Volume I

Intermodal Freight Transportation

Overview of Impediments

Data Sources for Intermodal Transportation Planning

Annotated Bibliography

U.S. Department of Transportation
Federal Highway Administration

Intermodal Freight Transportation, Volume 1

Overview of Impediments, Data Sources for Intermodal Transportation Planning, and Annotated Bibliography

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Prepared by
Cambridge Systematics, Inc.
with
Apogee Research, Inc.
Jack Faucett Associates
Sydec, Inc.

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A companion document, *Intermodal Freight Transportation Volume II*, includes a *Fact Sheet* and *Federal Aid Eligibility.*

Intermodal Freight Transportation

Overview of Impediments

Intermodal Freight Transportation

Overview of Impediments

Introduction

This report presents an overview of impediments to intermodal freight transportation. It identifies types of intermodal impediments based on studies, reports, and interviews with shippers, carriers, public agencies, and others involved in intermodal transportation.

One purpose of identifying intermodal impediments is so that effective actions can be designed to reduce or eliminate them. The actions may be undertaken by metropolitan transportation planning organizations (MPOs) and State and Federal governments working together and in partnership with private transportation companies.

Intermodal transportation has become a national priority. The Intermodal Surface Transportation Efficiency Act (ISTEA) states that it is the policy of the United States to develop a National Intermodal Transportation system that *". . . shall consist of all forms of transportation in a unified, interconnected manner, including transportation systems of the future, to reduce energy consumption and air pollution while promoting economic development and supporting the Nation's preeminent position in international commerce."*

The benefits of improved intermodal freight transportation include: 1) lowering transportation costs by allowing each mode to be used for the part of the trip for which it is best suited; 2) increasing national economic productivity and efficiency; 3) more efficient use of existing transportation infrastructure; 4) increased benefit from public and private infrastructure investments; and 5) improved air quality and environmental conditions, such as by reducing energy consumption.

Intermodal Goods Movement

Introduction

The Nation's transportation infrastructure encompasses a vast network of highways, rail lines, waterways, airline routes, and pipelines. These are linked together at various points of modal and intermodal interchange, such as ports, rail terminals, truck terminals and airports. The key modal components of the system generally provide efficient line-haul service. However the interchange points, such as terminals, where freight changes from one mode to another, are, *". . . the weakest links in the current national transportation system . . ."* according to the National Commission on Intermodal Transportation. From the perspective of door-to-door movement of freight, inefficient modal interchange points impede its seamless flow through the system. A container that is shipped from a producer located at A to a customer located at B can encounter obstacles at points of intermodal transfer that slow down its delivery even though the line-haul segment of the journey is rapid and on schedule. In addition, handling, switching and other sorting of the freight contributes to higher damage, loss, and delays. Identifying the factors that impede the efficient transfer of freight from

one mode to another at the intermodal transfer points is an important objective of this study.

Definition

In general, an intermodal shipment is one that is carried by two or more modes during a single journey. Intermodal transportation has been broadly defined as the sequential use of two or more forms of transport. Often, one entity takes responsibility for the entire multimodal movement of a freight shipment.

Intermodal transportation, as used in this study, has a broader emphasis; it focuses on:

- Freight transportation, especially containers (and trailers) because this sector has been experiencing the most rapid growth.
- Intermodal movements of goods, especially among trucks, railroads, ships/barges and aircraft. Special attention is given to the operation of ports, railroad terminals, and airports, as well as border crossings.
- Terminals with both modal and intermodal transfers. For example, it includes ports at which freight is transferred to truck, rail and barges from container ships, as well as large warehouse complexes at which some goods arrive by rail although most of their activity is consolidating, breaking down and transferring truck shipments. It includes terminals at which some containers are transshipped from large container ships to barges, and to truck terminals at which some large truckload shipments are broken down for delivery by small trucks and vans.

Attention is given to container movements because the numbers of them being handled are increasing rapidly. This is causing congestion requiring the expansion of many rail terminals and ports. New service and equipment, such as Triple Crown, the Iron Highway and RoadRailer are attracting more containers and trailers for medium- and short-haul movements, and double-stack service is attracting more containers for long-haul shipments.

The study focuses on intermodal freight transportation. It recognizes, but does not focus on, the intermodal movement of bulk commodities, such as grain and fuels. Special facilities, pipelines and terminals have been developed and used for many years. These systems, together with their constituent special facilities, are well developed.

Intermodal passenger transportation is not within the scope of this study. However, there is some overlap because some rail lines are used for both passengers and freight, and a large proportion of air cargo moves in the "bellies" of passenger aircraft.

Examples of Intermodal Movements

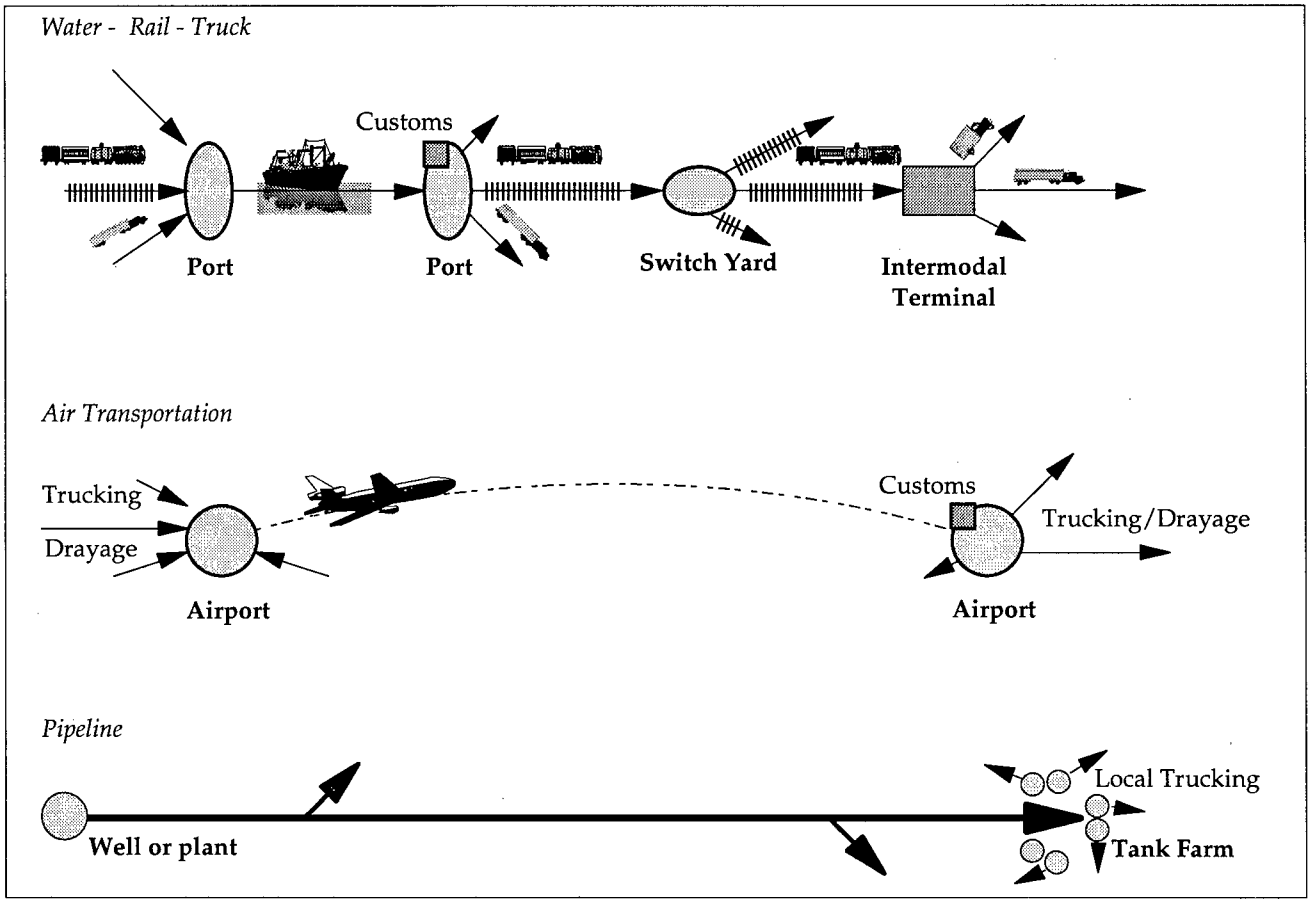
Three general examples of intermodal movements are shown in Figure 1 in order to provide some background about the typical steps involved in moving goods intermodally. The routing of shipments is done by shippers, freight forwarders and increasingly, by third parties who now account for about 20 percent of domestic intermodal freight movements.

International Ship-Rail-Truck Movement

The first example shows an international movement of a container from a foreign shipper to a domestic receiver. This is a typical movement for a container because more than 90 percent are used in international trade. The domestic part of the trip would be similar for that of a trailer or domestic container. The sequence of steps taken by an arriving shipment include:

- The shipment is delivered from the producer (or warehouse) to the port in a foreign country, usually by truck or rail.

Figure 1. Examples of Representative Intermodal Movements



- A shipload is assembled to meet the arrival of a container ship scheduled to serve the appropriate U.S. port.

- The ship is loaded, often with 1,200 or more containers. This is usually accomplished in 12 to 24 hours.

- The ship sails for its destination. It will either go directly there or make one or two short (less than 12 hour) stops to top-up the load. For a Pacific crossing, the trip is often eight to ten days.

- While on the way, notice of the containers and their contents is sent to the shipping company's agents at the arrival port and steps are initiated for customs clearance/preclearance. Carriers are notified of their requirements. This may include the number and type of railroad cars needed to make up a double-stack train, approximately when it should be available at dockside and the order in which it will be loaded (depending on destinations, etc.). Receivers are notified that their containers have been loaded and when they will be available for local delivery from the port of arrival and arrangements for clearance and drayage are made.

- On arrival at the port, the containers are off-loaded directly onto a waiting (double-stack) train or into an area where they will be loaded onto chassis and trucked to their destinations. Some containers may be off-loaded onto barges and transported to other coastal destinations, such as from New York to Boston. Customs and quota clearances for some containers have

been arranged at the port and others will be cleared at their final destination.

- Double-stack trains, some more than a mile long, will be made up and leave ports (such as Los Angeles/Long Beach) in as little as 12 hours after arrival of the container ship. Receivers, freight forwarders and others are notified that their containers have arrived, how these will be routed and when they will reach the destination intermodal terminal, so that arrangements can be made for drayage, customs clearance, etc.

- The through train drops off sections of rail cars bound for other destinations at switching yards as it moves across the country. At gateway cities, such as Chicago, shipments from the West Coast are transferred from a western to an eastern railroad. This is done in several ways, ranging from just changing crews, to changing engines and even to unloading containers, draying these from the western railroad's terminal to the eastern railroad's terminal and loading them onto an eastbound train.

- When the train carrying a shipment arrives at a destination intermodal terminal, it is unloaded onto a chassis and stored at a particular location. The receiver is notified of its arrival and arrangements are made by the receiver (forwarder, etc.) to pick it up during the terminal's hours of operation and for draying or trucking it to its destination, such as a plant or warehouse (or for customs inspection).

A domestic container movement follows the same pattern, but begins with trucking of the container to an intermodal terminal where it is loaded onto either a double-stack or single-stack train. Trailer movements are similar, except that the trailers are loaded onto (single-stack) flat cars (TOFC). In some cases, the TOFC rail cars may be included in a container train.

Air Cargo Movement

Air cargo generally includes items that have a high value per pound, are small in size and are especially time sensitive. Typically these include electronic equipment, clothing, flowers, medical supplies, small packages and similar goods. Because of their high value, these goods generally are small (in physical size) shipments. Few receivers require very fast delivery (at ten times the cost of other modes) of a full planeload of clothing or medical supplies, etc. Therefore, many small packages are generally assembled into a shipment for a specific destination and then booked on a flight of an air carrier providing frequent service to the nearest city. Air service enables goods to reach all major cities in the world within a day.

The steps in air cargo movement usually include:

- Arranging for air shipment, which is usually done through a freight forwarder or airline air freight department. This includes selecting the airline, airport from which the airline departs and negotiating the cost of the shipment.

  The origin airport must have airlines providing frequent service to the destination airport. If this is an international location, service only may be available at a few airports nationally, so trucking several hundred miles is not unusual.

- Trucking goods from the shipper to a freight forwarder or to the airline's air freight center on or near the origin airport.

- Making up the shipment and packing containers. In some cases this is done by shippers but in many other cases, it is done by freight forwarders or airlines. Container size varies to some extent depending on the type of aircraft. Some containers used for wide-bodied aircraft will not fit on narrow-bodied aircraft.

- The containers are loaded onto the aircraft and then flown to the destination airport.

- At the destination, the containers are usually unloaded by the airline. Their contents are cleared through customs by freight forwarders, customs brokers, air freight companies, etc. Then the shipments are trucked to their final destinations which may be in the local area or several hundred miles away.

Trucking freight to and from the airport and between freight forwarders located near the airport and freight terminals located on the airport encounters normal traffic and adds to congestion in the vicinity of most large airports, which is caused by vehicles used by passengers, airport employees and service activities.

Pipelines

Pipelines and several other types of bulk transfer involve an efficient long-distance movement of commodities. Typical steps in the shipment of products by pipeline are:

- The origin point is often a well or a large refinery that is connected directly to a pipeline.

- The commodity is shipped to a terminal/tank farm near its final destination through the pipeline – by a single mode.

- Some of the commodity (such as fuel oil or gasoline) is delivered by tank trucks to nearby users (such as gas stations), located within the local area (e.g., within 100 to 200 miles). In the case of natural gas and propane, it is mainly delivered by a local pipeline distribution network and some is delivered by trucks.

Pipelines are a very efficient mode of transportation, moving large volumes of liquid and gas products long distances. A large volume of heavy trucking occurs in the vicinity of distribution terminals and tank farms which are required to meet strict environmental and safety regulations, especially in the case of fuels, such as gasoline.

In practice, the movement of goods is much more complicated than indicated in the three examples presented above. Modes, routes and transfers differ depending on specific origin and destination points, the types of goods transported, characteristics of the goods (weight, volume, value, fragility, perishability, etc.), amount being shipped and distribution system.

From the point of view of businesses, most receive and ship a variety of materials and products, many of which are transported by different intermodal systems. For a manufacturing plant, some bulk raw materials may be received by rail, semi-finished components may be imported in containers, locally produced materials may be predominantly trucked from suppliers. Finished products may be shipped by different combinations of modes, depending on the specific product and markets served. Over time, suppliers change and markets expand, decline and shift in geographic location. Therefore the intermodal transportation requirements change.

For example, procurement of some components may change from domestic to overseas suppliers and the location of these may shift from Europe to the Far East. Market areas may shift regionally in the United States and overseas and the volume of goods shipped to each market area may vary as demand grows or declines. Distribution patterns may change so that more retail goods are transported in containers, by cargo planes and truckloads to central mixing warehouses. There the large shipments are sorted into smaller loads made up of a variety of products. These are trucked to specific stores daily to replenish their inventories, based on previous day's sales. Efficient and timely intermodal transportation is required to meet the scheduling requirements of manufacturers and retail stores, as well as to meet competitive challenges in domestic and world markets.

Seamless Freight Transportation

Improving intermodal transportation has an important role in achieving "seamless" transportation. This means that the transportation of goods by different modes is done so efficiently that the changes in mode are hardly noticeable. Shippers and receivers require "seamless" freight transportation because it enables them to move goods quickly and efficiently, using the transportation mode for each part of the trip that is most suited to their logistics requirements for cost, speed and reliability.

The transportation requirements of businesses nationally and internationally are shifting toward faster, less expensive and more reliable freight transportation. Businesses want to obtain the best transportation service that meets their specific logistics needs. They are not especially interested in which modes are used. All sizeable manufacturing companies depend on several modes of transportation for the movement of raw materials, finished and semi-finished goods. Of course, in some cases, certain transportation modes are key to handling specific types of raw materials and products and to reach certain suppliers and markets in a timely and cost effective way.

To meet emerging logistics requirements, there is increasingly close integration of different modes of transportation. Some integrated carriers (such as United Parcel Service (UPS) and Federal Express) provide door-to-door package service worldwide, operating their own fleets of trucks and airplanes. UPS also has long-term contracts with railroads and is one of their largest customers. Partnerships between trucking companies and rail lines, such as between Santa Fe and Schneider, are becoming more common.

This report focuses on identifying impediments to intermodal transportation so that these can be reduced or eliminated resulting in improved intermodal transportation thereby helping to achieve the overall objective of "seamless" and "borderless" freight transportation that is desired by shippers and receivers. It also will strengthen the United States economy and competitive position of its businesses.

Intermodal Service Deficiencies

Intermodal service has improved dramatically in recent years; however, it still is adversely affected by the perception of being a second-rate service. From its development in the 1920s through the late 1970s intermodal freight was synonymous with "piggyback" service. Piggyback or trailer on flat car generally involved highway trailers being loaded by "circus" ramps onto rail flat cars. Then they were moved several hundred miles to another destination and off-loaded. The service was hampered by a reputation for poor service characterized by high cargo damage, slow transit time, infrequent pickup and delivery schedules, poor customer service, and poor on-time performance. With rail and truck deregulation in the 1970s and 1980s, the rapid increase in numbers of international containers, new delivery requirements of shippers such as "just-in-time" requirements and development of lower-cost double-stack service, attention was focused on improving intermodal transportation. Although very substantial improvements have been made, intermodal transportation still faces strong competition from over-the-road trucking for perceived and actual reasons such as the following:

- **Less control over goods**. Intermodal rail involves trucking to a terminal, rail delivery and draying to the customer – three different movements which means some loss of control. On the other hand, trucking can offer point-to-point service which means that trucks can pick up a good from a shipper and deliver it to a receiver without intermediate handling.

- **Multiple handling of goods.** Containers (or trailers) are lifted on to and off of rail cars. The extra handling can lead to more damage to fragile goods, less control of exposure to heat and/or cold, and less monitoring of the container or trailer.

- **Longer time required for short-hauls.** Containers (or trailers) must be drayed to rail terminals to make "cut-off" times which allow for loading and train make-up. At the other end of the journey, time is required to unload the train, pick up and dray the container (or trailer) to the receiver. A truck can go directly from the shipper to the receiver.

- **Less flexible scheduling of intermodal shipments.** Trains are scheduled at specific times of day (or days of the week) and containers (and trailers) must be put on certain trains or wait for the next one. Trucks can leave when the load is ready. Most rail terminals do not operate 24 hours a day seven days a week, so shipments may arrive and have to wait for the terminal to open. Depending on the train schedule, goods may arrive on days that manufacturing plants or warehouses are not operating. Trucks can be scheduled to avoid such delays.

- **Costs of intermodal shipping generally are not significantly lower than truck for short- and medium-haul.** Although the line-haul transportation cost by rail may be lower, costs of draying containers and lifting them onto and off of rail cars must be added. Terminal costs add significantly to the cost of intermodal transportation. Generally intermodal container shipments must be over 500 miles to be competitive with the cost of trucking. New rail services, such as Triple Crown, Iron Highway and RoadRailer have been introduced to be more competitive with trucking over medium and shorter distances.

Eliminating or alleviating some of the specific impediments to intermodal transportation will help to reduce some of the problems listed above and provide faster, more reliable and more competitively priced intermodal transportation. This will help intermodal transportation to increase its share of the market in long-haul corridors and to increase its penetration in the short-haul market (less than 500 miles) which includes about 70 percent of all intercity freight traffic. For distances over 500 miles, rail intermodal (containers and trailers) increased its share of non-bulk goods movements from 17.0 to 21.4 percent between 1986 and 1990, according to the American Association of Railroads. In some long-haul rail corridors, 50 percent or more of these movements are by rail.

Background Information on Intermodal Transportation

Background

The freight transportation industry developed modally in the United States, partly because of antitrust restrictions limiting ownership of two or more modes of transportation by a single company. Railroads, airlines, trucking and ocean shipping companies all competed with each other and with other modes. Trucking companies competed especially strongly with rail lines for "boxcar" traffic. With deregulation of the transportation industries in the 1970s and 1980s, competition between modes increased substantially. Price and service competition within and between modes became increasingly intense. In the early days of deregulation, companies in specific modes competed with each other to increase their profits, not necessarily to provide the most efficient door-to-door movement of goods from shipper to receiver.

In the 1980s, the logistics requirements of shippers began to change rapidly. They became more interested in achieving the most efficient transportation of their goods in order to meet increasingly stringent time, cost and reliability requirements. Integrated carriers, such as Federal Express and UPS, expanded rapidly to provide door-to-door service for small packages and freight throughout the world. Freight forwarders and ocean shipping companies (such as APL, Maersk, Evergreen, etc.) increasingly offered intermodal service. To meet just-in-time and other requirements, they provided part of the transportation (usually by water or air) themselves and contracted with railroads and trucking companies for other (intermodal) parts of the trip. Domestic transportation companies began to make contractual arrangements and to acquire transportation companies in other modes. Railroads purchased barge lines, truck lines and entered into contracts with transportation companies operating other modes of transportation, and some freight forwarders chartered planes and ships.

Today, in response to the demand for better intermodal service by shippers, traditionally modal transportation companies are shifting from intense competition within their mode to competing to provide door-to-door service using more than one mode.

Economic Importance of Freight Transportation

The Nation's transportation system accounted for 16.8 percent of Gross National Product (GNP) in 1992. Expenditures totalled about $996 billion including investment of $226 billion in infrastructure and equipment. The freight sector of transportation accounted for about $367 billion or six percent of GNP.

The importance of freight transportation to the Nation's businesses is more than just the amount spent to purchase transportation services and equipment. Transportation is closely linked to the overall logistics costs of firms, including the amount of inventory to be maintained, turnover and related costs savings associated with just-in-time inventory management strategies. Logistics costs can account for as much as 25 to 35 percent of the sales dollar of some companies. Good intermodal transportation service can significantly reduce costs in these businesses.

Reliability of delivery schedules for components used in manufacturing is key to the continuous efficient operation of production lines. Shutting down a production line because a component does not arrive on time, or keeping large inventories of many parts to preclude this are expensive alternatives to reliable just-in-time delivery. In the retail sector, delivery of goods to meet the timing of special marketing initiatives is key to successful merchandising. Reliable delivery of goods for restocking shelves in supermarkets is critically important to a supermarket chain maintaining its competitive position.

Faster delivery times and reduced inventories are expected during the next five years and these will be required for domestic firms to meet global competition. For example, order cycle times for warehouses are expected to decrease by 15 to 20 percent during the next five years, and transit times to be reduced by between five and 10 percent. Inventory turnover is expected to increase by about 10 percent. The percent of products shipped just-in-time is expected to increase from 28 percent to 39 percent. These trends in goods movement and turnover indicate that not only increasing demands will be placed on the national transportation system for fast and efficient modal and intermodal movement of freight but that these will become increasingly important to more businesses.

Overview of Freight Transportation by Mode

A total of 3.8 billion revenue ton-miles of bulk and non-bulk intercity freight were transported domestically in the United States in 1993 by truck, rail, air, water and pipeline as shown in Table 1. Included is a significant amount of domestic offshore merchandise trade with Hawaii, Alaska, and Puerto Rico. A large volume of international freight, including petroleum and products, was handled at U.S. ports. United States airports handled almost as many tons of international as domestic air freight.

Table 1 shows that trucks carried 22.8 percent of all (bulk and non-bulk) intercity freight. Class I railroads, which have a longer average length of haul than trucks, carried 28.7 percent of the ton-miles of intercity freight. Waterborne commerce accounts for 33.3 percent of domestic revenue ton-miles, mainly of bulk freight. Air shipments only accounted for 0.3 percent of intercity ton-miles. However, these accounted for about three percent of the value of goods moving between cities.

Non-bulk intercity freight, which is mainly merchandise, is the focus of this report. Merchandise freight, as used here, generally refers to finished materials, semi-finished materials, components and other similar goods. It does not include bulk goods, such as most raw materials, agricultural products, coal, ores, sand and gravel, chemicals, petroleum and some construction materials. Many of these goods are shipped in special rail cars, such as tank cars, hopper cars and gondolas. The approximate proportion that merchandise comprises of the total tons handled by each mode is summarized below:

- **Truck.** About three-fifths of the intercity tons handled by truck is merchandise. Much of this moves in trailers and containers, especially if it moves internationally. Trucks handle most

Table 1. Domestic Revenue Ton-Miles of Freight by Mode – United States, 1993

Mode of Transportation	Revenue Ton-Miles	
	Number (billions)	Percent
Truck (Intercity)	880	22.8
Rail (Class I)	1,109	28.7
Water	1,284 (1,2)	33.3
Pipeline (Oil)	575	14.9
Air	11 (3)	0.3
Total	**3,859**	**100.0**

Notes:

(1) Includes domestic coastwise cargo.

(2) Excludes international water transportation associated with U.S. ports which totals about 968 million tons, not including bulk cargo such as petroleum.

(3) Excludes international air cargo ton-miles associated with U.S. airports which totals over 7 billion ton-miles.

(4) Data include all commodities, bulk and non-bulk carried by each mode.

Source: U.S. Department of Transportation, "National Transportation Statistics, 1995."

of the local deliveries of goods, including bulk goods because short-haul rail and barge is usually not cost effective nor convenient.

- **Rail.** About one-fourth of the intercity tons of freight handled by rail is merchandise. This includes a wide variety of products, such as automobile parts, machinery, canned goods and some building materials, most of which move long distances. Most of the freight tonnage handled by rail is bulk commodities such as coal, waste products, fuels, chemicals, bulk agricultural commodities such as wheat, sand and gravel and other similar commodities.

- **Water.** About one-tenth of the tonnage of goods moving by water is merchandise. This includes containers moving internationally, as well as automobile parts, machinery, paper, some fruits and vegetables, furniture, household furnishings, and other similar goods. Much of these goods move internationally into and out of U.S. ports. International goods are moved by truck or rail between the ports and their hinterlands. Domestic shipping is mainly bulk materials, including agricultural products, chemicals, fertilizer, sand and gravel, coal, fuel oil and waste. Internationally, bulk commodities include petroleum, raw materials such as ores, iron and steel, scrap, chemicals and other similar commodities.

- **Air.** Nearly all of the goods that move by air are merchandise that is trucked to and from airports. Generally these have high value per pound. It is estimated that air freight accounts for between 15 and 20 percent of the value of merchandise imported and exported from the United States.

- **Pipeline.** Nearly all of the goods transported by pipeline are considered bulk products. As noted earlier, some of these are trucked to local markets from tank farms located in destination areas.

Taking into account the volumes of goods and their characteristics, the main intermodal movements of merchandise freight are between:

- Rail and truck
- Water and rail and truck
- Truck and air

There are very few intermodal movements of goods between rail and air or water and air. In most cases, the cost, time sensitivity and physical characteristics of the goods moved by these modes differ too much for them to be shipped by these combinations of modes.

Containers and Trailers

Containers and trailers carry large amounts of merchandise. These can be handled by trucks, rail and ships (especially container ships), so they carry a large proportion of merchandise that moves intermodally. Containers mainly are used for transporting goods throughout the world. Over 90 percent of the containers in the United States carry international shipments. Trailers are mainly used for domestic shipments.

It is estimated that U.S. ports handled 17.7 million TEU containers in 1993. (A TEU is a standardized measure referring to a 20-foot equivalent unit, which is smaller than a typical 40-foot trailer or container.) This is more than twice the number (8.6 million) of TEU containers handled in 1980. The increase has placed substantial demands on the facilities of major container ports, such as Los Angeles/Long Beach, Seattle/Tacoma, San Francisco/Oakland, New York/Port Elizabeth, Norfolk, Miami and New Orleans. More space has been required for storing equipment and empty containers, new loading and unloading equipment has been added, terminal operations have become more congested, as has access to and from ports by truck and rail.

Railroads handled 3.5 million trailers and 3.7 million containers (not TEUs), or a total of 7.2 million units in 1993. Between 1980 and 1993, the numbers of trailers and containers more than doubled, increasing from 3.1 million to 7.2 million. From 1988 to 1993, the number of containers increased more than 60 percent, from 2.3 million to 3.7 million. However, the number of trailers remained about constant, at 3.5 million. The surge in container traffic has placed substantial demands on railroads, especially to expand their intermodal terminals, add new loading and unloading equipment and to increase clearances to permit extending double-stack routes.

To the year 2000, the American Association of Railroads estimates that:

- The number of international containers will increase at an average annual rate of between 6.3 percent and 7.3 percent annually, reaching 4.7 million to 5.2 million in the year 2000.
- The number of domestic containers will increase at an average annual rate of 25 percent to 30 percent, as some trailer shipments shift to containers and as container traffic grows. In the year 2000, it is estimated that there will be between 3.2 million and 4.5 million domestic container movements.
- The number of trailers handled will decrease at an average annual rate of between nine percent and 15 percent annually, reaching between 1.1 and 1.8 million in the year 2000.
- The number of RoadRailers are expected to reach between 0.3 million and 0.4 million by the year 2000.

Overall, the number of containers, trailers and RoadRailers handled by railroads is forecast to increase by between 25 and 50 percent over the next five years. This will place increasing burdens on railroad intermodal facilities, many of which are currently at or near capacity, especially in major interchange cities, such as Chicago, Kansas City, St. Louis and Atlanta, as well as in major container port cities such as Los Angeles/Long Beach, Seattle/Tacoma, New York, Philadelphia, New Orleans and Norfolk.

Classification of Impediments

Introduction

The increasing volume of intermodal freight is placing heavy burdens on transportation infrastructure. This was generally designed, built and operated primarily to serve modal rather than intermodal needs. Congestion and overcrowding, especially at terminals, is becoming more of a problem, and needs for new equipment, new electronic data interchange (EDI) systems for tracking freight, improved operating systems and better integration of modal systems are becoming more evident. Some of the current impediments to achieving "seamless" intermodal service are categorized and briefly discussed in this section. Among the types of impediments are:

- **Lack of adequate infrastructure,** such as the need for new, large, well-located intermodal terminals; shortages of new loading and unloading equipment; poor landside access, including larger capacity and better designed access roads, bridge improvements to assure adequate clearances and weight capacities for truck and (double-stack) rail; and dredging is needed to increase water depths at intermodal ports that will handle larger container ships.
- **Congestion**, such as on access routes, bridges and tunnels serving intermodal rail and port terminals located in large urban areas. Delays on access and major trucking routes increases costs and adversely affects the ability to provide reliable just-in-time service. The increase

in rail intermodal traffic is also causing congestion on some long-haul main lines.

- **Operational inefficiencies,** caused by the need for better located rail freight routes and extension of double-stack rail service; the need for new EDI facilities for managing and tracking shipments, preclearance, scheduling equipment usage, and managing fast and efficient flows of full and empty containers; and the need for better management of intermodal operations and improved coordination among modes.

- **Regulations that delay and/or raise the cost of developing new facilities,** such as long lead times for obtaining environmental permits for dredging and other improvements; inconsistent State regulations that adversely affect interstate shipments (such as differing truck size and weight limits); and increases in taxes and fees, including State franchise taxes on railroads, that raise the cost of rail and intermodal transportation.

- **Financial limitations,** such as only partial funding of ISTEA programs, limited flexibility in using Federal and State funds for intermodal rather than modal projects; low profitability of some transportation companies (especially airlines, trucking and ocean shipping companies), which restricts their ability to invest in facilities and equipment; and the need for more effective public/private partnerships for financing improvements to intermodal freight transportation systems.

- **Institutional relationships,** that impede the efficient interconnection of modal transportation, especially of eastern and western freight railroads in cities such as Chicago; better public and private sector relationships in terminal planning and operations so that the type and timing of publicly-funded projects will complement private sector initiatives; maintaining good management-labor relationships as new equipment and operating procedures are implemented; and improving public relations, so that the benefits of good intermodal transportation become more widely appreciated.

- **Other impediments,** such as customs clearance, especially of goods subject to quotas, and conflicting intergovernmental mandates, both domestic and foreign, cause delays in the efficient movement of goods shipped internationally and domestically in the United States.

These and other specific impediments are discussed in more detail below and are summarized in Figure 2.

Infrastructure Impediments

Inadequate Numbers and Poor Locations of Some Intermodal Terminals

Intermodal rail terminals and many port terminals are becoming overcrowded. In the case of intermodal rail yards, new terminals located in suburban areas will be required during the next decade. In cities such as Chicago, where eastern and western railroads interchange traffic, new terminals will be needed to handle the growing volume of freight and better located ones will be required which will enable railroads to interchange freight on line (steel wheel) without trucking it from one terminal to another (rubber tire interchange). It is estimated that in Chicago 8,000 trips a day are generated by drayage of containers from the arrival to the connecting rail intermodal terminals. Many large container ports are becoming congested. Major expansion programs, such as at Port Newark/Port Elizabeth are being implemented and others, such as the Alameda Corridor (serving Los Angeles/Long Beach) have been planned.

Figure 2. Example of Impediments to Intermodal Transportation

Impediments	General	Intermodal Terminals			Modal
		Port	Rail/Truck	Air	
Infrastructure	• Lack of coordinated infrastructure development among all modes • Insufficient number and size of intermodal terminals	• Inadequate size of major container ports • Constraints on access to some intermodal ports – congestion, clearances, inadequate staging areas • Dredging required for larger ships	• Inadequate number, size, and poor location of some intermodal terminals, such as in Chicago • Access deficiencies include clearances, congestion, and more direct routing, etc.	• Congested/inadequate access to cargo areas; conflicts with passenger traffic/operations • Inconvenient on-airport location of cargo facilities areas • Inadequate signage to cargo	• Double-stack rail network is not fully developed • More direct double-stack routes needed nationally and to serve certain cities • Grade crossing improvements needed – longer trains, etc.
Operational	• Need improved and more compatibility among EDI systems for tracking freight, customs clearance, etc. • Slow clearance of shipments at borders, especially with Mexico	• Higher capacity loading and unloading equipment needed to handle larger ships • Inefficient layout and flow of containers, including the need to load/unload long double-stack trains	• Additional equipment needed to handle increasing amounts of container and other traffic • Improved EDI systems needed for monitoring, tracking and scheduling shipments • Shortage of drivers in some areas • Some terminal operating schedules not responsive to shipper/carrier needs	• Inefficient consolidation and clearance of shipments at some airports • Not very efficient ground transportation of air cargo • Inefficient interlining of air cargo between large and small planes	• Some inefficient connections between western and eastern railroads • Circuitous routing of some rail lines and air service
Regulatory	• There are not sufficient nationally standardized transportation regulations applying to interstate shipments by all modes of transportation	• Time-consuming and difficult process for obtaining permits, such as for dredging • Air quality restrictions limit expansion and operations	• Long lead time to obtain permits and land use approvals; restrictions limit development of new and expanded terminals • Inefficient provisions for handling and routing hazardous materials • Taxes on international containers and carriers raise costs	• Environmental restrictions make it difficult and time-consuming to substantially expand many airports • Nighttime noise restrictions limit cargo flights at some airports	• Truck size and weight regulations are not standardized nationally • International commerce is hindered by lack of standardized regulations (e.g., Mexico)
Financial	• ISTEA is not fully funded to authorized levels • Better coordination of public (e.g. TIP) and private sector funding is needed • Not enough public/private partnerships	• Limited financial capacity of some port authorities restricts their ability to modernize, expand and provide needed infrastructure	• Limited financial capability of some trucking companies and railroads to provide needed terminal and rail double-stack improvements	• Weak financial condition of some airlines (esp. cargo) limits their ability to provide new cargo facilities • Airport authorities often give preference to passenger operations	• More public/private partnerships are required to leverage financing for needed modal and intermodal projects
Institutional	• Inadequate coordination between the public and private sectors • Different time horizons and objectives between public and private sectors	• Timing/difficulty in obtaining political and legislative support for improvements • Sometimes inconsistent objectives between public owners and private tenants • Labor issues	• Coordination is not always easy because truck and rail also compete with each other • Different cost/tax burdens because railroads build and maintain their rail lines and pay taxes on these	• Choice of air service is decreasing because hubs are becoming dominated by specific airlines • Coordination between international air carriers and foreign ground transportation is sometimes inefficient	• Connections between eastern and western railroads need improvement • International route agreements (bilaterals) are negotiated by governments and unduly limit some service

Inadequate Size of Terminal Facilities

The increase in numbers of containers is straining the capacity of many intermodal freight terminals which do not have enough land to expand. They are becoming overcrowded and do not have space to operate efficiently. Full containers must be stored while waiting for pickup or loading; empty containers and chassis must be stored, ready for use when needed. In addition, rail tracks, loading and unloading equipment and related facilities need to be accommodated onsite. Truck circulation should be more efficient. Many port and rail intermodal terminals are old facilities that are too small and were not designed for handling containers. Their layout, equipment and other facilities require substantial improvement. Larger container ships and longer double-stack trains will exacerbate existing operational problems by increasing peak demands.

Inadequate Double-Stack Routes

Railroads need to extend and increase the capacity of double-stack routes. For example, rail freight service from northern New Jersey, the largest intermodal port area on the East Coast, to the eastern side of the Hudson River and to New England is very circuitous. For containers to reach the eastern side of the Hudson where two-thirds of the people in the New York area live, rail freight is routed through Selkirk (which is nearly to Albany), across the Hudson and down the east side – a distance of more than 250 miles, just to reach destinations 25 miles away on the other side of the metropolitan area. Alternatively, some containers are barged across the harbor, but the cost is comparable with the Selkirk routing. For this reason, most of the containers destined from northern New Jersey to the east side of the Hudson River are trucked, which adds to the substantial congestion on the bridges and tunnels in the New York area.

Double-stack service is not available in many areas because of inadequate bridge and tunnel clearances. The State of Pennsylvania has nearly completed increasing clearances to accommodate double-stack service between Pittsburgh and the East Coast. This is an important step in providing double-stack service directly to the Midwest from the middle Atlantic area (such as Philadelphia and Baltimore). Currently routes are from New York City north and then west toward Buffalo and Cleveland, or from south Atlantic ports. Double-stack service on the east side of the Hudson River is currently precluded because of numerous bridge clearance limitations and double-stack does not reach the Port of Boston because of numerous inadequate bridge clearances and discontinued rail lines.

Poor and Restricted Access to Terminals

Access to many existing and new intermodal terminals is congested which increases trucking and drayage costs and causes delays in delivery times. This is partly because many rail and port terminals are located in heavily developed urban areas. Streets are congested, often narrow and were not designed for large trucks. Current infrastructure problems affect access to many terminals. These include pavement in poor condition and weight restrictions on bridges.

Other problems include signalization and congestion on access roads and circuitous routing between terminals and interstate highways. A special problem is grade crossings. Double-stack trains as long as 8,000 feet are now in operation from West Coast ports, such as Los Angeles/ Long Beach. These tie-up grade crossings for substantial periods of time. Also, bridge clearances for both trucks and for double-stack rail restrict freight movements in and out of some rail and port terminals.

Operational Impediments

Inefficient Layout of Terminal Facilities

Few rail and port intermodal terminals were designed for efficiently loading and unloading large numbers of intermodal containers on long double-stack trains. Most of these facilities do not have the marshalling area needed for the trains, dockside facilities for large container ships, nor the needed storage capacity for full and empty containers and chassis. The new generation of post Panamax container ships carry about 3,500 containers which must be loaded and unloaded quickly. This scale of operation is much larger than was planned when most port facilities were built. In the case of rail terminals, many of the intermodal facilities are incorporated in older marshalling yards which were not laid out efficiently for loading, unloading, moving, storing and repairing containers.

The rapid expansion of package freight has placed substantial demands on the cargo facilities at airports. In many instances, air cargo is handled in older hangar facilities which were not designed for that purpose. Many of these facilities require rebuilding, new aprons and taxiways are needed to handle larger aircraft and new cargo access roads are required to provide landside access to these facilities.

Insufficient Equipment for Handling and Transporting Containers and Trailers

Shortages of equipment contribute to delays and inefficient operation of some intermodal terminals. For example, new, larger container ships are placing more demands on loading and unloading and other equipment. Adequate numbers of large cranes that can quickly unload (or load) a ship onto a several thousand-foot long container train are required. The increasing numbers of containers and larger peak loads are requiring substantial equipment upgrades at most large container ports and rail terminals.

Managing the flow of containers and chassis is another key intermodal challenge. New systems for storing empty containers and chassis in regional "pools" from which they can be sent to a number of terminals need to be implemented. This will help to assure that sufficient numbers of chassis will be available when trains arrive at each intermodal terminal in a region. Managing empty containers includes marketing initiatives to obtain backhauls so that fewer containers are shipped empty, as well as arranging to reposition empties economically at other locations.

Additional equipment will be needed for some new kinds of rail service. RoadRailer equipment with the capability of operating both on highways and on rail lines will be needed for RoadRailer service. New types of railroad cars to efficiently load and unload trailers will be needed for the Iron Highway. The forecast expansion of domestic and international container activity will generate substantial new demand for containers, chassis and double-stack rail cars.

Technical Barriers

A variety of technical barriers are being encountered in handling growing volumes of intermodal, especially international, freight. At many ports, terminals and airports, electronic data systems to track and process large volumes of intermodal freight quickly need to be updated or installed. For example, the rapid unloading of a ship carrying 1,200 (and up to 3,500) containers and placing these on a mile-long train in a prescribed order so that shipments can be tracked and groups of cars can be shunted off to certain markets at switching yards as the train proceeds across the country, requires a sophisticated EDI system. This is key to efficient intermodal operations.

At both ports and airports, an added requirement is the expedited clearance of international shipments. This means working with U.S. Customs to preclear most shipments while these are on

the way and setting aside only those containers selected for inspection. Clearance of quota restricted goods is a special problem. The development and implementation of new electronic data systems for customs and quota purposes is essential to improving intermodal port and terminal operations. On-site U.S. Customs inspection at more terminals is necessary for fast and efficient processing of international goods.

Since the passage of the North American Free Trade Act (NAFTA), more attention has been given to faster clearance of border crossings. Substantial improvements have been made in speeding up truck and rail shipments across the Canadian border but major steps need to be taken to improve crossings at the Mexican border. Many trains currently unload their containers at the border and transfer these to Mexican companies who handle clearance and truck them to their destinations, rather than continuing by rail to terminals closer to their receivers.

New systems for the efficient management of terminals are needed to improve intermodal operations. At a basic level, this includes systems for keeping track of empty containers and chassis by size and other characteristics. It includes systems that can translate the size and destinations of containers on a ship that is in transit into the make-up of a train so that it will have the right mix of cars arranged in the proper order ready when the ship arrives. It also requires systems for scheduling the amount, types and efficient utilization of loading and unloading equipment.

Inadequate Terminal Operating Hours and Schedules

Train scheduling affects overall transit times of shipments. For example, if a shipment arrives at its destination terminal on a weekend when it is closed for pick-up or when the receiver is not open for business, its delivery is delayed. The effective arrival date to the receiver is when the shipment reaches its loading dock, not when the shipment arrives at the terminal. For some shippers who restock or ship for arrival on certain days of the week, train schedules are very important. The fact that goods move quickly and efficiently may be more than offset by the days of the week (and hours) during which rail/terminal service operates. Cut-off times at terminals are important. If these are late in the evening, so that a full day's production can be shipped, it is sometimes an advantage to shippers. Priority service is also important so that there is expedited through service. This may include timing short-haul rail shipments so that they connect at gateways with long-haul expedited train service.

Trucks have more flexibility in scheduling their departures, choice of routes, and they can make the whole trip from shipper to receiver. For rail to compete with trucks, especially in medium-haul distances, it is important that schedules, departure times, connections and drayage be efficient.

Insufficient Management Capabilities

The efficient management of intermodal shipments and facilities is critical to achieving good intermodal service. This involves utilizing the latest management techniques and systems in the operation of port, airport and rail terminal facilities. This is increasingly being done by companies or subsidiaries that specialize in such operations. Because of the profit incentive, there is sometimes an advantage in commercial operators carrying out the management of port facilities under contract with public agencies. The line-haul part of the intermodal journey is usually managed by a railroad, ocean shipping company, trucking company or airline. Generally they manage that part of the trip well.

Logistics companies and third parties are handling increasing numbers of intermodal shipments for many businesses. They arrange for transportation services for the whole journey. Some of the larger companies, such as Maersk, APL, UPS and others, contract with carriers for service. Some 60 percent of rail freight currently moves under contract rates. Large logistics companies, ocean lines and third party shippers contract for regularly scheduled priority service that interconnects efficiently between modes. For example, a contract container ship will be scheduled to meet a double-stack train at a port. The ship will be efficiently unloaded onto a waiting train, which then leaves on an expedited journey. Along the way, it drops off groups of rail cars/containers destined for nearby customers. Because of their large scale, knowledge of intermodal transportation, contract rates and coordinated intermodal service, these logistics/shipping companies are playing an increasingly important role requiring carriers to provide improved intermodal service.

The influence that large logistics companies, ocean lines and major corporations have in obtaining fast and efficient intermodal transportation to meet their needs requires that other shippers adapt their logistics strategies. One approach is for smaller shippers to get together to assemble larger shipments and thereby gain more leverage for better service with carriers and with logistics/shipping companies.

Low Profitability of Terminal Operations and Intermodal Service

Competition is restraining transportation costs. The National Commission on Intermodal Transportation concluded that transportation costs as a percent of GNP had decreased between 1980 and 1992, "... representing savings to the U.S. economy exceeding $31 billion in 1992." These savings resulted both from efficient transportation (such as double-stack) and from competition among and between modes, especially between truck and rail. Logistics and ocean lines have negotiated hard with carriers to obtain favorable rates. One result is that the profitability of intermodal transportation has been restrained. This limits the ability of carriers to invest in new facilities and equipment.

Competition between truck and rail is intense. For short distances, trucking is generally less expensive than rail. A truck shipment can go directly from a shipper (or port) to the receiver. An intermodal movement generally involves draying to a terminal, loading a container onto a railcar (or unloading from a ship onto a railcar), transporting the container by rail (line-haul movement), unloading the container at the destination terminal, and draying (trucking) it to the receiver. Drayage, loading and unloading add to the cost of a rail intermodal shipment. For example, two lifts add about $100 to $150 and drayage to and from the terminals may add $150 to $300 per container. Line-haul movement of a 20 ton container 1,000 miles at $0.05 per ton mile would cost about $1,000. Therefore, shipping the container intermodally by rail costs about $1,250 to $1,450, or about $0.0625 to $0.0725 per ton mile. About 20 percent to 30 percent of the cost is drayage and loading/unloading. Truck costs are estimated to be in the $0.06 to $0.08 range per ton mile, so trucks would provide strong competition in this example. Double-stack service would reduce line-haul rail costs by about one-third, which would improve the competitive position of rail. However, offsetting this is rail's slower and less flexible service, as well as higher loss and damage rates. Triple Crown, Iron Highway and RoadRailer rail services are focussed on making rail more competitive with trucks for medium and short-haul freight service.

Trucking is very competitive with rail over distances of less than 1,000 miles. Over longer distances, rail service, especially double-stack, is often lower cost than trucking. Favorable rail

rates are negotiated by large volume shippers, shipping companies and third parties, such as logistics companies. Trucking is competitive over a wide range of distances because it can offer special service for some types of shipments, such as when flexible departure and arrival times are important, for fragile goods, in cases in which shippers/receivers prefer goods to move by one mode to their destination, for better "tracking" of shipments and for other specific reasons. The competition between truck and rail benefits shippers by helping to encourage fast and efficient transportation.

Regulatory Impediments

Environmental Restrictions

Environmental regulations make it more expensive, time-consuming and complicated to expand existing terminals and to develop new ones. In the case of ports, environmental regulations make it very difficult to undertake dredging projects and wetlands regulations often make expansion of existing terminals and other facilities difficult and slow. Railroads need to expand and build new terminals faster than it is likely they will be able to obtain environmental, zoning and other development approvals. Airport expansion and development is severely constrained by environmental regulations, as well as by financial considerations.

Lack of Standardized Regulations

A variety of truck regulations adversely affect their operating efficiency. For example, differences in size and weight regulations among States adversely affects the efficiency and cost of interstate trucking. Standard national size, weight and other regulations applying to interstate truck movements would make truck operations more efficient. Including truck routes and access roads in local transportation plans, land use planning and the National Highway System would help to increase funding opportunities for them.

Taxes, Fees and Other Charges

Standardization of taxes, fees and other charges across States and among different modes should be encouraged. Most intermodal transportation involves goods moving across more than one State boundary, so more standardization nationwide of charges and fees and base State reporting would be desirable. For example, franchise taxes and real estate taxes on railroads might be made more equal among States. Sharp increases in railroad franchise taxes, such as occurred in Ohio, or increases in port charges to fund other programs, such as occurred in Los Angeles, should be avoided because these distort efficient intermodal transportation.

New taxes on intermodal freight would have an adverse impact on intermodal transportation, offsetting some of the cost savings that have occurred. As noted in the National Commission on Intermodal Transportation's report, the recent decision to permit the imposition of sales taxes on the lease of intermodal containers used exclusively in international commerce could lead to other taxes, such as local property taxes on domestically owned containers used exclusively in international commerce.

Financial Impediments

Limited Financial Resources

The expansion of rail, port and airport terminals and facilities, and building new ones will require substantial public and private investment. ISTEA has made some funds available for intermodal terminal facilities; however, the major focus of Federal transportation funding from the highway and air trust funds remains on modal systems.

Most rail and truck intermodal terminals and facilities are privately owned and operated, so it is mainly the private sector's responsibility to finance improvements to these. Railroads also make most of the investment in their rail systems and airlines make most of the investment in aircraft and cargo facilities. The public sector also plays a key role in financing basic infrastructure improvements at ports and airports which are generally owned by port and airport authorities, and by State and local governments. The public sector also has the primary role in improving access to these and other terminals and facilities.

Public and private partnerships are needed to fund many of the improvements required to facilitate intermodal transportation. These involve the joint planning and financing of improvements in which there is both a public and a private interest. Typical projects include improving access roads to terminals, grade crossings, increasing bridge and tunnel clearances, development of new multi-tenant intermodal facilities and other initiatives.

The need for funding Federal transportation infrastructure programs at authorized levels, strategically targeting these funds for maximum impact, allowing more flexibility in funding intermodal projects, expanding innovative financing methods, and providing Federal funding incentives for intermodal projects are recommended by the National Commission on Intermodal Transportation.

In the short-term, MPOs and port authorities may not be able to commit adequate funds for needed port and rail terminal improvements. Local and State transportation improvement programs (TIPS) and the National Highway System (NHS) require projects to be justified before being included in five-year capital budgets for transportation improvements. Faster action requires re-prioritizing projects, which is not easy to do. On one hand, there is concern about using public funds to benefit a private transportation company. On the other hand, railroads and trucking companies are often reluctant to share terminal facilities.

Freight railroads, trucking companies, airlines and ocean shipping lines are mainly privately owned. Their financial strength varies widely and so does their ability to participate in funding improvement projects. Airlines, for example, are going through a difficult financial period and most have few resources to devote to expansion and modernization of airport facilities. The U.S. merchant fleet has shrunk considerably and ocean trade currently has a low rate of profit which makes it difficult for them to participate in expensive port improvement projects. Many railroads are burdened by the costs of rebuilding facilities that were damaged or destroyed by floods in the Midwest or by earthquakes in California during the last few years.

Institutional Impediments

Competitive Industry Structure Hinders System Integration

The competitive structure of the transportation industry contributes to the difficulty of achieving "seamless" intermodal transportation. For example, competition between railroads has the advantage of resulting in lower rates and better service in transportation corridors where there is competition. However, railroads are generally subdivided into eastern and western railroad systems that must interchange traffic at mid-points, such as at Chicago, Kansas City and St. Louis. Sometimes this requires switching engines and crews and adjustments in train size. Also, connecting railroads will not necessarily give the same priority to shipments originating on other lines as they do to those that originate/terminate on their lines. Third party contracts for through service are helping to upgrade the

interchange of interline shipments but more improvement is needed.

Competitive considerations can deter some improvements. For example, some railroads are reluctant to cooperate with each other to develop joint terminals (or co-locating in a publicly developed terminal) because they are concerned that it will adversely affect their competitive position. Competition between different modes sometimes leads to regulations that adversely affect more efficient transportation. For example, railroads argue against increases in the size and weight of trucks and "triple-trailers" (or truck trains) for competitive reasons. Often other considerations, such as safety, play a role making it difficult to distinguish competitive-generated regulations from those imposed for real safety reasons.

Different Public and Private Objectives

Since the passage of ISTEA, increased attention has been given to freight transportation and especially to intermodal freight. Because freight transportation has largely been controlled by private companies, most government organizations and transportation planning agencies have not focussed on freight issues. It is evident that substantial benefits can be realized by both the public and private sectors working more closely together to improve intermodal transportation. However, both the public and private interests need to gain a better understanding of the other's views and needs. On one hand, this means that transportation planning agencies, such as MPOs, need to gain more insight into the freight industry, how it functions and what are its needs. On the other hand, private freight interests need to understand the planning process, timing and funding of roads and other transportation infrastructure. This will help both to work constructively to achieve better intermodal transportation, and at the same time, to understand the difficulties and risks that each needs to take into account.

Different Time Horizons of the Public and Private Sectors

The timeframe for which public and private agencies plan is different, making it difficult to develop coordinated plans. Most private transportation companies focus on the short-term, which often means on the next year or two. Public agencies' infrastructure development programs are typically based on five-year capital budgets and 10- to 25-year plans. It is necessary for railroads, trucking companies and air freight companies to begin to develop longer-term outlooks and for transportation planning agencies at the State and local level to develop more "early action" implementation programs.

Labor Issues

Labor agreements should be reviewed in the light of efficient operation of intermodal terminals and transportation systems. To the extent appropriate, work rules should be adjusted.

Training of workers engaged in the EDI, logistics, and the operations of terminals and other facilities, will be needed to complement the introduction of new systems and technologies.

Limited Community Support for Freight Transportation

Community attitudes toward freight facilities and freight transportation sometimes hinder the development of intermodal transportation. Expansion of port facilities, rail terminals and airports will be required in the future. Trucks will be viewed as a more significant problem as congestion increases in major cities, such as in Los Angeles, New York and Chicago. There is likely to be increasing resistance from some community groups to expanding freight transportation facilities because of traffic impacts, environmental/air quality impacts, perceived safety issues and costs. Therefore, it will become

increasingly important for both the economic and environmental benefits of intermodal transportation to be publicized more widely in order to gain greater public support.

Conclusion

The outlook is for continued rapid growth in intermodal transportation. This means that impediments, such as those that have been identified, will become greater hindrances in the future unless expanded and new public and private initiatives are undertaken at the Federal, State and local level.

Achieving good intermodal service is a challenge, as evidenced by the impediments that have been identified. However, numerous pioneering initiatives are underway and more are being planned that will help to overcome the obstacles to realizing better intermodal freight service. Some of these include the improvement of the 20-mile long Alameda Corridor, public/private development of a large multi-tenant intermodal terminal in Detroit, innovative financing of a new intermodal terminal in Stark County, Ohio, development of the Columbus Inland Port, regional intermodal freight planning carried out in the New England Transportation Initiative, planning for cross harbor freight transportation in the New York area, a public/private partnership that is providing double-stack capability in Pennsylvania extending west to Pittsburgh; State initiatives, such as in Florida, which provide funding for intermodal projects complementing Federal ISTEA funding; and numerous projects by MPOs.

Carrying out initiatives to improve intermodal transportation by removing or reducing the impediments that have been identified will benefit activities dependent on freight transportation, improve the competitive position of the United States, result in faster economic growth and generate more jobs and income for the American people.

This report was prepared in September 1995 as part of an ongoing project examining "Impediments to Efficient Intermodal Transportation" under contract with the Federal Highway Administration by a consultant team headed by Cambridge Systematics, Inc., and including Apogee Research, Inc., Jack Faucett Associates, and Sydec, Inc.

The principal author of this report was John S. Reed of Cambridge Systematics, Inc.

Intermodal Freight Transportation

Data Sources for Intermodal Transportation Planning

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Data Sources for Intermodal Transportation Planning

Introduction

Sources of freight data that can be used for intermodal freight planning together with some examples of their use are described in this report. It includes information about freight flows by commodity, by mode and by area, existing infrastructure, equipment and its utilization, as well as other relevant characteristics.

Purpose

The report provides a brief overview and evaluation of existing intermodal transportation data sources and their applications to intermodal freight planning. Information is provided about freight databases that are sponsored by various government and private agencies. This includes types of data, scope, coverage, and collection methods. This information provides a summary of existing data collection programs and indicates some of the ways the data may be used for identifying operational and technical improvements that will facilitate intermodal freight transportation.

Attached to this section is an appendix that provides detailed information about selected data sources listed in this review. Examples of applications of the data for intermodal planning are presented. Detailed database characteristics and utilization examples have not been provided for all identified data sources because this information is being compiled in two existing FHWA freight data related projects, "The Characteristics of Urban Freight Systems" (University of Tennessee) and "A Quick Response Manual for Freight Modeling and Planning by State Departments of Transportation and Metropolitan Planning Organizations" (Cambridge Systematics, Inc.). These provide far more information about the uses of existing freight and intermodal data sources.

Deficiencies in Intermodal Transportation Data Sources

Effective intermodal transportation planning requires that pertinent data be available to transportation planners. A variety of data sources and analytical programs that attempt to address these needs are currently in place. There are, however, significant data and analytical gaps that will need to be filled in order to improve intermodal transportation planning.

ISTEA requires the States to develop, establish, and implement an Intermodal Management System (IMS) for managing intermodal transportation facilities. In metropolitan areas, these systems must be developed and implemented in cooperation with the MPOs responsible for carrying out the planning process. The management systems will provide information needed by State and local officials to make informed decisions about how to best utilize their limited resources. The March 2, 1993 issue of the Federal Register includes the proposed rule for ISTEA management systems, which states that "The primary purpose of the management systems is to provide additional information needed to make effective decisions on the use of limited

resources to improve the efficiency of, and protect the investment in, the nation's existing and future transportation infrastructure at all levels of jurisdictional control." The Proposed Rule includes minimum requirements for each system with an emphasis on an "end result" philosophy, as distinct from detailed specifications of the content of each management system.

The proposed Rule states that "The objective of the IMS as a transportation planning element is to increase efficiency, productivity and the use of advanced technologies in transportation systems." A fully implemented IMS would result in:

- A continuing inventory of intermodal facilities and systems.
- Incorporation of IMS strategies and actions into transportation planning processes.
- An implementation plan for integrating results of an IMS into statewide and metropolitan plans and programs.

Included in responses to an earlier announcement of the proposed rule which identified several parameters that should be used to measure efficiency of intermodal freight transportation facilities and systems were: "Time, cost, delay, system reliability, system flexibility, ease of access, modal commodity changes, turnaround rates, contingency operations, information flows, level of service, impacts on air quality and energy consumption, condition of freight on arrival, facilities and equipment capacity and measures of freight cargo, value, units per distance traveled, transfers, and origins and destinations."

In order to build effective Intermodal Management Systems and to evaluate the overall effectiveness and market penetration of intermodal technologies, improvements in data currently collected are required. At present almost all of the data sources are information on either movements by a single mode or information by type of facility. For example, the Carload Waybill Sample provides data on rail movements of commodities, Waterborne Commerce provides information on inland movements by water, the Truck Activity Survey and the Truck Inventory and Use Survey provide data on highway movements, the FAA Air Traffic Activity provides information on air movements, and the Port Import/Export Reporting Service and U.S. Waterborne Exports and General Imports provide information on oceanborne water movements. Similarly, other sources provide information on specific types of equipment or facilities. For example, the American Intermodal Equipment Inventory records stocks of intermodal equipment for major U.S. marine carriers and leasing companies. The Analysis of Ports for National Defense, in the Port Facilities series, provides information on port facilities.

The problem with these various data series are that they were not designed to be used together and therefore do not provide information on the linkages that are the crux of intermodal planning. The Carload Waybill Sample provides detailed information on railroad movements including starting and ending points, transfers, tonnage, revenues, names of carriers, and a host of other information. Unfortunately, it does not indicate where a particular movement entered the rail system, whether that is where the movement actually started or whether it was moved to rail on another mode such as truck. Since almost all of the existing transportation data are mode- or facility-specific and are not designed to be linked, they lack the "network" capability that is central to measuring and improving intermodalism.

The Commodity Flow Survey (CFS) is the most detailed multimodal data source that compiles information on freight movements from origin to destination. This source, which formerly listed only the primary mode of transport, will list each

mode separately in the 1993 CFS. The 1993 survey, which is scheduled for release in late 1995, will allow for the first time a more accurate study of multimodalism. For example, it will be possible to tell how much freight moved exclusively on one transport mode, and how much moved using a combination of modes.

Planning for intermodal transportation improvement takes into account modal and intermodal performance, as well as comparisons with alternatives. For example, if two rail lines are linked to eliminate a truck haul, this is considered an intermodal improvement even though it results in a decrease in intermodal freight movement. Data designed to capture the phenomenon of intermodalism, therefore, must measure the efficiency of each modal segment as well as each transfer between modes. Efficiency in this context refers to the gamut of operational characteristics enumerated above including cost, time, damage, and other factors.

Intermodal Freight Data Sources and Activities

The data sources are divided into primary and secondary sources according to data collection responsibilities. Primary data sources are specific data activities intended to collect information for a particular study or project whereas secondary data sources are existing or ongoing data collection efforts being performed by government agencies or private organizations. Both primary and secondary data sources and activities can be extremely useful in intermodal planning and the identification of impediments to intermodal transportation.

Primary Data Sources

Primary data sources are data collection efforts designed and performed to produce detailed information for a specific purpose or study. Primary data collection activities focus on particular geographic areas and/or transportation facilities and data collection required for a transportation study or project. The most common techniques for gathering primary transportation data are mail/telephone surveys, direct interviews, and traffic monitoring.

Special Surveys

Special surveys provide a means for collecting detailed information on freight shipments occurring in specific areas. Collection procedures may include mail or telephone survey techniques, depending on the size and population of the geographic target area. Surveys are designed to provide specific shipment information such as origin/destination points, transportation mode, commodity distribution, and vehicle type, class, and weight.

A special survey was performed as part of the Arizona DOT's Urban Truck Travel Model study. A commercial vehicle survey in the Phoenix area provided detailed information on 3,402 trips made by 606 commercial vehicles registered in Maricopa County. The data collection procedure used for vehicles selected from the Department of Motor Vehicle (DMV) file was a combined telephone/mail method. Vehicle owners were called, initial screening questions were asked, and cooperation was requested in the mail portion of the survey. A mail-back questionnaire that included a one-day trip diary was mailed to vehicle owners. The results of the combined telephone/mail survey demonstrated an effective strategy for collecting detailed trip generation information.

Interviews with Shipping Firms and Public Sector Officials

Direct interviews with shipping firms and public officials draw on knowledge from experienced personnel in the freight industry to provide

information related to intermodal transportation. Direct interviews are important in identifying problems associated with intermodal freight transport and can be conducted in person or by phone.

An example of obtaining intermodal planning information directly from public and private sector representatives was performed in the *Inland Port Infrastructure Study*, for the Mid-Ohio Regional Planning Commission. The Greater Columbus Inland Port Commission was the focal point for development of the Inland Port. The commission included representatives of rail lines; airlines; trucking companies; shippers; private businesses; port authorities; transportation agencies; Greater Columbus Chambers of Commerce; and the Ohio State University. Many of the recommendations of the Inland Port Study were made by members of the Inland Port Commission who were interviewed in person or participated in shipper, carrier and other freight service panels. The recommendations included infrastructure improvements and other actions by both the private and public sectors to improve intermodal transportation in the Columbus area. Implementation of the recommendations is resulting in more efficient intermodal transportation which is benefitting shippers and other private sector businesses. It also is resulting in improvements in transportation and faster economic growth which is benefitting the public sector and the economy of the area.

Descriptions of Existing Intermodal Transportation Data Sources

Secondary data sources include existing databases and compilation of data that provide useful information in evaluating intermodal transportation. A significant amount of transportation-related data is currently collected by public and private agencies and firms and provided to transportation planners. A combination of several existing data sources may provide sufficient information to address many of the transportation issues.

The secondary data sources which have been identified in providing useful information for intermodal transportation planning include:

- American Intermodal Equipment Inventory
- Analysis of Ports for National Defense
- Cargo Preference Overview System
- Carload Waybill Sample
- Commodity Flow Survey
- Domestic Waterborne Commerce of the United States
- FAA Air Traffic Activity
- Highway Performance Monitoring System
- National Truck Activity Survey
- Port Facilities
- Port Import/Export Reporting Service
- Port Series
- Tonnage for Selected United States Ports
- TRANSEARCH
- Truck Inventory and Use Survey
- U.S. Exports by State of Origin
- U.S. Waterborne Exports and General Imports
- Waterborne Commerce Statistics
- World Sea Trade Service

Scope and Coverage of Data Sources for Intermodal Planning

Scope and coverage of data sources are dependent on characteristics of the database development process such as objective, intended users, sampling base, and frequency of collection. Data bases often are developed for a primary objective or user group but are frequently implemented for a variety of additional purposes. It is critical to understand the original scope of the data col-

lection activity in order to account for any bias related to sample selection, aggregation, and summarization of results.

Figure 2.1 provides scope and coverage information for each of the intermodal planning data sources. The government agency or private firm responsible for collecting and/or distributing the transportation data is also identified. Modal coverage of the data source including highway, rail, waterborne, transit, air, and intermodal systems are specified with either a complete or partial coverage indicator. Finally, a brief description of the primary focus or scope of the data collection effort is provided.

Modal System Information from Intermodal Planning Data Sources

Transportation data sources frequently focus on a particular modal system, subsystem, or type of monitored activity. Multimodal transportation sources often provide specific information across various modes such as travel demand, commodity distribution, or trip characteristics. Intermodal planning requires transportation information across all transport modes but must rely on different data sources because multimodal data sources do not provide sufficient detail in all required information.

Figure 2.2 summarizes the type of information provided by the secondary intermodal planning data sources by transportation modal system. The transportation information varies according to modal system but includes the following categories:

- Vehicle/Passenger
- Freight Shipment
- Commodity Distribution
- Origin/Destination
- Facilities
  - Condition
  - Capacity
  - Volume/Capacity (V/C) Ratio

Collection, Distribution, and Utilization of Data Sources for Intermodal Planning

Collection responsibilities, product distribution, and data utilization are important factors in evaluating existing data sources for intermodal planning purposes. Frequency of data collection activities varies depending on the design and sponsorship of the data source. Geographic coverage or levels of aggregation affect the usefulness in applying transportation data to intermodal planning. Specific data sources such as the Carload Waybill Sample collects information on a regional level. This provides a useful analysis of regional flows but limits its usefulness for a particular urban area or intermodal facility.

Figure 2.3 provides collection, distribution, and utilization information for the intermodal data sources reviewed. The primary categories are:

- Area (geographic coverage)
- Collection (frequency)
- Sponsorship (agency or firm)
- Media (distribution type)
- Analytical Issues (utilization)

Descriptions of Existing Intermodal Transportation Data Sources

American Intermodal Equipment Inventory. This system records all intermodal equipment of U.S.-flag intermodal marine carriers and major container leasing companies operating in the U.S. It includes for each company the type, number, and dimensions of containers and trailers. Chassis are shown by type, number of units, and containers carried. The size and number of slots

Figure 2.1 Scope and Coverage of Data Sources for Intermodal Planning

Data Source	Agency/Firm	Modal Coverage						Scope
		Highway	Rail	Waterborne	Transit	Air	Intermodal	
American Intermodal Equipment Inventory	MARAD/U.S. DOT			●			●	Record of all intermodal equipment of U.S.-flag intermodal marine carriers & container leasing com.
Analysis of Ports for National Defense	MTMCTEA/Dept. of Army			●				Data on specific evaluations of commercial ports capabilities to support DoD military units.
Cargo Preference Overview System	MARAD/U.S. DOT			●				Contains information on government shipping activities using private shipping lines.
Carload Waybill Sample	Interstate Commerce Comm.		●				○	A stratified sample of all rail waybills - traffic, commodity, revenue, and routing characteristics.
Commodity Flow Survey	Bureau of the Census/U.S. DOT	●	●	●	●	●	●	Tracking commodity movements and transportation usage for policy analysis of U.S. transportation.
Domestic Waterborne Commerce of the United States	MARAD/U.S. DOT			●				Domestic waterborne commerce by commodity, vessel, operator, type of service, and trade segment.
FAA Air Traffic Activity	FAA/U.S. DOT					●	○	Data on terminal and enroute air traffic activity including operations, approaches and departures.
Highway Performance Monitoring System	FHWA/U.S. DOT	●						Includes universe data consisting of a small amount of information for all public road mileage.
National Truck Activity Survey	FHWA/FRA/OTS/U.S. DOT	●						Follow-on of 1987 TIUS designed to collect detailed information on travel characteristics.
Port Facilities Inventory	MARAD/ U.S. DOT			○				Detailed physical characteristics and cargo capacities for approximately 4,000 major port facilities.
Port Import/Export Reporting Service	Journal of Commerce			●				Detailed information on maritime shipments to facilitate international trade of intermodal containers.
Port Series	U.S. Army Corps of Engineers			●				Information on commercial facilities at principal U.S. Coastal, Great Lakes, and Inland Ports.
Tonnage for Selected United States Ports	U.S. Army Corps of Engineers			●				Listing of total, domestic, and foreign tons handled at U.S. Ports for a given calendar year.
TRANSEARCH	Reebie Associates, Inc.	●	●	●	●	●	●	Multimodal traffic statistics between 183 Business Economic Areas by commodity type.
Truck Inventory and Use Survey	Bureau of the Census	●						A survey of registered trucks producing state universe estimates of the nations truck population.
U.S. Exports by State of Origin	Bureau of the Census	○	○	●	○	●	○	Reporting value of U.S. exports for all transportation modes; weight for air and vessel movements.
U.S. Waterborne Exports & General Imports	Bureau of the Census			●				Information on type of vessel service, U.S. coastal district, customs district and port.
Waterborne Commerce Statistics	U.S. Army Corps of Engineers			●				Information on waterborne shipments including ports and docks, commodity type, and tonnage.
World Sea Trade Service	DRI McGraw-Hill			●				International waterborne shipments to anticipate changes in liner and bulk cargo movements in future.

● Complete ○ Partial

Figure 2.2 Type of Information by Modal System of Data Sources for Intermodal Planning

Data Source	Highway							Rail						Waterborne						Transit						Air						Intermodal					
					Facility						Facility						Facility				Facility						Facility						Facility					
	Vehicles/Passengers	Freight Shipment	Commodity Distribution	Origin/Destination	Condition	Capacity	V/C Ratio	Freight Shipment	Commodity Distribution	Origin/Destination	Condition	Capacity	V/C Ratio	Freight Shipment	Commodity Distribution	Origin/Destination	Condition	Capacity	V/C Ratio	Passengers	Vehicle Miles	Condition	Capacity	V/C Ratio	Air Traffic	Freight Shipments	Commodity Distribution	Condition	Capacity	V/C Ratio	Freight Shipment	Commodity Distribution	Origin/Destination	Condition	Capacity	V/C Ratio
American Intermodal Equipment Inventory																																		●	
Analysis of Ports for National Defense																		●	●																	
Cargo Preference Overview System														●	●	●																				
Carload Waybill Sample								●	●	●																●	●									
Commodity Flow Survey		●	●	●				●	●	●				●	●	●					●					●	●				●	●	●			
Domestic Waterborne Commerce of the United States														●	●																					
FAA Air Traffic Activity																									●	●										
Highway Performance Monitoring System	●				●	●	●																													
National Truck Activity Survey		●	●																																	
Port Facilities Inventory														●	●		○	●	●																	
Port Import/Export Reporting Service																															●	●				
Port Series														●	●		●	●	●																	
Tonnage for Selected United States Ports														●	●																					
TRANSEARCH		●	●	●				●	●	●				●	●	●										●	●				●	●	●			
Truck Inventory and Use Survey			●																																	
U.S. Exports by State of Origin														●	●	●										●	●									
U.S. Waterborne Exports & General Imports														●	●																					
Waterborne Commerce Statistics														●	●																					
World Sea Trade Service		●	●					●	●					●	●										●	●					●	●				

● Complete ○ Partial

Figure 2.3 Collection, Distribution, and Utilization of Data Sources for Intermodal Planning

Data Source	Area						Collection				Sponsorship					Media				Analytical Issues					
	National	State	Region	County	Corridor	Facility	Multi-year	Annual	Quarterly	Periodic	U.S. DOT	Bureau of Census	Army Corps of Eng.	Private	Other	Hard Copy	Computer Disk	Public Use Tape	CD-ROM	Historical Data	Summarized in Publication	Easily Understood	Cost Effective	Readily Available	Forecastable
American Intermodal Equipment Inventory	●						●				●					●							●	●	
Analysis of Ports for National Defense						●	●								●	●					●	●	●		
Cargo Preference Overview System	●						●				●						●						●		
Carload Waybill Sample	●		●					●			●				●			●	●	●		○	●	●	●
Commodity Flow Survey	●	●	●				●				●	●				●				○	●	●	●	●	
Domestic Waterborne Commerce of the United States	●					●		●			●		●			●	●			●	●	●	●	●	●
FAA Air Traffic Activity						●		●			●					●	●			●	●	○	●	●	●
Highway Performance Monitoring System	●	●		●	●			●			●						●		●	●	○		●		●
National Truck Activity Survey	●	●									●								●			○	●	○	
Port Facilities Inventory						●				●	●					○	○						●	●	
Port Import/Export Reporting Service	●					●		●						●		●	●			●	●	●			●
Port Series						●				●			●			●	●			●	●	●	●	●	●
Tonnage for Selected United States Ports						●		●					●			●	●			●	●	●	●	●	●
TRANSEARCH	●	●			●			●						●		●				●	●	●			●
Truck Inventory and Use Survey	●	●					●					●				●		●	●	○	●	●	●	●	○
U.S. Exports by State of Origin	●	●						●				●													
U.S. Waterborne Exports & General Imports	●							●					●												
Waterborne Commerce Statistics	●					●		●					●			●	●			●	●	○	●	●	●
World Sea Trade Service	●							●						●		●				●	●	●			●

● Complete ○ Partial

available on container vessels and barges is recorded. Forty-foot equivalent units of trailers along with automobile capacity are also included for Ro/Ro ships and barges.

Analysis of Ports for National Defense. This system includes data on specific evaluations of the commercial ports' capabilities to support early deployment of U.S. Department of Defense (DoD) military units during a contingency. Port areas analyzed include Baltimore, Boston, Charleston, Hampton Roads, Jacksonville, Morehead City, Narraganset Bay, New York, New Jersey, Philadelphia, Savannah, Wilmington (NC), Beaumont, Houston, New Orleans, Gulfport, Port Arthur, Pascagoula, Lake Charles, Port Hueneme, Los Angeles, Long Beach, and San Diego. Military Ocean Terminals in New Jersey and Oakland are also evaluated. Data include the number and characteristics of berths, ship mixes, staging areas, inloading/outloading positions, cargo handling apparatus, rail and highway access, and general information on port facilities. Also included is a theoretical cargo throughput capability for each port.

Cargo Preference Overview System contains information on government shipping activities by tracking individual cargo preference shipments. U.S. Maritime Administration (MARAD) is responsible for ensuring compliance with cargo preference laws to maximize the use of U.S.-flag vessels.

Carload Waybill Sample is a stratified sample of rail carload waybills representing the movement of rail cars and commodities over the nation's rail system. Large railroads have supplied the government with a stratified sample of waybills for the past 40 years to produce the waybill sample database. The primary purpose of the sample was to enable planners to estimate flow and rate characteristics of rail carload traffic on a continuous national level. Information provided in the Interstate Commerce Commission (ICC) Carload Waybill Sample includes origin, destination, routing, type of car, commodity classification, mileage, revenue, and type of rate.

1993 Commodity Flow Survey (CFS) is an extensive survey of commodity movements by type of transportation mode in the United States. The CFS is a continuation of statistics collected in the Commodity Transportation Survey from 1963 through 1977 with improvements to the methodology, sample size, and scope. The survey, designed to collect data on the flow of goods and materials by transportation mode, has become a regular part of the quinquennial Economic Censuses. The Bureau of the Census and the U.S. Department of Transportation conduct the CFS sampling of approximately 200,000 randomly selected domestic establishments. Each selected establishment reports a sample of 30 outbound shipments for a two week period in each of four calendar quarters for the sample year. Information collected includes origin, destination, commodity classification, and mode of transport.

Domestic Waterborne Commerce of the United States is a freight database that contains information on domestic waterborne commerce in short tons by commodity, vessel, operator, shipping and receiving dock, service type, and trade segment. It also includes detailed data on vessels and operators engaged in this commerce.

FAA Air Traffic Activity is a report that contains data on terminal and air traffic activity for selected airports in the United States. Data include airport operations, instrument operations, instrument approaches, departures, overflights, aircraft handled, total flight services, aircraft contracted, flight plans originated, radio contacts, pilot briefs, and airport advisories.

Highway Performance Monitoring System includes data consisting of a small amount of information for all public road mileage in each State. Additional information on physical

characteristics, condition, use, and performance for sample roadway sections within the State are included in the sample data. The data are based on statistically valid samples, consisting of accident data, system length and travel by functional system, and travel activity by vehicle type. The accident data contain summary statistics on fatal and non-fatal injury accidents.

Port Facilities Inventory contains detailed information on more than 4,000 major ocean and river port facilities, including location, physical characteristics, cargo handling equipment, and capacities.

Port Import/Export Reporting Service (PIERS) is a database of intermodal containerized shipments information for containers entering or leaving U.S. ports. The PIERS database is collected and maintained by The Journal of Commerce. Data are collected from import manifests and export bills of lading, either electronically or directly from hard copy documents. Intermodal carriers, steamship lines, and U.S. port authorities all subscribe to this reporting service for container shipment planning purposes. Shipment, carrier, and container characteristics are entered in the database; data are taken from shipping documents rather than from physical inspections. Beginning in 1994, origin/destination information was available for intermodal shipments; however, reported origins and destinations may be billing addresses rather than shipment points.

Port Series is a collection of fifty-seven reports that includes information on commercial facilities at the principal U.S. Coastal, Great Lakes, and Inland Ports. Each report consists of complete listings of a port area's waterfront facilities, including information on berthing, cranes, transit sheds, grain elevators, marine repair plants, fleeting areas, and docking and storage facilities. Aerial maps show the location of the described facilities.

Tonnage for Selected United States Ports is a database that provides a listing of tons handled at major U.S. ports for a given calendar year. The ports are sorted by total, domestic and foreign tonnage, and alphabetically. The total tonnage handled by port is taken from vessel operation reports filed by steamship lines.

TRANSEARCH is a traffic flow database providing transportation information of domestic freight traffic movements by market area, traffic lane, commodity, and mode of transport. The database has been developed and maintained since 1978 by Reebie Associates and is targeted for use by motor carriers, railroads, steamship companies, equipment suppliers, public sector agencies, and major shippers. A variety of data reports is available by origin/destination markets, commodity, or traffic lane. Traffic flow information is taken from a number of sources such as the Carload Waybill Sample, Census of Transportation, and Import/Export Trade Statistics.

Truck Inventory and Use Survey (TIUS) is a vehicle-based survey of truck activity conducted by the Bureau of the Census as part of the quinquennial Census of Transportation. TIUS collects data to measure truck usage from a sample of approximately 150,000 trucks, vans, and minivans out of an entire population of 50 million private and commercial registered trucks. Data collection is performed through a mail survey sent to vehicle owners covering physical and operational vehicular statistics. TIUS data are available on public use tapes; however, records are modified to avoid disclosure of sampled vehicles or operating companies.

U.S. Exports by State of Origin Data are collected by the Data User Services Division of the U.S. Bureau of the Census. Data records provide commodity and routing profiles on a State, regional, or national level. The State of origin data include an unknown proportion of errors

due to such factors as reporting of a headquarters' office as an origin or reporting of a transshipment port as an origin. Also, shipments without origin-destination information are not included in the database but are estimated in other databases. Export tapes are available for purchase approximately 4 months after close of period.

U.S. Waterborne Exports and General Imports (TIM-985) is a publication that presents information in terms of type of vessel service, U.S. coastal district, customs district and port, foreign trade overseas, and flag of vessel. An annual report (TM-987) that summarizes the data is also available .

Waterborne Commerce Statistics Detailed Data File. The U.S. Army Corps of Engineers Waterborne Commerce Statistics Center is responsible for collecting, compiling, and distributing all waterborne commerce statistics within the policies approved by the HQ, U.S. Army Corps of Engineers under authority of various laws dating from 1866 to present. Data provided by the reporting carriers include the names of the shipping and receiving ports and docks, vessel name and commodity type and tonnage. Waterborne statistics have been published in five parts by the regional offices of the Corps of Engineers since 1953. Tables provide tonnage and ton-miles of freight traffic by commodity, drafts of vessels, and other data.

World Sea Trade Service is a commodity flow database developed and maintained by DRI/McGraw-Hill. The data service provides forecasts and assessments of global commodity flows for use in policy analysis, port traffic forecasting, and world seaborne trade. Data are organized by country (origin/destination), commodity, service liner type, and cargo weight. Data reports can be generated on short-term quarterly movements or long-term five-year horizons.

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University of Tennessee; *Characteristics of Urban Freight Systems (CUFS)*; Transportation Center; Preliminary Review Draft; November 1994.

The Data Source for Intermodal Transportation Planning section of the Impediments to Efficient Intermodal Freight Planning report provides an evaluation of existing intermodal transportation data sources and their application towards planning activities. This information is intended to provide readers with a summary of existing data collection programs and a focused view of the utilization of the data in planning for intermodal transportation. Selected data sources are used in providing examples of data applications for intermodal planning.

This report was prepared in September 1995 as part of an ongoing project examining "Impediments to Efficient Intermodal Transportation" under contract with the Federal Highway Administration by a consultant team headed by Cambridge Systematics, Inc., and including Apogee Research, Inc., Jack Faucett Associates, and Sydec, Inc.

The principal author of this report was Cambridge Systematics, Inc., under the direction of Daniel Haling.

Appendix A

Appendix A provides detailed information on the individual data sources identified for intermodal planning. The information includes:

- **Objective Statement**. Briefly describes the primary objective of the data collection activity and important information on the source.
- **Agency/Firm**. The government agency or private firm responsible for collecting and distributing the data.
- **Modes**. Transportation modes covered by the data source.
- **Source**. Provides the original source of the transportation data such as waybills, manifests, customs documents, or surveys.
- **Transport**. Provides detailed information on the transportation data recorded in the database.
- **Availability**. Documents the availability of the data source in terms of time lag between data collection and publication dates.
- **Examples**. Presents case study applications of the transportation data for intermodal planning. Figures are provided to demonstrate the usefulness of the data source.

Carload Waybill Sample

Objective: A sample of railroad freight waybills for rail movements originating and terminating on U.S. railroads (4,500 carloads per year within last 3 years or 5 percent or more of any State's traffic). The sample is used as input to many transportation projects and studies and as a major source of information for developing State transportation plans.

Agency/Firm: Interstate Commerce Commission

Mode: Rail

Source: A stratified sample of waybills from railroads terminating 4,500 cars per year.

Commodity: 7-digit STCC on microfiche (MF); 2- to 5-digit STCC on public use file (PUF) excluding hazardous materials (STCC 49) and bulk materials in boxcars (STCC 50) which are classified.

Transport: Equipment type, shipment and expanded revenue by type (freight, transit, miscellaneous), short line miles, number of interchanges, number of intermodal units (Public Use File PUF and Microfiche MF); carrier and equipment type, design, capacity, dimensions, and ID number (MF). Short line miles is the shortest rail distance between origin and destination.

Availability: The Master File is proprietary and not available to the public. The annual Public Use Tape is available from the AAR about the end of July and is distributed by BTS on CD-ROM.

Examples: Figure A.1 presents a rail flow diagram for Trailers On Flat Cars (TOFC) and Containers On Flat Car (COFC) shipments terminating in Philadelphia, PA. The Carload Waybill Sample provides detailed information on shipments of Class 1 railroads and identifies container and trailer handling. The flow diagram illustrates the primary originating locations and the proportion of shipments generated from that location. Chicago, Illinois is the largest source of rail containers and trailers terminating in Philadelphia and represents over 50 percent of the total.

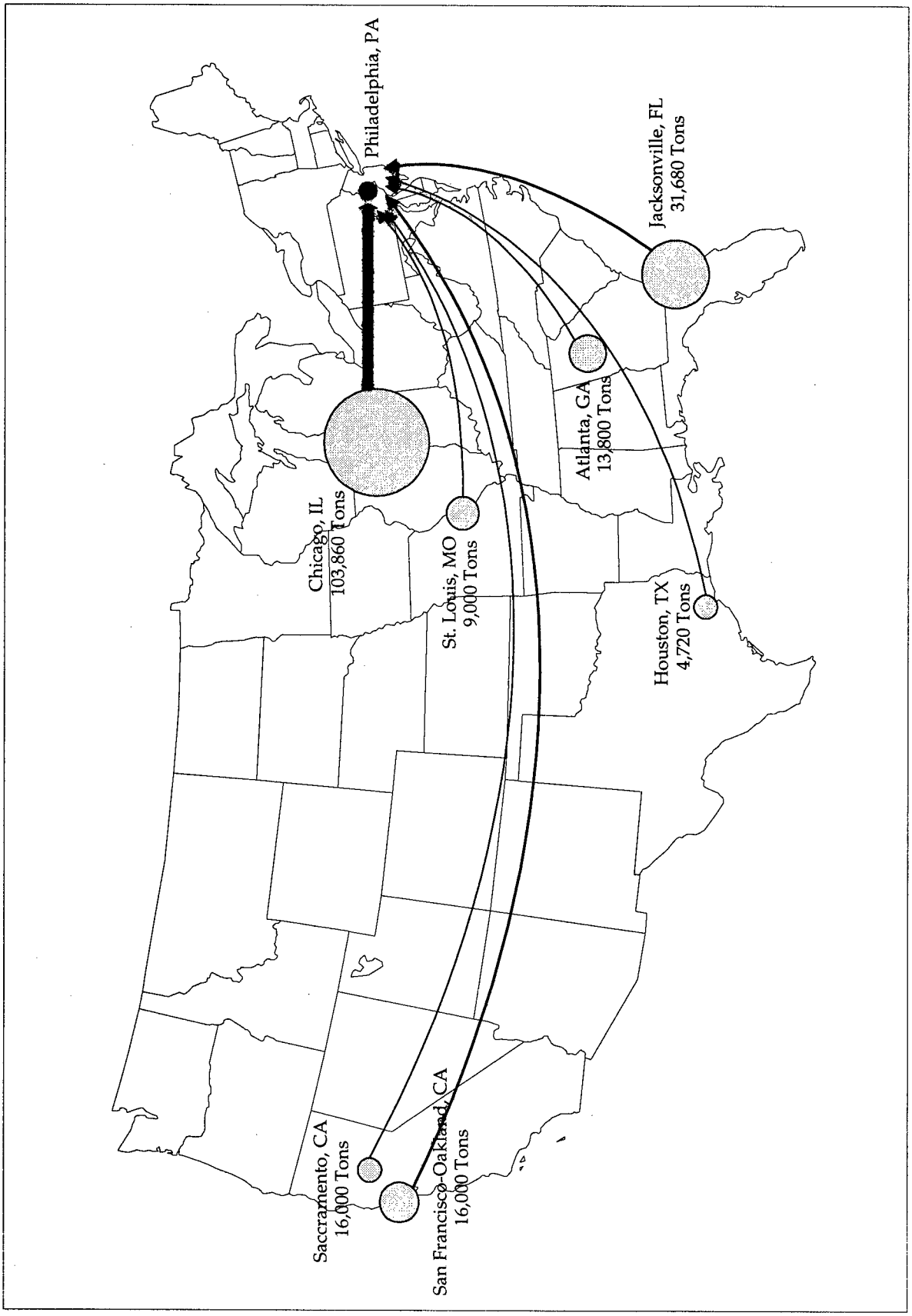


Figure A.1 Flow of TOFC/COFC Rail Shipments Terminating in Philadelphia, PA

Notes: Flow diagram presents only originating locations of greater than 2,000 tons annually.
Source: ICC Carload Waybill Sample, 1992.

Port Import/Export Reporting Service (PIERS)

Objective: The Port Import/Export Reporting Service data is designed to provide detailed shipping and logistic information to the international shipping community which includes shippers, receivers, truckers, shipping lines, and port and harbor authorities. The data contains shipment information for most U.S. waterborne foreign trade including shipments entering or exiting Puerto Rico.

Agency/Firm: The Journal of Commerce
Two World Trade Center, 27th Floor
New York, NY 10048

Mode: Waterborne

Source: PIERS data is obtained from shipment manifest or bills of lading collected by U.S. Customs. Data is collected from electronically-filed Customs data or directly from hard copy reports.

Commodity: 6-digit Harmonized, 7-digit PIERS Comcode (loosely based on 1979 TSUSA), and actual manifest/bill of lading descriptions.

Transport:

Availability: The most recent 24 months of complete data are available on-line on a subscription basis with customized reporting and data base development also available. Historical months are archived and available. A complete month's data is available the first Monday of the fourth week following the end of the month, although individual vessel activity may be available sooner.

Examples: Figure A.2 presents the ten top ranked States for container exports in 1990 as reported by the Journal of Commerce. The container exports represent only waterborne container exports and do not include over-land container shipments with Mexico and Canada or domestic container shipments. California produces the most container exports representing approximately 22 percent of total U.S. container exports.

Figure A.3 demonstrates the distribution of container imports by State for 1990. As with container exports California was the largest State for imported containers followed by New York and New Jersey.

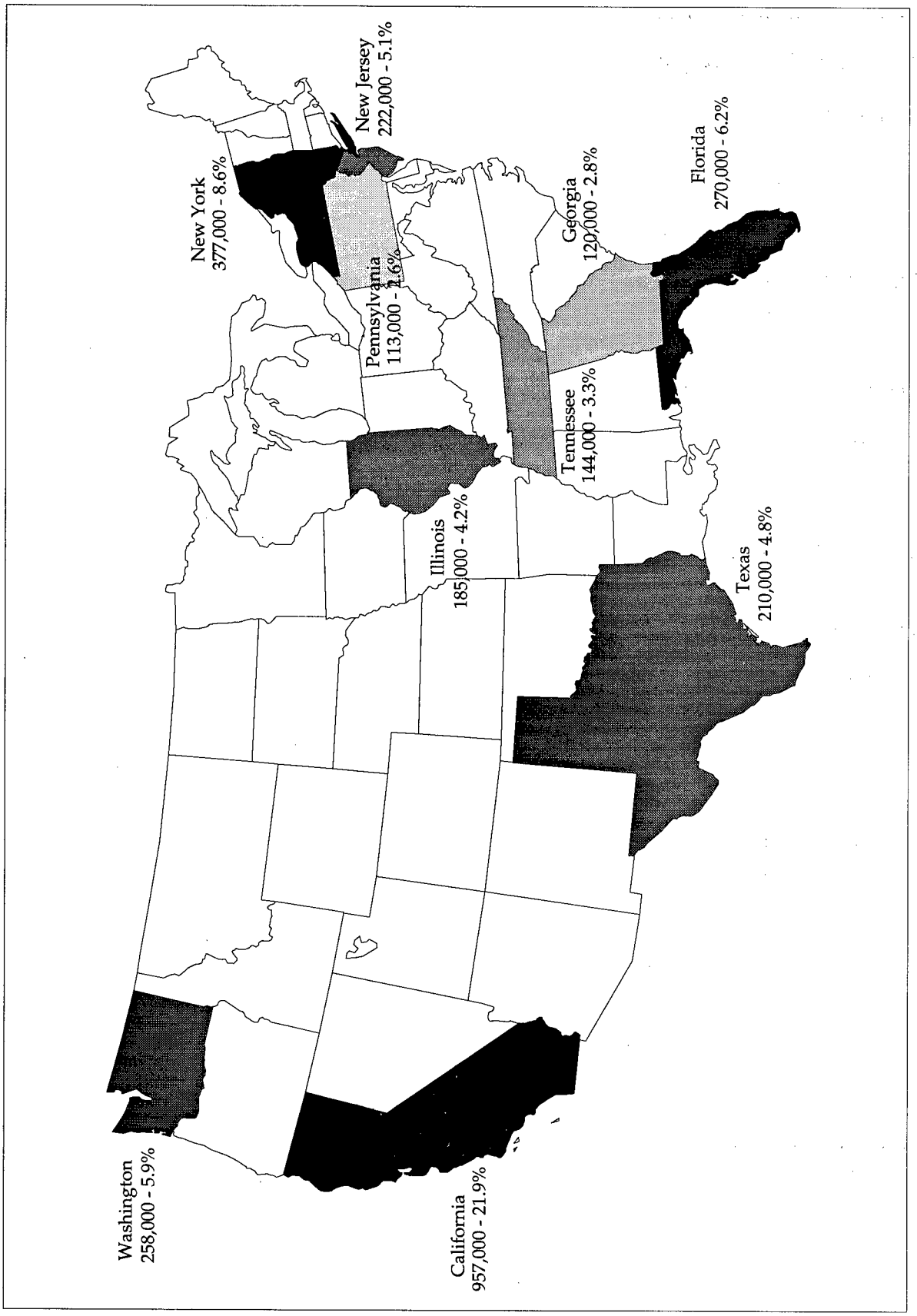


Figure A.2 Container Exports – Top Ten States in the U.S. in 1990

Notes: Container export quantities are in TEUs.
Source: Journal of Commerce, PIERS; Reported in Washington State DOT, Overweight Container Study, October 1992.

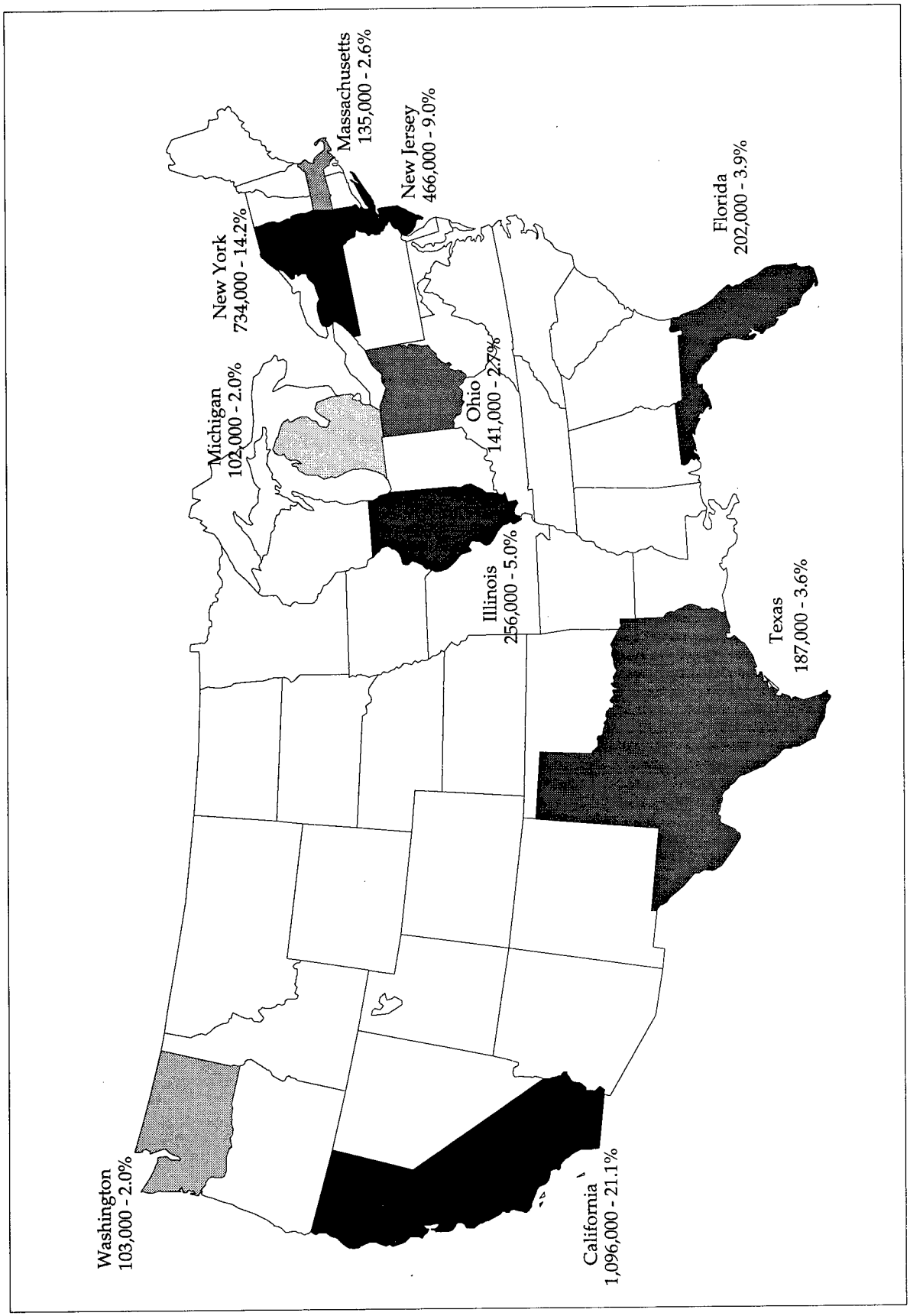


Figure A.3 Container Imports – Top Ten States in the U.S. in 1990

Notes: Container import quantities are in TEUs.
Source: Journal of Commerce, PIERS; Reported in Washington State DOT, Overweight Container Study, October 1992.

Tonnage for Selected United States Ports

Objective: Waterborne tons handled in selected U.S. ports during a calendar year. Provides total tonnage broken down into foreign imports, exports and domestic shipments. Includes a ranking of ports according to total tons handled during the monitored year.

Agency/Firm: U.S. Army Corp of Engineers

Mode: Waterborne

Source: Section 11 of the Rivers and Harbors Appropriations Act of 1922 (42 Stat. 1043), requires individuals and corporations to submit to the Department of the Army statements relative to vessels, passengers, freight, and tonnage for all waterborne movements. Data on foreign commerce are supplied by the Bureau of the Census.

Commodity: No commodity distribution is provided.

Transport: Tons of water carriage for major U.S. ports broken down by foreign imports, foreign exports, and domestic shipments.

Availability: Tons for selected U.S. ports tables are available from the Waterborne Commerce Statistical Center approximately 18 months after the end of the year. Data is also available on computer disk for a small fee.

Examples: Figure A.4 illustrates the location and commodity shipments handled by major U.S. ports in 1990. The waterborne commerce includes foreign imports and exports along with domestic internal and coastwise shipments. The commerce statistics are in thousands of short tons. The Port of South Louisiana, New York, and Houston are the three largest U.S. ports in terms of total commerce handled.

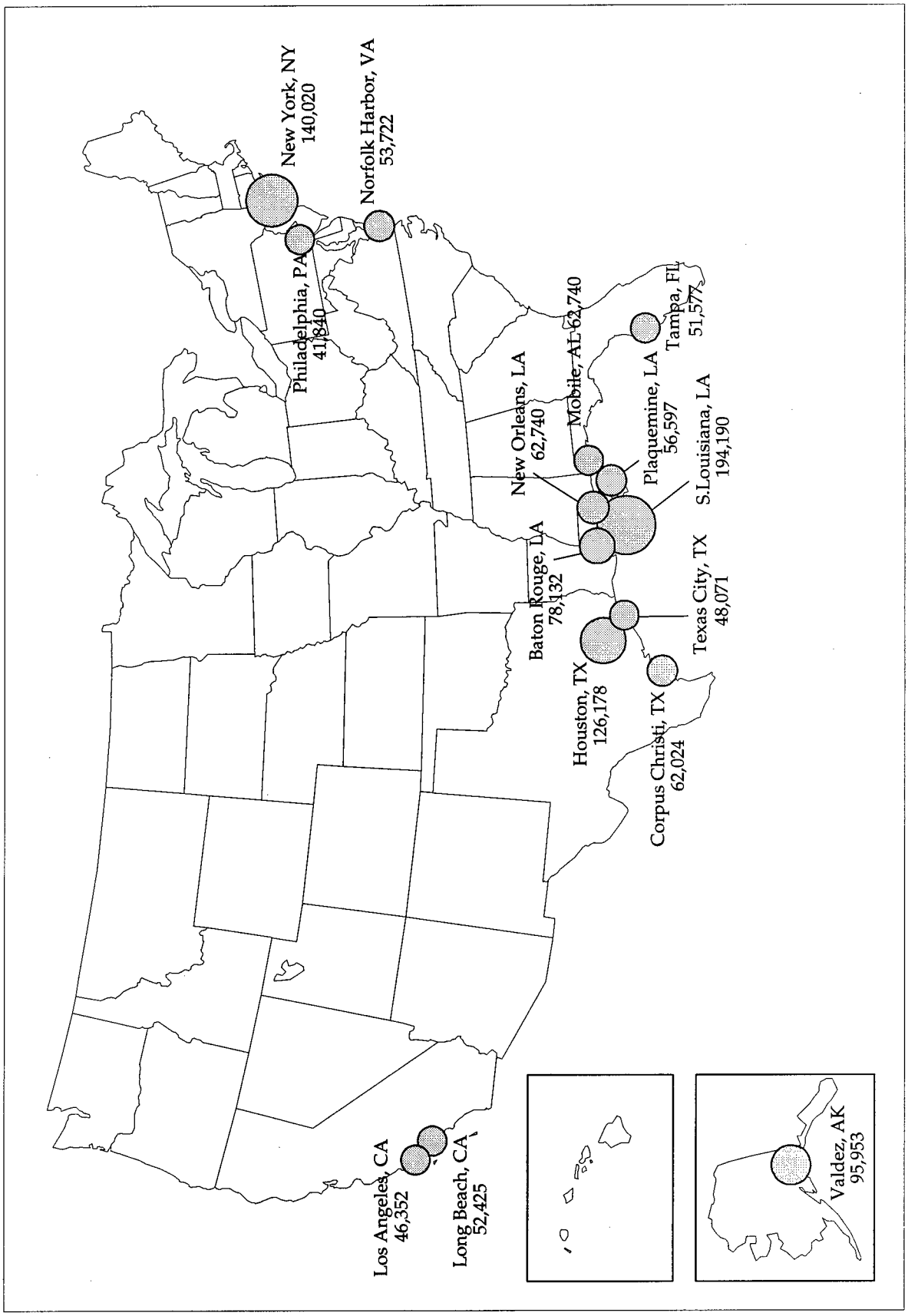


Figure A.4 Waterborne Commerce Through Major U.S. Ports, 1990

Notes: Figures are in thousand short tons and represent foreign and domestic shipments.
Source: U.S. Army Corps of Engineers, Waterborne Commerce of the United States, 1990.

Waterborne Commerce Statistics

Objective: Vessel and commodity movement information collected and compiled to meet the data requirements of the Department of the Army in connection with the duties assigned by Congress. These data also provide valuable information for other governmental departments, commercial and shipping concerns, and other interested in the U.S. transportation industry.

Agency/Firm: U.S. Army Corps of Engineers

Mode: Waterborne

Source: Section 11 of the Rivers and Harbors Appropriations Act of 1922 (42 Stat. 1043), requires individuals and corporations to submit to the Department of the Army statements relative to vessels, passengers, freight, and tonnage for all waterborne movements. Data on foreign commerce are supplied by the Bureau of the Census.

Commodity: The first two digits of the WCSC publication codes correspond with the Lock Performance Monitoring System, LPMS, commodity codes. Both LPMS and WCSC codes were standardized to reflect the hierarchical structure of the Standard Industrial Trade Classification (SITC) Revision 3 commodity codes.

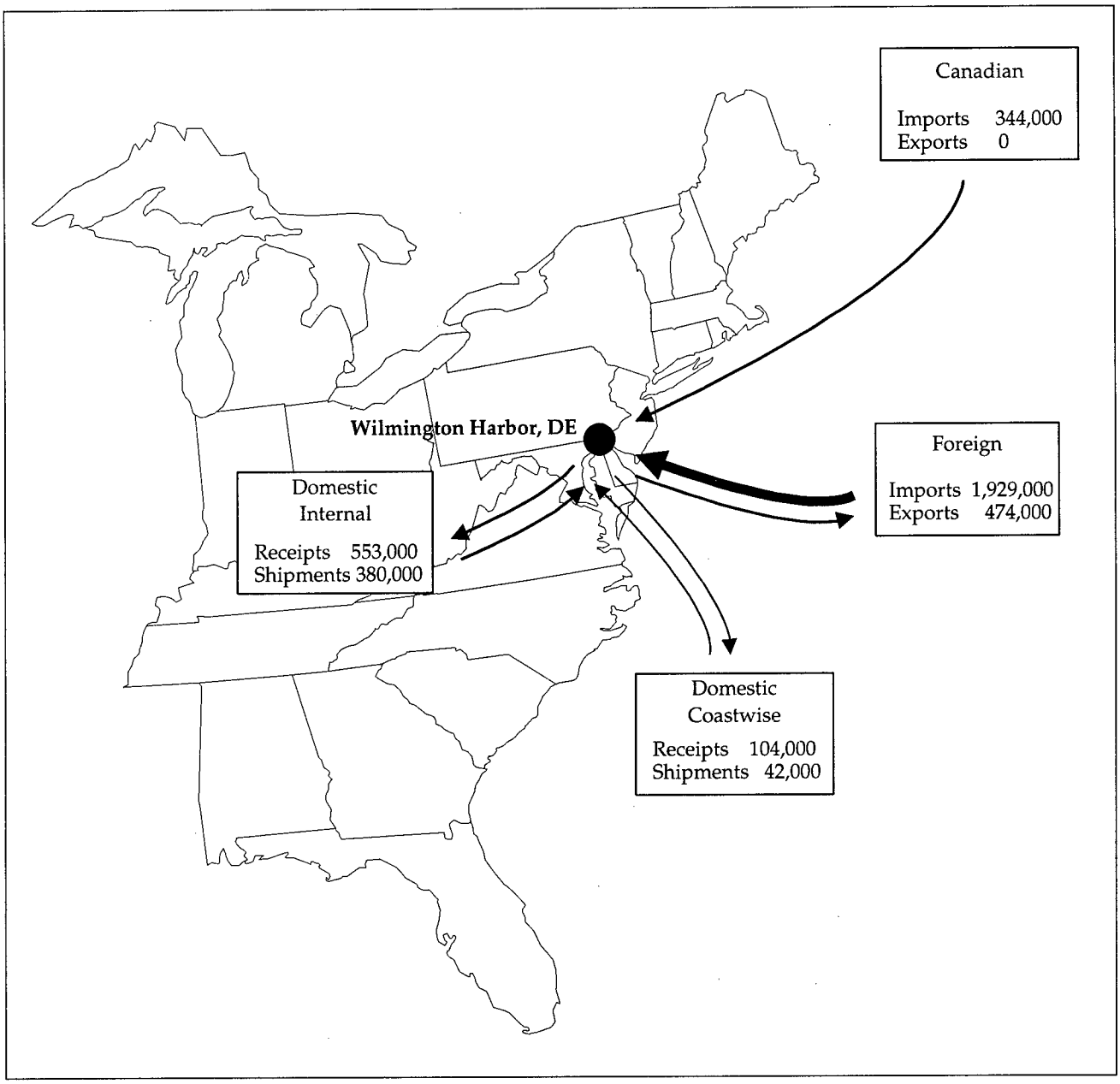
Transport: Tons of water carriage by WCSC (4-digit) commodity classification for U.S. waterways and ports including intraport, through, intra-waterway, and intra-territory movements. Shipments are classified by foreign, Canadian, and domestic.

Availability: Regional Freight Traffic tables are available from the Waterborne Commerce Statistical Center approximately 18 months after the end of the year. Data is also available on computer disk for a small fee.

Examples: Figure A.5 illustrates the waterborne commerce data representing shipments traveling through Wilmington Harbor in 1992. As the diagram indicates the largest percentage of traffic is attributed to foreign imports at approximately 2 million tons or 50 percent. Domestic internal shipments represent 24 percent while Canadian and domestic coastwise represent 9 and 4 percent respectively.

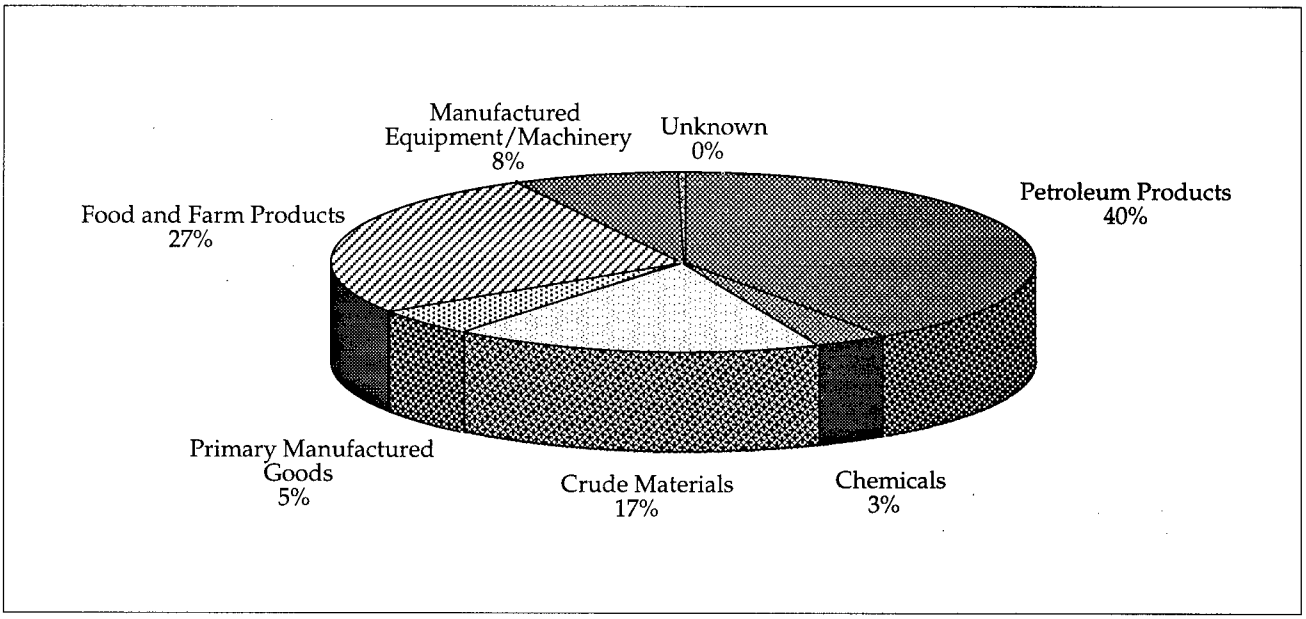
Figure A.6 demonstrates the commodity distribution of total waterborne traffic through Wilmington Harbor in 1992. Petroleum products accounted for 40 percent of the total shipments while food and farm products represented 27 percent and crude materials 17 percent. Further breakdown of commodity types is provided in the data source but have been aggregated for illustrative purposes.

Figure A.5 Waterborne Traffic Through Wilmington Harbor, 1992



Note: Figures are in short tons.
Source: U.S. Army Corps of Engineers, Waterborne Commerce Statistics, 1992.

Figure A.6 Commodity Distribution of Waterborne Traffic Through Wilmington Harbor, 1992



Note: Commodity Distribution is for all shipment types.
Source: U.S. Army Corps of Engineers, Waterborne Commerce Statistics, 1992

Intermodal Freight Transportation

Annotated Bibliography

Intermodal Freight Transportation
Annotated Bibliography[1]

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The principal author of this report was Jack Faucett Associates, under the direction of Mr. Michael Lawrence.

NOTICE

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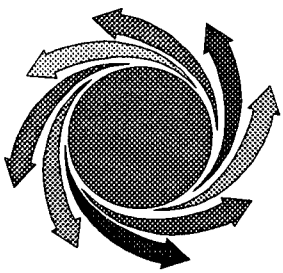

Technology Sharing

A Program of the U.S. Department of Transportation