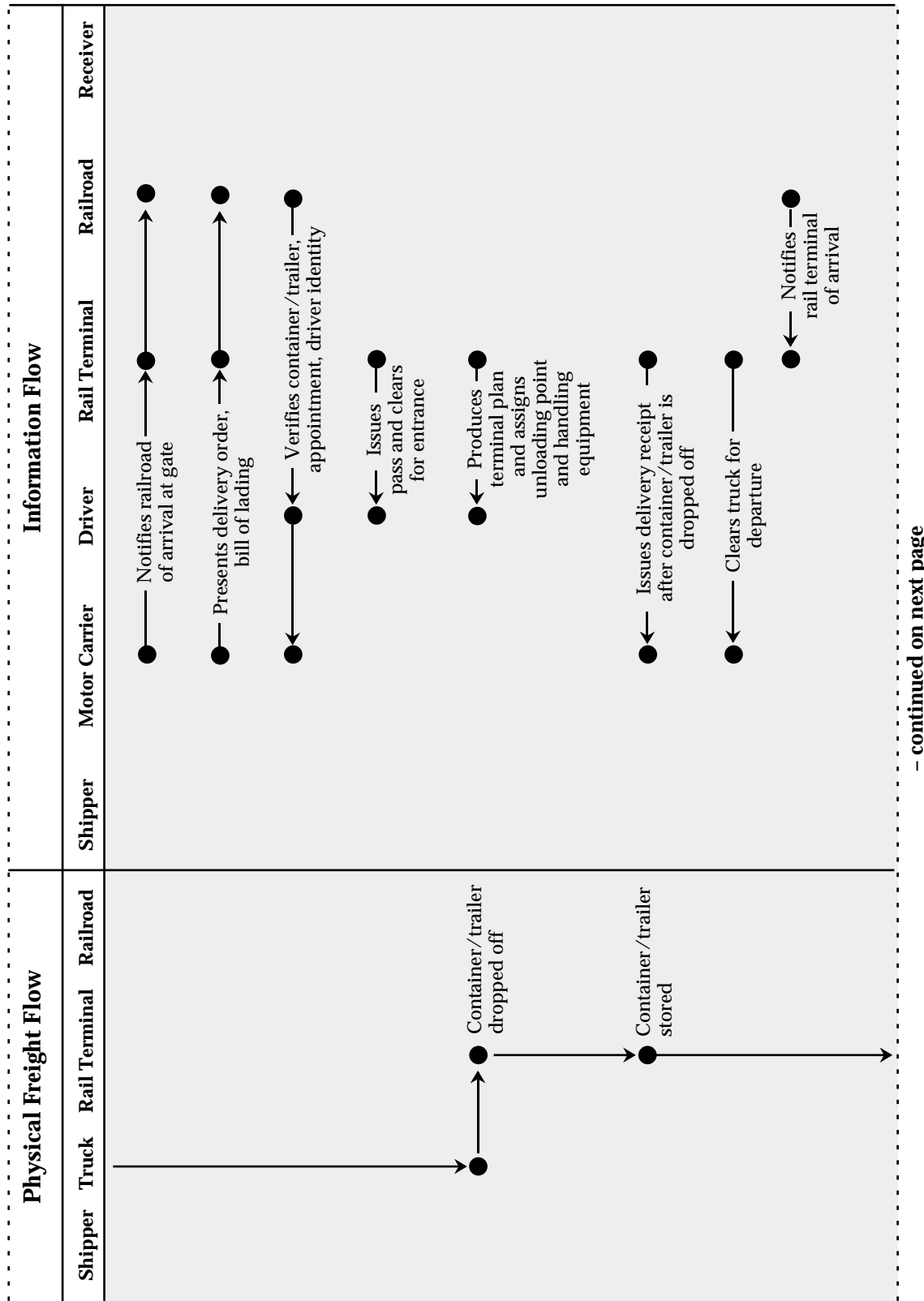
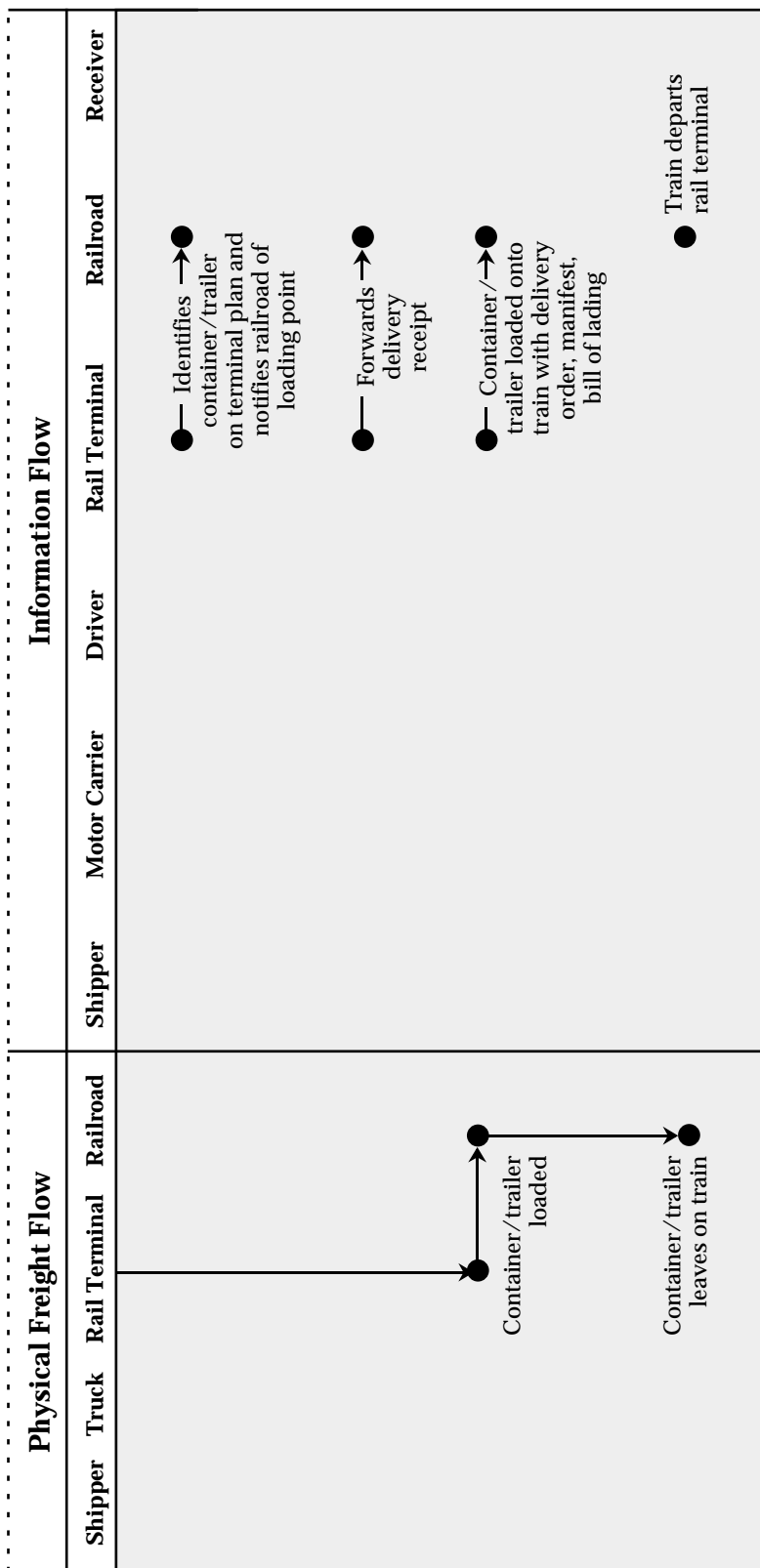


Figure C-4. Typical Domestic Truck-Rail Intermodal Movement (continued)



**Figure C-4. Typical Domestic Truck-Rail Intermodal Movement (continued)**

## **Information Flow**

The information flow begins when the receiver issues a purchase order for the cargo, and the receiver acknowledges it. The shipper books the motor and rail carriers to transport the goods that were ordered. The carriers make the necessary scheduling and routing decisions required for the trip.

The initial movement of the cargo begins with shipper and the motor carrier. The information exchange for the shipper and the motor carrier are the same as in the description provided for intermodal marine movement. As mentioned before, there may be little advance notification or electronic exchange of information.

The motor carrier transports the container and its associated documentation to the rail terminal. The railroad is notified of the motor carrier's arrival at the gate, and usually has no advance notification or real-time information available to help the railroad prepare for the truck's arrival. The railroad goes through a review of the freight and documentation similar to that described for the intermodal marine movement. Once the motor carrier is cleared for entry, the rail terminal produces a terminal or yard plan, assigns an unloading point and equipment to the motor carrier, and allows the driver to enter the facility. The cargo is unloaded and the documentation is passed on to the railroad. The truck is inspected as it leaves, and is cleared to exit.

The container is loaded onto a train along with the delivery order, train manifest, and a bill of lading. The documentation may be paper-based and is forwarded with the container to the next rail terminal. The current standard of tagging all rail cars allows tracking of rail shipments as they pass readers along the rail lines.

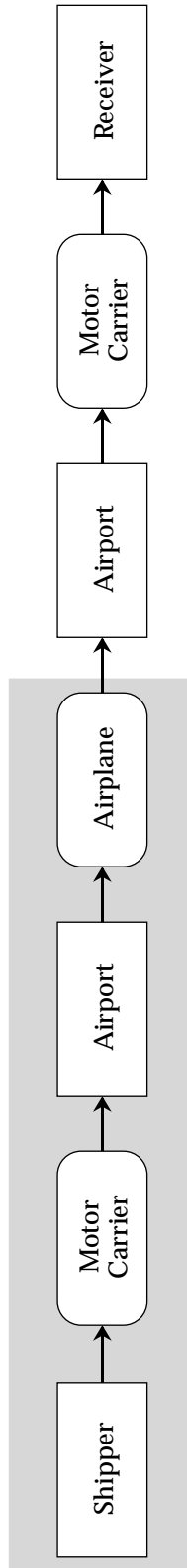
At the destination rail terminal, the documentation is transferred to the motor carrier who transports the cargo and the paperwork to its final destination. Invoicing and payment is the same as for the intermodal marine movement.

## **INTERMODAL AIR**

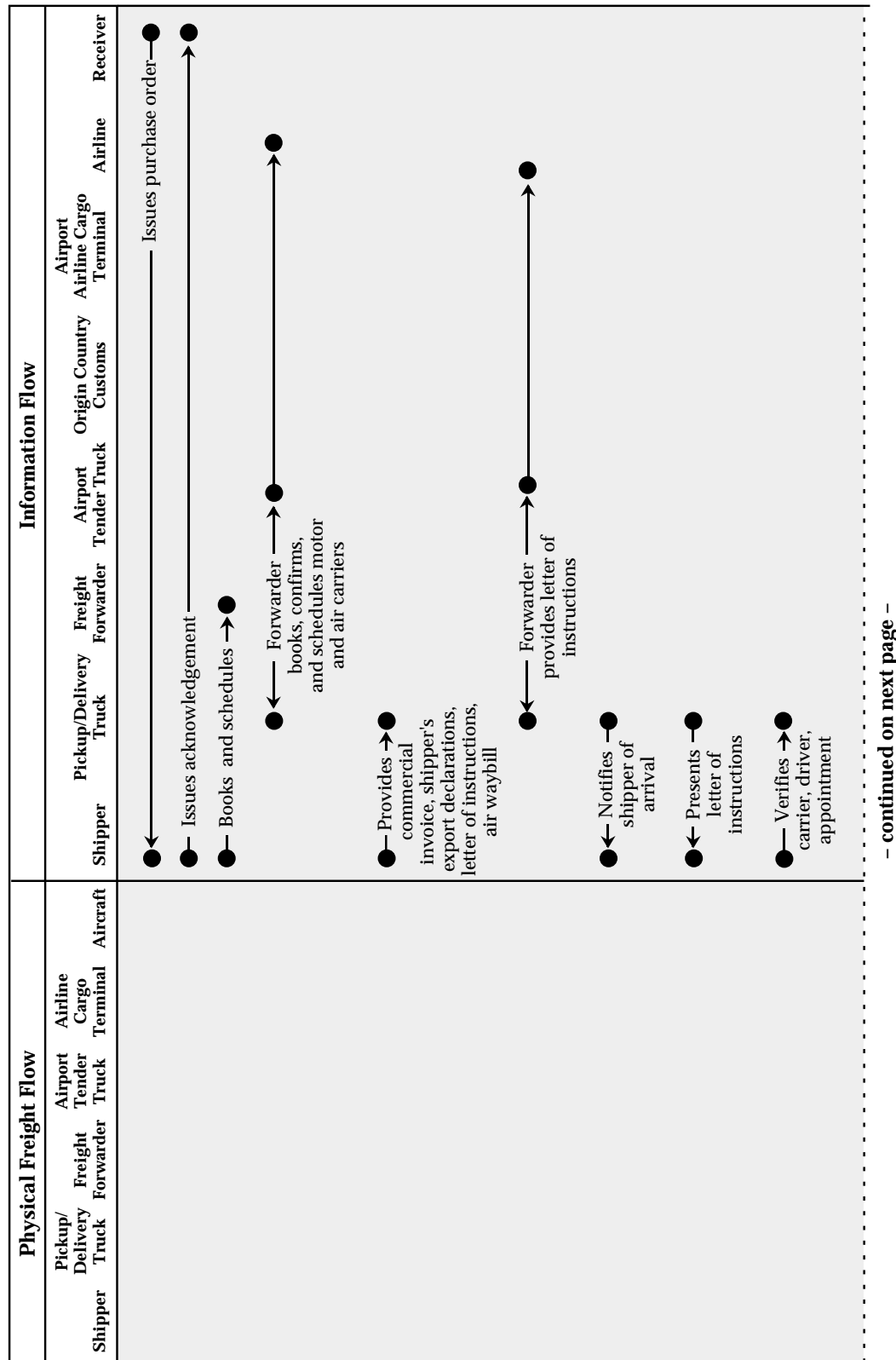
Figures C-5 and C-6 depict the intermodal movement of freight from a motor carrier to an air cargo carrier.

### **Physical Freight Flow**

The intermodal movement begins with the shipper. A pick-up and delivery truck transports the cargo to the shipper's freight forwarder. The freight forwarder repackages the freight and loads it onto an airport tender truck. The tender truck transports the cargo to the airport's airline cargo terminal where the cargo is unloaded and transferred to the airline. The cargo is loaded onto the aircraft, which flies the cargo to an airport close to the shipment's final destination. The cargo is unloaded from the aircraft at the foreign airport and delivered by a motor carrier to the receiver.

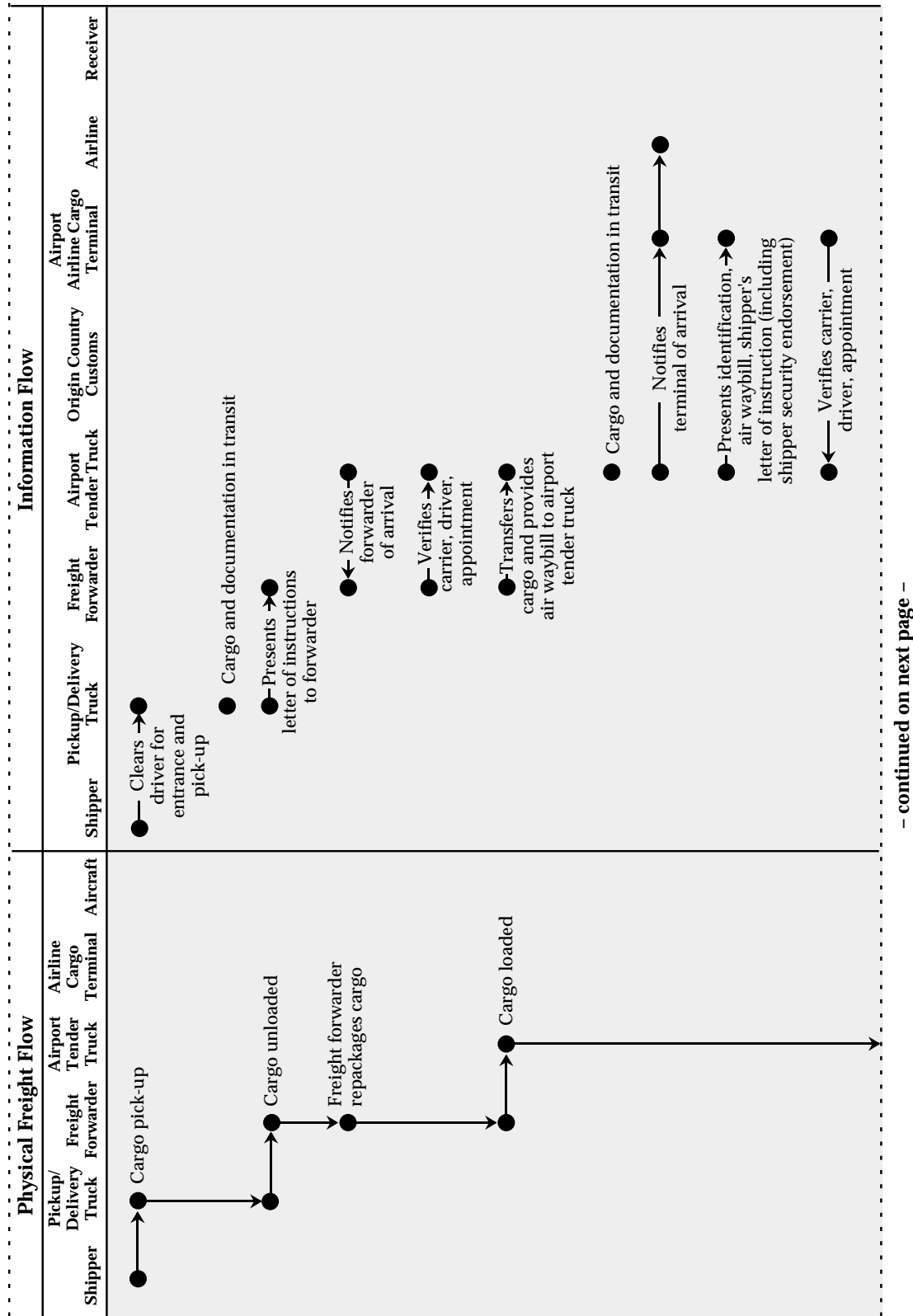


**Figure C-5. Typical International Truck-Air Intermodal Movement**



**Figure C-6. Typical International Truck-Air Intermodal Movement**





**Figure C-6. Typical International Truck-Air Intermodal Movement (continued)**

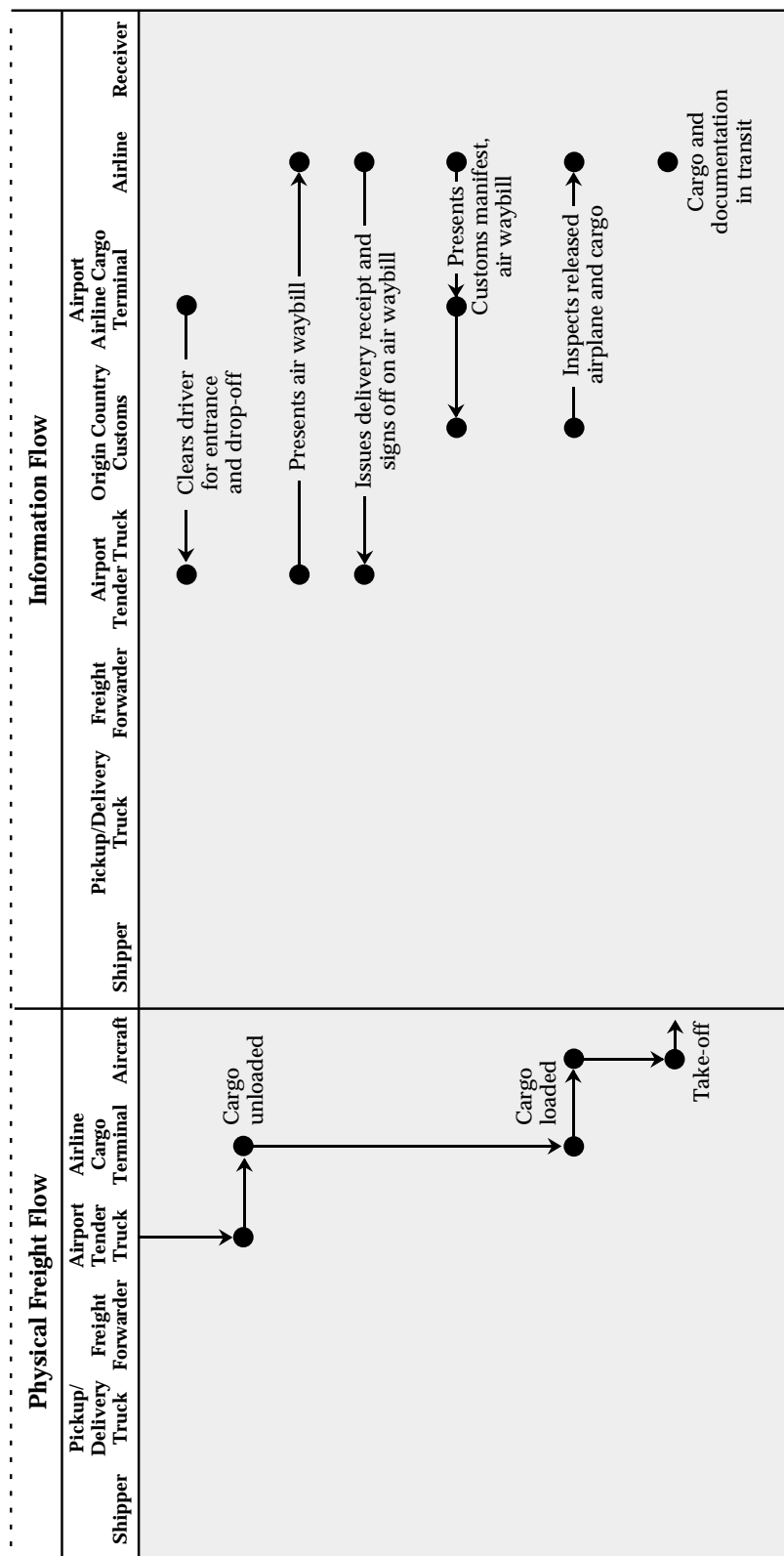


Figure C-6. Typical International Truck-Air Intermodal Movement (continued)

## Information Flow

After the shipper issues the purchase order for the delivery and the receiver acknowledges it, the shipper turns over the transportation and delivery responsibilities to the shipper's freight forwarder. Booking and scheduling of the motor and air carriers is arranged by the freight forwarder. The carriers make the necessary scheduling and routing decisions to arrange for the pick-up and delivery of the shipment.

The information exchange for the shipper and the pick-up and delivery truck are similar to the description of the motor carrier segment in the intermodal marine movement. As the intermodal move is international and by air, the shipper must provide the truck driver with export declaration documents and the air waybill. There may be little advance notification or electronic exchange of information.

The truck driver transports the shipment and its associated documentation to the freight forwarder. After the freight forwarder has repackaged the freight, the forwarder transmits the delivery instructions and documentation to all the carriers involved in the intermodal movement.

The freight forwarder sends the shipment on an airport tender truck to the airline's cargo terminal at the airport. The same exchange and verification of carrier and shipment information occurs at the airport cargo terminal as occurs at the gate of a port. Once the driver is cleared for entrance, the cargo is unloaded and transferred with the export and air waybill documentation to the air cargo carrier. The airplane signs off on the air waybill and the airport cargo terminal clears the driver for exit.

The U.S. Customs Service is responsible for inspecting the cargo, the documentation, and the aircraft. The airline presents Customs with the Customs' manifest and the air waybill, in addition to the flight plan and related flight documentation. Once Customs inspects and approves the cargo and aircraft for departure, the aircraft requires a final approval from the airport traffic control tower for takeoff.

The aircraft flies the shipment and the associated documentation to a foreign airport near to the final destinations of the aircraft's cargo. At the foreign airport, the shipment and the documentation must be reviewed and approved by the airport and Customs before it can be delivered by a motor carrier to the shipment's receiver. As processes, paperwork, and personnel vary greatly between countries, the information flow is frequently delayed because of numerous paperwork and information requirements, and inadequate notification, pre-clearance, and response capabilities for changes and delays.

## SUMMARY

This appendix has discussed how freight moves in an intermodal logistics chain. Three examples were diagrammed depicting the transfer of freight from a motor carrier to an ocean carrier, to a railroad, and to an air carrier. The brief descriptions of the physical freight moves and their accompanying informational requirements indicated the complexity of the intermodal freight information process and how that complexity can impede the efficient flow of intermodal freight.

## Appendix D

# Previous U.S. DOT Initiatives to Address Intermodal Freight Challenges

### Outreach

#### National Conference on Intermodalism

In December 1994, five U.S. DOT operating administrations and the Secretary's Office of Intermodalism worked with the Transportation Research Board (TRB) to convene national transportation leaders at a three-day conference addressing intermodal issues. In a conference session on new technologies, partnerships, and procedures, participants emphasized that many innovations and improvements to freight transportation could be achieved through enhanced EDI system applications and links to improved data on traffic flows. The session also focused on the need to understand the impacts and opportunities of technological innovation on the entire logistics chain.

#### ITS/CVO Program Briefing

In November 1995, the Federal Highway Administration (FHWA) met with private industry intermodal leaders in Baltimore, Maryland to brief them on the ITS/Commercial Vehicle Operations (CVO) program and information systems architecture. At this meeting, the industry leaders communicated to the FHWA the need to take into account private sector needs and priorities regarding ITS/CVO technologies when designing a systems architecture and setting standards and protocols. The private sector message was strong and clear: ITS architecture must be "open," and the industry must be involved in discussions of standards setting.

#### Conference on Setting an Intermodal Research Agenda

In March 1996, the U.S. DOT joined with the DoD's Defense Advanced Research Projects Agency (DARPA) and the TRB to sponsor a conference intended to define a long-term commitment to research and deployment of technologies that facilitate intermodal transport. An important case was made for Federal involvement through financial investment in high-risk, long-term research and programmatic endeavors – ones in which the private sector or smaller governmental entities would otherwise not participate. Throughout the conference, it was emphasized that partnerships and coordination were at the foundation of any attempts to achieve improved intermodal transportation through information sharing.

## **Outreach (continued)**

### **National Freight Partnership**

From 1995 through 1997, the U.S. DOT sponsored an outreach initiative with the intermodal freight industry called the “National Freight Partnership.” This effort convened transportation decision-makers representing different levels of government and many segments of the intermodal freight industry to better understand the service requirements of the freight community; identify emerging freight and trade developments; and create public-private teams to define problems and devise solutions. Activities included the creation of freight advisory committees for metropolitan planning organizations in four cities; identification of critical connections to intermodal terminals; examination of more cost-effective means of fulfilling freight-related regulatory mandates; and examination of critical international trade issues. One of the most frequently discussed topics during this initiative involved information that would be useful to both public and private sector transportation managers in pursuing more effective system operations.

### **Megaships Meetings and Report**

In response to the introduction of large containerhips or “megaships” handling international cargo at domestic ports, the U.S. DOT sponsored four regional meetings during 1997 to solicit views and perspectives from regional private and public stakeholders about the current conditions and future needs of their marine transportation systems. The findings were summarized in the February 1998 report, *The Impacts of Changes in Ship Design on Transportation Infrastructure and Operations*. Comments were made at every regional meeting that ITS technologies could help achieve greater port terminal efficiencies. Many participants from the private sector predicted that there would be rapid deployment of ITS technologies to intermodal freight transportation once compatibility issues with private sector systems were resolved.

### **Intermodal Freight Identification Technology Workshop**

The Intermodal Freight Identification Technology Workshop, held in Reston, Virginia in June 1998, brought together leaders from the public and private sectors to outline a planning framework that would address intermodal freight identification and tracking technologies. Participants produced a plan of activities and projects that included creating intermodal standards for freight identification and location; evaluating the feasibility of an “universal reader” that could accommodate different modes and container types; and developing readable security tags for containers. An Intermodal Freight Technology Working Group was formed and co-chaired by the U.S. DOT and the private sector to implement the workshop recommendations. The goal of the working group is to identify and support technologies that promote interoperability, asset and cargo visibility, and system harmonization.

**Outreach (continued)**

**National Conference on the Marine Transportation System**

In a three-day conference hosted by the U.S. DOT in November 1998, senior management from several Federal agencies met with transportation industry executives and state and local government officials to address Marine Transportation System (MTS) initiatives. The conference focused on topics relating to safety, security, infrastructure, environment, and economic competitiveness, and recommended a framework for collaborative planning both nationally and locally. Among the recommendations addressing ITS issues were: 1) increase the use of ITS technologies to better utilize existing MTS infrastructure; 2) improve awareness of the importance of seamless, end-to-end transportation in meeting the public's demand for goods; and 3) promote and expand cooperative research and technology programs between government and industry.

**Listening Sessions on ITS/Intermodal Freight Pilot Tests**

In November and December 1998, the U.S. DOT's ITS Joint Program Office, Office of Intermodalism, and Maritime Administration (MARAD) conducted six listening sessions in six U.S. cities to solicit ideas on facilitating intermodal freight transportation through deployment of ITS technologies. Ideas for linking communication and information systems in the public and private sectors emphasized the need for cooperation among system stakeholders and concentration on shared information that would be of greatest benefit to all pilot test participants. The concept of an ITS/Intermodal Freight Program was validated through the listening sessions, and input from participants will be used by the U.S. DOT as a framework for future ITS operational tests.

## Studies

### Intermodal Freight: An Industry Overview

In March 1994, the Volpe National Transportation Systems Center completed a study for the FHWA's Office of Policy Development that provided an overview of the intermodal freight industry's operating practices. The report noted that improved information systems, along with fully integrated service delivery systems, are pivotal to a successfully operating intermodal freight service. The report cited predictions that the use of neutral, non-carrier-specific EDI systems was expected to be one of the major developments of the 1990s.

### Toward a National Intermodal Transportation System

The National Commission on Intermodal Transportation, created by ISTEA, made several observations relating to intermodal information in its report, *Towards a National Intermodal Transportation System*, published in September 1994. For example, the Commission recognized that information systems provide critical support for transportation. Telecommuting, video-audio conferencing, and electronic interchange were cited as technologies that can alter both passenger and freight transportation patterns. The committee emphasized that planners must recognize the importance of information systems development and ensure that the potential benefits of such systems are fully exploited.

### Intermodal Freight Transportation

Recognizing that the new priorities established by the Congress with the passage of ISTEA included understanding the intermodal freight transportation system, the FHWA sponsored a study of the impediments to intermodal freight transportation. The final report, *Intermodal Freight Transportation*, published in December 1995, focused almost exclusively on impediments to intermodal freight posed by the transportation system's physical infrastructure. It noted that congestion and overcrowding was becoming especially problematical at terminals. It also noted, however, a comparable need for new equipment, new EDI systems for tracking freight, improved operating systems, and better integration of modal systems.

**Studies (continued)**

**Implications of Intermodal Freight Movement for Infrastructure  
Access, Capacity, and Productivity**

In March 1996, the Volpe National Transportation Systems Center completed a report for the FHWA's Office of Policy Development that evaluated the status of intermodal freight in the U.S. with reference to problems of physical infrastructure access and capacity. The report identified opportunities to improve system operations and expand capacity by applying ITS/CVO technologies to expedite freight processing, streamline gate procedures, preclear vehicles requiring documentation, and track freight while en route to its destination.

**Intelligent Transportation Systems and Intermodal Freight**

In December 1996, the Volpe National Transportation Systems Center produced a paper for the U.S. DOT's ITS Joint Program Office entitled *Intelligent Transportation Systems and Intermodal Freight Transportation*. The paper described EDI technologies already in use by the intermodal freight industry and suggested how Federal actions could enhance the interface between the ITS program and industry initiatives. The paper concluded that individual private sector companies have invested significantly in advanced technologies specific to their own operations, but that there were very few examples of applications being used by more than one mode. The paper did suggest opportunities for ITS technology applications to the freight transportation system that could enhance the capacity of the system as a whole.

**Initiative to Promote Enhanced Freight Movement at Ports and Intermodal Terminals**

In December 1998, the Volpe National Transportation Systems Center delivered a strategic plan to the U.S. DOT's Research and Special Programs Administration that addressed the National Science and Technology Council initiative to promote "Enhanced Goods and Freight Movement at Domestic and International Gateways." The plan suggested ways that Federal research and development addressing freight movement could be coordinated, targeted, and leveraged to ensure the best investments and most valuable products. To support its objective to "promote advanced intermodal terminals and communications systems," the plan noted that information systems must be deployed to optimize fleet management and load dispatching, reduce transit times, and improve equipment utilization.



## **Program Initiatives**

### **ITS/Intermodal Freight Program**

The FHWA is developing a national ITS/Intermodal Freight Program to promote the application of ITS technology to intermodal freight transportation. The program goals are to enhance the safety, reliability, and responsiveness of the intermodal freight transportation system and contribute to enhanced transportation efficiency and safety. The program posits that sharing information across the intermodal freight system is key to regaining capacity and reliability in intermodal freight movement.

### **Assessments for an Intermodal Operations Planning and Coordination System**

The Metropolitan Planning group of the new (1999) Planning, Environment, and Real Estate organizational unit within the FHWA is implementing phase two of a research and deployment testing project that is assessing state-of-the-art ITS technologies that facilitate landside access to ports. The deployment test incorporates a paperless gate entry system that uses an Internet interface to improve motor carrier scheduling and coordination of pickups, drop-offs, and backhauls.

### **International Border Clearance Program**

Through the International Border Clearance (IBC) Program, the FHWA has sponsored a number of field operational tests of border crossing technologies and processes, including standardized data elements, electronic credentials, electronic clearance, and onboard systems, to facilitate international trade and transportation efficiency and safety. A strategic plan, a comprehensive IBC system design and information systems architecture, a concept of operations, and an IBC business operations and processes document also have been prepared.

### **Strategic Partnership Initiative**

The National Science and Technology Council has developed a Strategic Partnership Initiative focused on identifying technology-based partnerships among government, industry, and academia to speed the introduction of new technologies into transportation systems and operations. One initiative area includes the improvement of intermodal information infrastructure to enhance goods and freight movement at domestic and international gateways. The focus includes advanced ocean terminal design and operating systems, advanced high-speed rail freight networks, and advanced truck-container transport and handling systems.

## Appendix E

# Intermodal Operational Test Initiatives

This appendix highlights some of the intermodal technology demonstration projects and initiatives that are being conducted parallel with the ITS/Intermodal Freight Program. The U.S. DOT should explore opportunities to partner and share resources with these initiatives, build upon existing efforts, coordinate tests and programs, and learn lessons from other intermodal operational tests.

### **CARGO HANDLING COOPERATIVE PROGRAM: DEMONSTRATION PROJECTS**

The Cargo Handling Cooperative Program (CHCP) has been administered by the U.S. DOT Maritime Administration since 1983. The CHCP consists of private and public entities involved in the ownership, management, operation, and movement of marine freight and seeks opportunities to develop innovative cargo handling systems to increase productivity and cost effectiveness.<sup>1</sup> Currently the program's focus is to support industry-driven technology solutions. In support of this new mandate, the CHCP is pursuing several demonstration projects in the United States. Demonstrations that fall into the categories of the ITS/Intermodal Freight Program are cited below in the three areas, gate and terminal management, route and fleet management, and shipment tracing and management.

#### **Gate and Terminal Management**

Some examples of gate and terminal management demonstration projects being conducted by the CHCP include the following:

- Gate hand-off productivity review and demonstration which will review current inbound and outbound processing methods at terminals, assess which are most efficient, and model the methods at high-volume locations.
- Automated guided vehicle (AGV) demonstration which will deploy AGV in an outdoor terminal environment. The demonstration will assist with typical maneuvers required for a truck or straddle carrier at container and rail terminals.
- Marine-rail cargo terminal interface demonstration which will identify an inland port system to improve the efficient transfer of cargo between marine terminals to an inland sorting facility, and to the final transportation mode. The demonstration will include applications for both commercial and military terminals.

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<sup>1</sup> U.S. DOT web site, [www.dot.gov](http://www.dot.gov) and U.S. DOT MARAD web site, [marad.dot.gov](http://marad.dot.gov).

## Route and Fleet Management

One of the route and fleet management projects that the CHCP is conducting is the following:

- Demonstration of terminal truck traffic routing to the most efficient route as trucks are identified at electronic tollbooths. Trucks are pre-cleared at terminals so they can be assigned quickly to a specific delivery or pick-up area.

## Shipment Tracing and Management

Examples of the CHCP shipment tracing and management projects include:

- Tagging the world container fleet by tagging new containers as they are constructed and introduced into operation.
- Reviewing the best practices in customer service (i.e., shipment tracking) of intermodal carriers, then modeling an optimally functioning system based on these practices.
- Reviewing the current technologies offered in the area of biometrics (e.g., techniques to check authenticity and identity that rely on measurable physical characteristics which can be checked automatically by computer analysis of fingerprints or speech) for application to intermodal freight clearance systems.

## INTERMODAL FREIGHT TECHNOLOGY WORKING GROUP: INITIATIVES

The Intermodal Freight Technology Working Group, convened under the auspices of ITS America, is initiating a series of intermodal pilot projects. The objective of the projects is to improve intermodal freight equipment identification and location, container identification and location, and delivery status and cargo condition notification. The working group's initial pilot project is an intermodal chassis identification and location project. The objective of the project is to facilitate the process of locating available chassis in a specific geographical area. The project will use a tracking device that can be recharged by the vehicle's tractor. The lessons that are learned from this operational test will be applied to a future phase of the project which will address the identification and location of international intermodal containers and deploy more sophisticated technologies.

The Intermodal Freight Technology Working Group also is initiating an operational test for intermodal freight information systems. It will allow for data to be collected from tracking technologies, organized, and distributed quickly to relevant users, thereby providing greater in-transit visibility and enabling faster and better informed decision-making.<sup>2</sup> It will link Global Position Systems (GPS) tracking systems, a network control center, PC-based information systems, and satellite or cellular communication systems.

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<sup>2</sup> Meeting minutes from the Intermodal Freight Technology Working Group, January 14, 1999.

## **INTERMODAL FREIGHT IDENTIFICATION TECHNOLOGY WORKSHOP: RECOMMENDATIONS**

Several project ideas resulted from the Intermodal Freight Identification Technology Workshop held in June 1998 in Reston, Virginia. Some of the recommendations resulted from discussions and working sessions conducted at the workshop. Other ideas were drafted in preparation for the workshop and the sessions and would require an agency or stakeholder group to champion the effort.

One of the key recommendations proposed at the workshop was to conduct and document technical assessments of significant research and development projects carried out by commercial enterprises and government agencies. These analyses would allow intermodal operators and regulators to better understand the costs and benefits of technical interoperability and specific initiatives. Some of the best practices and activities cited at the workshop include:

- Commercial initiatives of intermodal technologies, including container and chassis fleet tagging (e.g., American Presidents Line's chassis fleet tags) and gate clearance systems (e.g., Port Authority of New York and New Jersey's Sea-Link motor carrier identification card); and
- Government initiatives of clearance programs, including the international land border clearance programs (for application to international clearance by air and ocean); electronic toll collection and CVO activities (for application to other modal carriers and functions); and the U.S. Department of Defense (DoD) Automatic Identification Technology (AIT) and Defense Advanced Research Projects Agency (DARPA) research (for application to intermodal shipment information and operational activities).<sup>3</sup>

There was also consensus at the Intermodal Freight Identification Technology Workshop to develop information technology solutions to address specific problems in intermodal freight movement. Proposed applications and functions include:

- A "super reader" to read different tags and facilitate multiple functions, such as gate clearance requirements, driver and cargo identification and certification, and toll management;
- An automated scheduling system using artificial intelligence to coordinate the complexity of scheduling and routing tasks;

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<sup>3</sup> The AIT was developed by the U.S. DoD Tactical Management Information Systems to facilitate DoD's goal of total asset visibility (TAV). TAV involves the collection of information from DoD operations on the identification, quantity, condition, location, movement, and status of material, units, personnel, equipment, and supplies in the logistics supply chain for all times and locations, and to be apply to apply that information to improve DoD's logistics processes. U.S. DoD web site, [www.defenselink.mil](http://www.defenselink.mil).

DARPA is the central research and development organization for the U.S. DoD. Current DARPA research projects which may be of relevance to the intermodal freight system include: mobile computing, networking, and information systems; security technologies; advanced sensor technology applications; and advanced defense applications of computing and information technologies. U.S. DoD DARPA web site, [www.darpa.mil](http://www.darpa.mil).

- A hazardous materials transportation identification and response system for different modes to identify the commodities being transported and automate the required communication and response in the event of an accident or emergency; and
- A port and gate clearance system to facilitate clearance and entry, credentialing, and state and Federal freight regulatory requirements; and integrate Commercial Vehicle Information Systems and Networks (CVISN), state owned communication infrastructure, and port gate systems.

To prepare for the Intermodal Freight Identification Technology Workshop, several project ideas were proposed that would help advance intermodal transportation. These proposals were based on the results of research and stakeholder interviews conducted for this project. These initiatives could be pursued at the regional or national level and include:

- Accelerating the development of standards for interoperable freight identification tags which currently are tailored to specific modes and applications (e.g., automatic equipment identification for railroads, electronic toll collection for commercial and passenger vehicles);
- Accelerating the development and commercialization of auto-networking or hierarchical freight identification tags;
- Accelerating the development and commercialization of cargo security tags to reduce container and cargo theft;
- Demonstrating the integration of intermodal freight identification and location data into a logistics management system for a large shipper, such as the U.S. Department of Defense;
- Using electronic toll collection systems to track cargo transported by dray carriers to intermodal terminals to facilitate preclearance, reduce cargo loss, improve customer service, and minimize delays; and
- Demonstrating the application of parking garage management technologies that track space availability and utilization for the management and enforcement of commercial vehicle docking and parking spaces in congested urban business areas.

## Appendix F

### Glossary of Terms<sup>1</sup>

<b>Bill of lading</b>	Principal transportation document by which a carrier acknowledges receipt of freight, and sets forth a contract of carriage. Terms and conditions, responsibilities, and liabilities vary with manner and place of use. Bills of lading may be negotiable or non-negotiable.
<b>Container</b>	A box-like device used to store, protect, and handle several packages as a unit of transit; shipping system based on large cargo-carrying containers that can be interchanged between trucks, trains, and ships without rehandling contents.
<b>Delivery order</b>	Instructions given to participating parts of the intermodal chain, telling where the cargo is to be delivered.
<b>Demurrage</b>	Penalty for exceeding free time, usually 48 hours, allowed for loading/unloading under terms of railroad/ocean carriers; detention means the same thing for motor carriers.
<b>Dock receipt</b>	A steamship company form, evidencing receipt of the goods at a pier. Copies of this form are made available to shippers as a means of expediting handling at piers. The dock receipt controls the ownership of the goods until the ocean bill of lading is issued.
<b>Intermodal</b>	A logistically linked movement using two or more modes of transport. Typically (but not always) involving the interchange of freight in containers or trailers among different transportation modes, where the containers and trailers are of standard sizes, having common handling characteristics, permitting them to be efficiently transferred between modes as necessary during the origin-to destination movement.
<b>Line haul</b>	The movement of freight over the road from origin terminal to destination terminal, usually separated by substantial distance; does not include pickup and delivery.
<b>Manifest</b>	A list of all cargoes on a vessel. The specifications of a cargo made out and signed by the master of a ship.

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<sup>1</sup> Intermodal Freight Transportation, 3<sup>rd</sup> Edition, by Gerhardt Muller, Intermodal Association of North America, Eno Transportation Foundation, Inc., 1995.

<b>Purchase order</b>	Form buyer uses when placing order for merchandise.
<b>Shippers Export Declaration (SED)</b>	Form required by Treasury Department and completed by shipper showing value, weight, receiver, destination, etc., of export shipments, as well as Schedule B identification.
<b>Stevedore</b>	Person in charge of loading/unloading ships.
<b>Waybill</b>	A document prepared by a transportation line at the point of origin of a shipment, showing the point of origin, destination, route, shipper, receiver, description of shipment and amount charged for transportation, and forwarded with the shipment, or directly mailed to the agent at the transfer point or waybill destination.
<b>Wharfage</b>	The charge or toll assessed against all cargo passing or conveyed over, onto, or under any wharf.