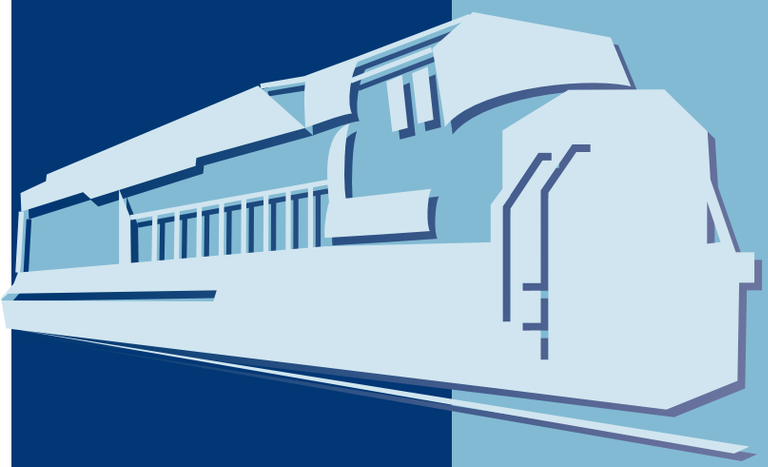
U.S. Department of Transportation

Federal Highway Administration

U.S. Freight: Economy in Motion

1998



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Acknowledgment

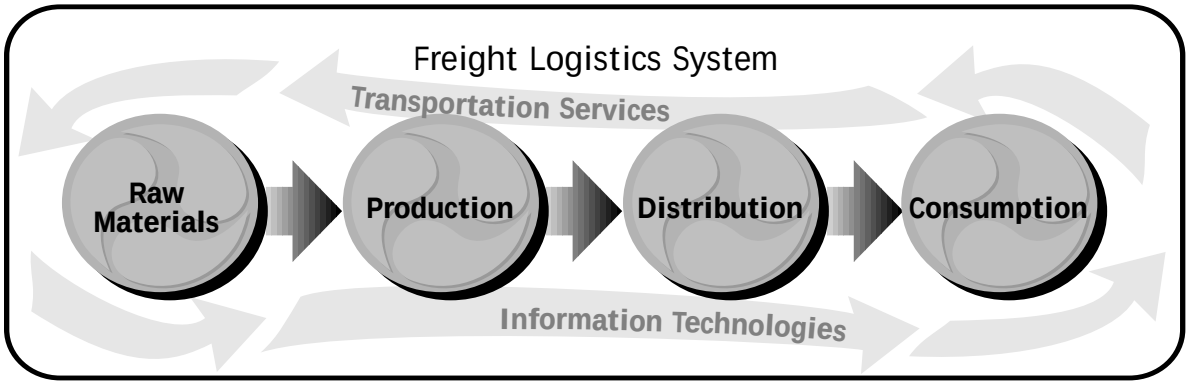
This report was prepared by M.J. Fiocco of the Office of Intermodalism, Office of the Secretary of Transportation. Please contact her directly at 202-366-5781 to obtain further information about the report or its contents.

A report is never the work of only one person. The author would like to thank Madeleine Bloom and Harry Caldwell of the Office of Policy Development, Federal Highway Administration for the opportunity to take on this challenge, all of the Departmental staff who supplied information and feedback as well as all of those in the private sector who helped to create this primer on the freight industry. Their input and assistance was invaluable and deeply appreciated.

Table of Contents

Synopsis

Freight logistics is an increasingly important tool in maintaining the nation's ability to effectively compete in the global marketplace. Logistics is premised, among other things, on ever more reliable transportation systems as well as greater use of information technology. As a simple flow chart, the freight logistics system looks like this:



Transportation Services and Information Technologies

- Logistics seeks to eliminate unnecessary inventory from the manufacturing / production process by putting supplies and finished goods in the distribution pipeline for the minimum amount of time possible. As a result, transportation carriers and the infrastructure over which they operate are being asked to perform with precessions never before required. This is expected to challenge our existing ability to respond to unanticipated demands for transport services.
- More and more businesses are switching from a "push" inventory system to a "pull" system. The traditional "push" system assumes levels of demand and distributes goods based on those assumptions so that inventory is pushed through the distribution system. The "pull" system allows market demand to determine production levels so that inventory is pulled through the distribution system. The pull system seeks only to produce goods for which actual market demand is known. As more

companies switch to the "pull" model, the distribution system is expected to require less capacity since the excess inventory now needed to hedge "push" system assumptions about demand will not be needed. This shrinkage in inventory and system capacity could pose new challenges for those responding to emergencies, disasters, or military actions.

- Understanding the role played by each of the transport modes in supporting logistics operations, especially when they either compete with or complement one another, is essential to making infrastructure decisions that will support our nation's continued economic competitiveness.
- Traditionally, Federal, state, and local governments made capital investments along modal lines. Until the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, there was no clear Federal mandate linking transportation investment to freight needs. Since ISTEA, the government investment policy has begun to facilitate freight's ability to flow seamlessly across transportation systems. While some progress has been made, what is needed is a better understanding by each side of the dynamic forces governing the public and private sectors, as well as more work on actual infrastructure and regulations.
- As the National Commission on Intermodal Transportation reported, "The weakest links in the current transportation system are the points of transfer between the modes. And, because the current system is funded and managed separately by each mode, responsibility for strengthening these links is unclear." The commission recommended that Federal policies "foster the development of the private sector freight intermodal system and reduce barriers to the free flow of freight, particularly at international ports and border crossings."
- Information technology also takes on increasing importance in managing freight flows, since it is not likely that currently planned capital investments in infrastructure improvements for any mode will be able to keep pace with the demands expected to be generated by anticipated population growth. The U.S. Census Bureau has projected an increase of 60 million citizens between 1990 and 2020 (from 250 million -310 million) — a 24 percent increase in overall population.
- Based on past experience, growth in freight traffic could significantly exceed projected population gains. Between 1965 and 1992, U.S. population rose by 61 million or 31 percent. During the same period, the total number of freight tons in the economy increased 63 percent, while the number of freight ton miles traveled expanded by 52 percent and the number of freight ton miles per person grew 37 percent.
- Making effective decisions about freight transportation investments requires a better understanding of the needs of the various sectors of the freight community. To assist in this effort, industry experts from a wide variety of disciplines explain how they each determine effective performance for their transportation sector, including performance.

Introduction

They sit silently in the stores—row upon row, rack upon rack, stacked, piled, arranged for our convenience—meat, produce, foodstuffs, clothing, household goods, cleaning supplies, even videotapes and ice cream. How do these things that comprise modern living get there?

What happens in the United States that allows goods to flow effortlessly through the nation?

What processes occur so that a person in Minot, North Dakota has the same range of choices as a person in New York City? Why doesn't the U.S. have the shortages of goods and the long lines of customers common in other countries with equally complex and long distance transportation systems?

The reason U.S. consumers are the envy of the world is that our nation essentially is an economy in motion. For a variety of reasons, our nation has the ability to move raw materials, manufactured products, and finished goods with very high degrees of precision and reliability. One primary reason is a freight logistics system that is second to none.

No one person or entity is responsible for this success. Rather, it is the sometimes cooperative, sometimes competitive, actions of a range of players that make all of this possible. These players are public and private sector entities who must juggle a host of often conflicting and ever changing mandates in a world that is growing more compressed and time sensitive.

The purpose of this paper is to explain the operation of these entities and their interactions, as well as to highlight those trends or forces of change that shape our continued ability to transport what we want, when and where we want it. It also will highlight how different entities benchmark the performance of their companies and / or industries, including how they view the performance of our transportation systems.

In researching the information for this study, it became apparent that measurement of freight transportation activity is a field where there is variation among the experts. It is due in part to how each expert defines the activity being measured. To the extent that there are variations in the statistics used in this study, it is a reflection of this diversity.

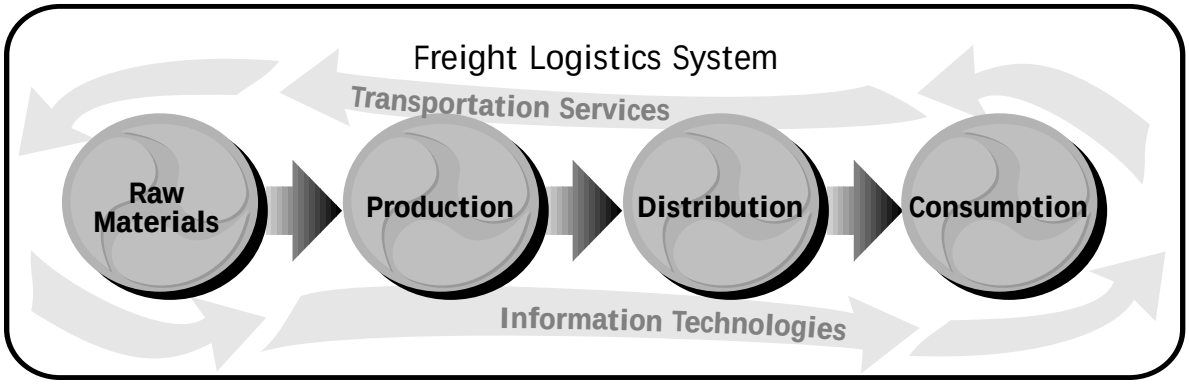
WHAT IS FREIGHT LOGISTICS?

Unpacking the things we buy in stores or through direct mail outlets is the last step in a process that industry professionals and public policy makers call the freight logistics system, or simply, logistics. In its most basic terms, logistics is finding the most efficient way to source, manufacture, and distribute a given product or products. Each of these steps intrinsically is linked with transportation—transporting raw materials to markets or production sites; moving semi-finished goods to and from production sites; sending finished goods to distribution centers for subsequent delivery to stores or consumers.

According to the Council of Logistics Management, logistics is "the process of planning, implementing, and controlling the efficient, effective flow and storage of raw materials, in-process inventory, finished goods, services and related information from point of origin to point of consumption for the purpose of conforming to customer requirements."

Another expert describes logistics as "moving the warehouse closer to the customer, reducing or eliminating the need for outside distributors, consolidating distribution across product lines, and rationalizing transportation and logistics operations ... [It] requires looking at how a company or organization functions, seeking to eliminate duplicative services, establishing benchmarks to improve performance, monitoring or adjusting where necessary. Finally, because it is a global economy where the customer often has the upper hand in market development opportunities, the supplier ... must listen to what the customer wants."[1]

As a process diagrammed in its simplest form, freight logistics looks like this:



[1] *International Freight Transportation*, Third Edition, Gerhardt Muller, Eno Transportation Foundation and Intermodal Association of North America.

Transportation Services and Information Technology

To understand the elements of logistics, as well as the types of services and decisions it encompasses, consider the following two examples.

First Example: A car manufacturer needs seats. Its supplier is located within the U.S. about 100 miles from the manufacturer's plant. The manufacturer calls the supplier and orders the seats. The next day, the supplier assembles the order and prepares it for shipment. For distances of less than 100 miles, the significant majority of goods are moved by truck.

The terms of sale can make either the manufacturer or the supplier responsible for arranging transportation. In this case, the seat supplier is responsible. Once the shipment is ready, the supplier calls a motor carrier to pick up the load. It can take multiple phone calls to find an available motor carrier. The motor carrier tells the supplier when pick up can be expected. This can be later the same day, the next day, or in several days. At the appropriate time, the carrier dispatches a driver to pick up the load. The driver delivers the shipment to the car manufacturer, in this case, probably early the next day or the day after.

Second Example: A major department store in New York City wants to hold a holiday clothing sale. Its supplier is located overseas in a Pacific Rim nation. Three months before the sale, the store calls the supplier's U.S. based distributor and places an order. The distributor then contacts the supplier to convey the order.

The clothing maker contacts its suppliers for material, thread, and other goods needed to complete the order. These materials are transported to the clothing supplier's factory and the order is completed. Once the order is ready to ship, usually in a marine container, the clothier, its U.S. distributor, or whoever is specified in the terms of sale, arranges for the necessary trade documentation, such as export and import declarations. They then either must select and hire transport carriers to move the shipment, or hire a third party to arrange how the goods will get to the U.S. store. In many cases, the customs broker preparing the export/import documents also can make the transportation arrangements.

A number of carriers are required to transport this shipment. In the overseas country, a motor, rail, or water carrier must transport the shipment to an airport or seaport. Since more than 90 percent of U.S. import tonnage enters the U.S. by ship, this example will use a seaport destination. At the port, export documents must be approved, the shipment must be released to the maritime carrier, and the carrier must load the goods on its vessel. This process can take less than 24 hours to several days or weeks depending on vessel sailing schedules and other factors.

Once the shipment arrives in a U.S. port, the goods must clear U.S. Customs and any other inspections deemed necessary. Once cleared to enter the U.S., the goods must be transported to the store. This can be part of the original transportation arrangements or it can require a new set of arrangements. This can be done directly with a carrier or carriers or through a third party.

Unless there are rail facilities on or near the dock or pier of the U.S. port, a truck will take the clothing shipment either to its final destination or to a nearby rail yard for long distance transport by railroad and for final delivery to the customer, normally by truck. If on-dock rail is present shipside, intermodal shipments (shipments using two or modes or different types of carriers for transport) can be placed on trains without having to be

trucked or drayed to the intermodal yard.

For this example, the shipment will arrive at a West Coast port without on-dock rail facilities. Since the distance to New York is more than 1,000 miles, intermodal, in this case rail and truck, is the most efficient way to move the goods. This means that a truck is used to take the shipment to the rail yard where it makes the long distance land leg of the journey by railroad. In most circumstances, another truck is used to take the load from the new rail yard to its final destination.

Now that the shipment is cleared for transport, a local, often called drayage, carrier must be selected and hired to take the clothing shipment to the intermodal yard. The drayage carrier must arrange to have the appropriate paperwork in the right vehicle, use that paperwork to enter the maritime carrier's terminal storage yard, find the shipment, load the shipment, and receive the necessary paperwork to leave the storage area. The drayage carrier then must transport the shipment to the intermodal yard where this process is repeated—present paperwork, find the assigned unload spot, unload, and receive the necessary paperwork to leave. It may take anywhere from one to several days for a shipment to leave a storage area and be transported to an intermodal yard.

The railroad then assigns the shipment to a train for transport east. Depending on the frequency of service, a shipment could leave the intermodal yard anywhere from the same day it is delivered to several days later. Transport time for the railroad to deliver the clothing shipment to New York City can be anywhere from two days to a week.

Once the shipment arrives in New York, the drayage process must occur again as the shipment is taken from the intermodal yard to the department store's loading dock. Again, it can take anywhere from one to several days for the shipment to be delivered.

When state of the art logistics techniques are applied to these examples, procedures and time lines change. These changes alter how integrated the operations of shippers, carriers and vendors become as well as the role information plays in how and when service is rendered.

First Example with Logistics: The car seat example would be affected this way: The seat supplier, the car manufacturer, and the motor carrier have entered into a multi-year strategic alliance. This alliance not only specifies how transportation services will be performed, it requires that the three share information through a linking of their computer and other informational systems. In the regularly scheduled download, which can be daily, hourly, or whatever the parties agree upon, the supplier sees that the manufacturer needs to be resupplied tomorrow. While the supplier is assembling the shipment, the motor carrier, which was given the same information in its download, sees that a pick up is needed tomorrow at the supplier's facility. It arranges for a driver and equipment to be at the supplier's facility at the designated time. The manufacturer will receive delivery as specified in the alliance agreement.

Second Example with Logistics: The department store and the Pacific Rim clothing supplier have a strategic alliance between themselves as well as with a licensed international freight forwarder and customs broker. This forwarder / broker also is able to provide transportation services. The firm has service contracts with the transport entities needed to move the clothing from the supplier to the department store.

As a result, efficiencies are gained throughout the process. The clothing supplier is able to more efficiently source its material, thread, and other goods, thus reducing production time. The forwarder / broker is able to target delivery at the origin port so that the goods are cleared and loaded on a ship that is

leaving the next day for the U.S. The ship is destined for a West Coast port with on-dock rail facilities. The firm also participates in the U.S. Customs Service pre-clearance program so that all U.S. paperwork requirements will be met, and any issues resolved, prior to the ship's arrival in the U.S.

While the Customs information exchange is occurring, the broker is communicating with the maritime carrier and railroad about transport needs once the shipment is landed. The maritime carrier and railroad also exchange information to facilitate how freight will be loaded from the ship to the train. Once docked, the goods are loaded directly onto a train, which will leave as soon as the ship is unloaded, and without the delays and additional work associated with a dray to an intermodal yard.

The train operates under performance agreements, which guarantee goods will arrive the third morning after they are loaded. Because the broker is able to electronically track the shipment through the railroad's Automatic Equipment Identification system, the drayage carrier is able to be at the intermodal yard with the correct paperwork when the train arrives. The shipment is unloaded directly from the train to the drayage carrier who delivers the shipment to the department store. The time needed to place and receive the order is reduced from 12 weeks to 6 to 8 weeks.

The net results of applying state-of-the-art techniques to these two scenarios include:

- Time saved in the process of sourcing, producing, and distributing goods. This allows quicker response to market needs.
- Reduced opportunity for misinformation and error when data are transmitted electronically to each partner in the transportation process or supply chain. Reducing misinformation eliminates errors, which require additional handling of goods and unnecessary use of freight equipment.
- Reduced inventory needs for each of the supply chain partners because of more timely information sharing and improved transport times. By better integrating transportation into the production process, these assets will be unused for shorter periods of time. Less of them will be needed at any one time. This should allow more productive use of existing transport equipment, thus reducing the need for additional transport vehicles.

Logistics Drives the Economic Engine

Another way of explaining logistics, especially the state of the art techniques such as enhanced logistics or supply chain, is to view the economy as an engine and logistics as its carburetor. By eliminating unnecessary inventory thus reducing the need for freight transportation capacity, logistics allows the economic engine to operate more efficiently the way a carburetor prevents an engine from wasting fuel.

Consider that in the mid-1980s, when logistics and just-in-time production were still relatively new ideas, a factory was proud of its ability to operate on two to three hours of inventory when more traditional practices would have had days, if not weeks, of production materials on hand. In the early 1990s, enhanced logistics and supply chain practices allowed factories to run on as little as 15 minutes of inventory. Today, further refinements to these practices allow factories to operate on 10 minute margins.

Using the mid-1980s as a benchmark, in about a decade, logistics practices have cut the margins on the goods on-hand needed to run a factory to between 5.5 percent and

8.3 percent of what was once needed. According to industry experts, in 1995, 28 percent of U.S. production was accomplished by state-of-the-art logistics practices—up 56 percent from 1990 figures. This growth rate is expected to continue for the foreseeable future.

Logistics' ability to eliminate inventory from the production process has focused attention on how inventory is treated generally, not just in transportation. The traditional approach to inventory is called "push." Under a "push" scenario, a vendor estimates, sometimes months in advance, what its customers want. These estimates often cover a range of outcomes. They are put into production with finished goods sent to outlets for sale and / or distribution centers for storage and subsequent release. Once distributed to outlets, the customers buy the goods they want. Unwanted and surplus goods are repackaged and returned to the manufacturer for subsequent disposal.

As an alternative to this "push" model, many companies are designing their inventory systems based on actual consumer demand. Known as a "pull" system, inventory decisions are made based on what customers are actually buying. This more market-oriented approach is made possible because of the information revolution, as well as these firms' innovative use of strategic alliances with suppliers, transporters, and vendors.

The information revolution allows the collection and forwarding of point-of-sale information on an almost real time basis. Innovations in information technology allow the compiling, sorting, and disseminating of information at speeds not possible a decade ago. When this information is shared with the partners of a manufacturer's strategic alliance, decisions about stock replenishment and production are made quickly and stock can be deployed promptly. In some cases, they can be done automatically.

The excess stock needed under a "push" system is not needed under a "pull" scenario because estimates are replaced with actual knowledge. It is possible from cash register receipts to know detailed information about selling trends and take immediate action to capitalize on them.

For example, the overnight receipts show that at Store A blue sweaters are selling well but green pants are not. At Store B, blue sweaters and green pants are selling but yellow sweaters are not. At Store C, blue sweaters and yellow sweaters are selling well. This alerts the strategic partners to start production of blue sweaters and to reposition the items not selling well at one store to a store where they are selling. Because this information is routinely shared, the adjustments to inventory can be made in the stores' regular deliveries. These deliveries can be scheduled to assure the most efficient loading and routing possible.

As a result, the "pull" system's ability to fine tune and quickly respond reduces the amount of inventory needed to meet customer demand and the amount of transportation resources needed to produce and distribute inventory over the resources needed to meet the requirements of a "push" system.

The innovations, which created and continue to transform the logistics industry, have important public policy ramifications. The efficiencies created by more targeted inventory management and faster transportation systems have interesting implications for congestion management interests. Since surface transportation, both rail and truck, involve the movement of both freight and passengers, solutions for bottlenecks, whether tracks or roads, requires an understanding of how people and goods move and how their movements interact and affect overall system mobility.

In addition, the elimination of excess transport capacity created by this more precise balancing of supply and demand can have serious implications for those responsible for disaster or military response planning. A more extensive discussion of the forces of change reshaping logistics is presented later in this paper.

What is the Freight Industry?

Using a macroeconomic perspective, freight transportation is a significant share of the economy. In 1994, business and industry spent $421 billion to move 3.5 trillion tons of freight over system networks totaling 2.3 million miles across the continental U.S.[2] This number does not include the additional monies spent on inventory, warehousing, and logistics services, nor does it include the international transport networks used by imports to reach and exports to leave the U.S. mainland.

From a microeconomic viewpoint, transportation is a large part of our daily lives. Only housing, health care, and food have a larger share of our personal budgets. Americans spend more on transportation (freight and personal) than they do on clothing themselves, operating their households, enjoying recreation and travel, and contributing to religious and welfare activities.[3] In short, these transportation costs account for almost 11 percent of disposable personal income.[4]

From a business standpoint, freight transportation accounts for one of its top operating expenses.

Using 1994 Gross National Product numbers as a yardstick, freight transportation accounted for 6.3 percent of total expenditures. Using Gross Domestic Product statistics, freight was 6.2 percent of those expenditures. These numbers do not include the revenues spent on inventory, warehousing, and logistics services. Some experts estimate that these numbers could raise the GNP estimate to 10 -11 percent of total expenditures.

Another way to look at freight transportation's impact on the economy is to consider its effects on transport jobs and salaries. Overall, one out of every 10 U.S. jobs is either directly or indirectly related to transportation.[5] Some industry experts say this figure is one out of four or five when all inventory, logistics, and related corporate functions are added to these totals.

Of the nearly 4 million jobs directly attributable to transportation, roughly 75 percent— about 3 million — are freight-related. In addition, there are 1.8 million jobs in equipment manufacturing for all the modes. For motor vehicles, nearly half of all factory sales were commercial freight units.[6]

In looking at wages and salaries, the average for all industry non-executive employees in 1992 was about $26,700 in salary and $34,600 with fringes. Non-executive transportation workers that year earned about $31,400 per year, with their total compensation package averaging $38,800. Segments of the transportation industry had even higher totals. For railroads, wages were $49,700 or $64,300 with fringe benefits. For air common carriers, the totals were $38,100 in salary and $48,300 with fringes, while oil pipeline workers were paid about $51,000 in salary or $57,800 with fringes.[7]

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[2] *Transportation in America 1995*, Eno Transportation Foundation, Inc.

[3] *National Transportation Statistics 1996*, Bureau of Transportation Statistics, U.S. Department of Transportation.

[4] *National Transportation Statistics 1996*, Bureau of Transportation Statistics, U.S. Department of Transportation.

[5] *Transportation in America 1995*, Eno Transportation Foundation, Inc.

[6] *National Transportation Statistics 1996*, Bureau of Transportation Statistics, U.S. Department of Transportation

[7] *Transportation in America 1995*, Eno Transportation Foundation, Inc.

Wages and Salaries per Full-Time Transportation Employee by Sector

TRANSPORT SECTOR	1992	1993
Railroad	$ 50,004	$ 54,181
Trucking & Warehousing	$ 27,812	$ 28,569
Water	$36,160	$ 37,843
Air	$ 38,146	$ 38,941
Pipeline (not natural gas)	$ 51,053	$ 50,105
Transportation Services	$ 28,141	$ 29,150

SOURCE: *National Transportation Statistics 1996,* Bureau of Transportation Statistics, U.S. Department of Transportation.

Elements of the System

Freight transportation is not a single industry or defined set of procedures. It is the dynamic interaction of many industries focused on producing and distributing goods in commerce. Freight transport has many players who use physical equipment and information technology to source raw materials and move semi-finished and finished products in regional, national, and international trade. It encompasses the public as well as private sector, and includes the Department of Defense, which is the nation's largest shipper.

Local and long distance trucking companies, railroads, ocean-going or maritime carriers, barge lines, pipelines, intermodal marketing companies, property brokers, freight forwarders and other intermediaries, air carriers, package express carriers and all of their customers are the firms who assure that products ranging from fuel oil to fried chicken safely and efficiently crisscross the nation every day. Distinguishing competitor from customer is not always easy. Carriers not only price their services against those of the other modes, they also use these modes to provide seamless services to their own customers. For example, on any given day, a motor carrier can be competing against a railroad for one type of freight, while hiring it to transport some of its other loads.

Defining the dominant modes of transportation within the U.S. depends on the yardstick being used. Using a mode's market share based on the value of cargo hauled creates one picture. Using a mode's market share based on volume of goods hauled creates another. Assessing the modes based on the per-pound value of the cargo generates a totally different ranking than if the percentages of ton-miles hauled or average length of haul is the measuring tool. Taken collectively, these different pictures capture the freight industry's interactive and dynamic nature.

In 1994, the U.S. spent about $420 billion to move its freight. Using this yardstick, trucking was the dominant freight choice —

Per Capita Freight Statistics

	1970	1980	1993	1994
Freight Tons	5.0 million	5.5 million	6.9 million	7.3 million
Freight Ton-Miles	2.2 trillion	3.0 trillion	3.4 trillion	3.5 trillion
Population	205 million	228 million	258 million	261 million
Freight Tons per Capita	25	24	27	28
Freight Ton-Miles per Capita	10,764	13,123	13,031	13,593
Freight Ton-Miles per Dollar of GDP	0.77	0.79	0.66	0.66
Freight Ton-Miles per Dollar of GNP	0.76	0.78	0.65	0.66

SOURCE: *National Transportation Statistics 1996,* Bureau of Transportation Statistics, U.S. Department of Transportation.

accounting for $331 billion or 79 percent of the total freight bill. Railroads came in second, generating about $34 billion or 8 percent of the total bill. International, inland, and coastwise water transportation was the next largest portion with $22 billion or 5 percent. Air freight followed with about $17 billion or 4 percent. Oil pipelines and miscellaneous modes each generated another 2 percentage points or about $8 billion.[8] If the "value-added services of third parties were added, the total would increase another $20 billion to $30 billion a year.[9]

Measuring the modes based on the overall value of the cargoes they haul, a somewhat different picture occurs. Like percentage of freight bill, trucking clearly dominates. Of the $6.3 trillion in goods handled, trucks, both private and for-hire, accounted for $4.6 trillion or 73 percent.

Intermodal shipments finished second with goods totaling $660 billion or 10.4 percent. Intermodal comprises parcel, postal, and courier service ($564 billion or 8.9 percent), rail and truck service combinations ($83 billion or 1.3 percent) and other combinations ($14 million or 0.2 percent)

Railroads tied for third with water finishing very close behind. The value of rail shipments totaled $250 billion or 4 percent of the total value, while water captured 3.9 percent of the total at about $246 billion. Pipelines accounted

[8] *Transportation in America 1995,* Eno Transportation Foundation, Inc.

[9] Transportation Intermediaries Association.

for $180 billion or 2.8 percent of total value, while air freight made up $149.3 billion or 2.4 percent of the total [10]

However, if value is analyzed on a per pound basis, the modes reorder themselves again. Here, air freight is clearly is the mode of choice for high value shipments, with cargo values of $26.77 per pound. Intermodal is second with an averaged value of $1.61 per pound. Parcel, postal, and courier service shipments show values of $15 per pound, and rail / truck intermodal loads at $1.09. Other intermodal moves have values of about 5 cents per pound.

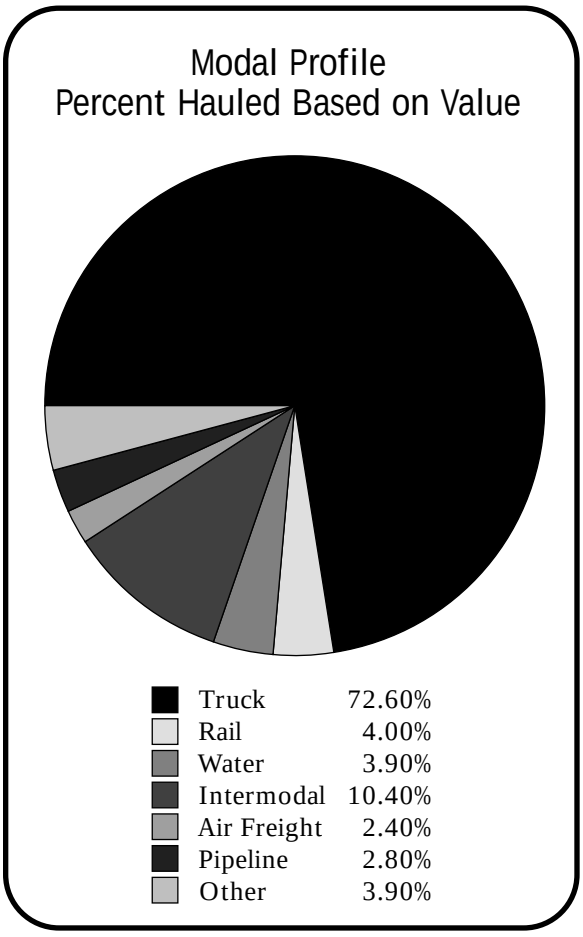
Trucking moves the next most valuable loads at 35 cents per pound, more than four times the average value of rail goods' 8 cents per pound. Water shipments are estimated at 6 cents per pound, while pipeline shipments have a 6 to 9 cents range in their value.[11]

Evaluating the transport modes based solely on the number of tons moved, again trucking dominates the other modes but not by as much as the previous measures. Of the 12.3 trillion tons transported, motor carriers only moved 6.5 trillion or 52.6 percent. Water carriers hauled the next largest number of tons — 2.1 trillion or 17.2 percent. Railroads were third carrying 1.6 trillion or 12.7 percent of the tonnage.

Pipelines carried the next largest number of tons — 1.3 trillion or 10.8 percent. Intermodal accounted for 205 million tons or 1.7 percent of these totals. Air freight was the smallest component —2.8 million tons or 0.02 percent[12]

However, trucking's domination of the freight industry disappears if a ton-mile yardstick is used. Ton-mile is a volume measure. It is derived by multiplying the weight in tons of each shipment moved by the distance it is hauled.

Here, railroads are the dominant mode moving 1.2 billion ton-miles in 1994, more than a quarter of all ton-miles hauled. Intercity trucking comes in second with 908 million ton-miles or 23.7 percent of the total. If local trucking numbers were added to the



SOURCE: *1993 Commodity Flow Survey: State Summaries,* September 1996, U.S. Department of Transportation, Bureau of Transportation

[10] *Transportation Statistics Annual Report 1996*, U.S. Department of Transportation, Bureau of Transportation Statistics.

[11] *1993 Commodity Flow Survey: State Summaries*, September 1996, U.S. Department of Transportation, Bureau of Transportation Statistics.

[12] *1993 Commodity Flow Survey: State Summaries*, September 1996, U.S. Department of Transportation, Bureau of Transportation Statistics.

intercity numbers, trucking could be expected to narrow the gap with railroads and perhaps even outperform them.

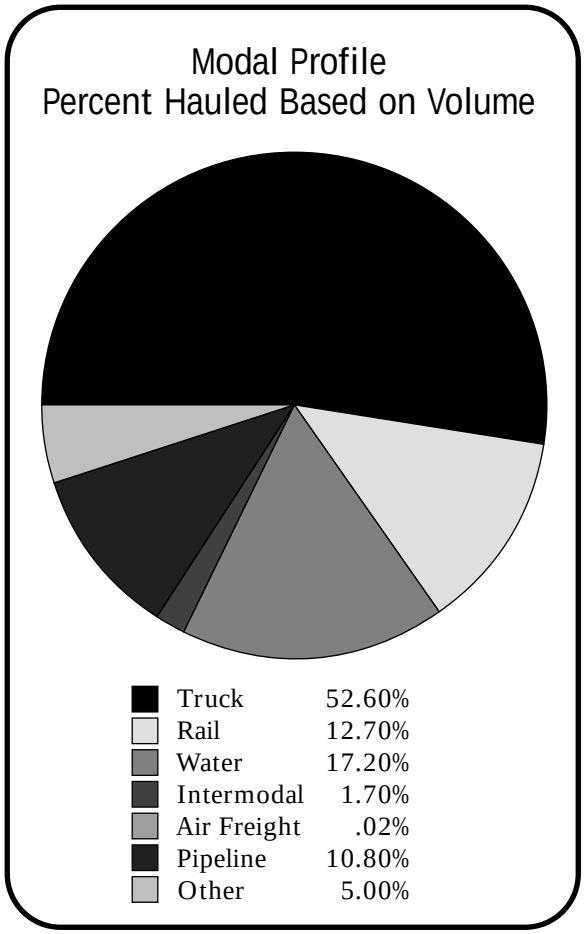
Measuring by ton-miles, oil pipelines place third hauling 608 million tons or 16.2 percent of total volume. Following close behind is domestic water shipments. Those moving in the coastwise trade or along the nation's rivers and lakes totaled 517 million tons or 16 percent of the volume. International maritime generated 298 million tons or 8 percent. Air carrier movements accounted for the smallest number of ton-miles — 12 million or 0.09 percent.[13]

This short overview of the freight industry provides a context for exploring each of its component modes. However, it cannot do justice to their individual complexity or their connectivity to the entire system.

To address those issues, even on a simple basis, a common framework is needed, such as:

- What Does the Transport Mode Do?
- What Markets Does It Serve?
- What Goods Does It Haul?
- How and Where Does It Interact with Its Competitors and Customers?
- What has been the Role of Government?
- What Is the Role of Informational and Other Technology?

Understanding the answers to these questions allows a broader policy discussion of the issues that have shaped and will be shaping how this nation moves its goods in local, regional, national, and international commerce. It creates a platform from which to begin the discussion about freight performance standards and how different parts of the industry, as well as its different segments, define and measure success.



SOURCE: *1993 Commodity Flow Survey: State Summaries,* September 1996, U.S. Department of Transportation, Bureau of Transportation

[13] *National Transportation Statistics 1996,* U.S. Department of Transportation, Research and Special Programs Administration and Bureau of Transportation Statistics.

Modal Profile

TRANSPORT MODE	% of U.S. Freight Bill	Shipment Value ($/lb.)	Avg. Length of Haul (Miles)
Truck	79	$0.35	416**
Rail	8	$0.08	794
Water	5	$0.06	+2,3000: maritime 1,650: domestic
Intermodal	*	$1.61#	***
Air Freight	4	$26.77	1,325
Pipeline	2	$0.09–$0.06	825: crude 375: product
Other	2	$0.20	unknown

SOURCE: *1993 Commodity Flow Survey: State Summaries*, September 1996, U.S. Department of Transportation, Bureau of Transportation Statistics, Association of American Railroads, and USDOT's Maritime Administration.

* Percentage incorporated into underlying modal totals.

** Without local trucking operations, which would lower this intercity average. Two-thirds of domestic freight shipments by volume have a length of haul that is less than 100 miles.

*** Not specified. Generally, a minimum distance of 750 miles is needed, with best economies appearing when shipping distances are 1,000 – 1,500 miles or greater.

\# Averaged value. Package express has a value of $15/lb; rail/truck intermodal $1.09/lb; and other intermodal $0.05/lb.

Freight Profile

MODE	Cargo Value	Cargo Volume	Service	Distance Traveled
Truck	Moderate to High	Loads of less than 50,000 pounds per vehicle. Higher weights with state permits	Single driver can go 500 / day. Team or relay driving can go further. On-time performance varies by carrier. Most better than 90% with some at 99% or better.	Varies by carrier type. Two-thirds of tonnage moves less than 100 miles. Interstate carriers average me than 400 miles.
Rail	Moderate to Low	Multiple carloads. No weight restrictions	Dedicated service can move goods cross-country by third morning. More normal times 4–7 days. On-time performance varies by carrier. Some meet 85% or better. Others 60%–70% range.	Average length of haul is 670–803 miles.
Intermodal	Moderate to High	Truck trailers by rail or water are most common haul of multiple carloads. No weight restrictions. Other combinations include air / truck, water / rail, and pipeline / truck or ship	Matches top end of rail—third morning for cross country. Also uses more normal rail transits of 4–7 days. On-time performance equal to or better than rail but not as good as truck, generally.	No average length specified. However, distances normally range from 700 miles to 1,500 miles or more.
Air	High	Small. Most are less than 100 pounds	Normally overnight or second day service	Average distance is more than 1,300 miles.
Domestic U.S. Water	Moderate to Low	Normally bulk shipments totalling in the millions of tons	Varies according to system segment. Competitive with rail on large dimension and bulk shipments	Based on system segment, average distances range from 356 to about 1,600.
Domestic Off-Shore Water	Moderate to Low	Container and general freight as well as bulk shipments	Bulk service is slower than container. Container transits can occur within 7–10 days trans-Pacific and trans-Atlantic	Distance varies based on the state, territory, possession being served.
International Water	High to Low with most moves Moderate to Low	Bulk shipments similar to domestic. Container shipments similar to rail and truck	Bulk service is slower than container. Container transits can occur within 7–10 days trans-Pacific and trans-Atlantic	Average distance is more than 2,300 miles.
Pipeline	Low	Bulk shipments in the millions of tons or trillions of gallons	Flow rates vary with consumer demand. Can range from 0 to 20 miles per hour	Average distance for crude oil is 825 and 375 for finished products.

Who Regulates Freight Transportation Services

MODE	Domestic – U.S.	International
Air Service	• Federal Aviation Administration • Environmental Protection Agency	• Federal Aviation Administration • International Air Transport Assoc. • International Civil Aviation Org. • U.S. Customs Service • U.S. Immigration and Naturalization Service (for imports)
Truck Service	• Federal Highway Administration • Environmental Protection Agency • Occupational Safety and Health Administration • Surface Transportation Board • State and Local Safety and Tax Officials	• U.S. Customs Service • U.S. Immigration and Naturalization Service (for imports) • Requirements of foreign country where truck is being operated
Rail Service	• Federal Railroad Administration • Surface Transportation Board • Environmental Protection Agency	• U.S. Customs Service • U.S. Immigration and Naturalization Service (for imports) • Requirements of foreign country where train is being operated
Barge	• U.S. Coast Guard • Environmental Protection Agency • Surface Transportation Board	• U.S. Customs Service • U.S. Immigration and Naturalization Service (for imports) • U.S. Coast Guard • Federal Maritime Commission • Requirements of foreign country where barge service is performed
Maritime	• U.S. Coast Guard • Federal Maritime Commission • Environmental Protection Agency	• U.S. Coast Guard (within U.S. territorial limits) • Federal Maritime Commission • U.S. Customs Service • U.S. Immigration and Naturalization Service (for imports) • Internal Maritime Organization • Requirements of foreign country where maritime service is performed
Pipeline	• Federal Energy Regulatory Commission • Office of Pipeline Safety of USDOT	N / A

Railroads

Railroads are wholesalers of transportation services. They concentrate on hauling bulk commodities and large quantity shipments over long distances. Based on volume, they transport 12.7 percent of the nation's goods.

In addition, they are the long-distance link in providing intermodal freight services. Each railroad owns the track over which it operates. In some cases, they operate joint services with or operate over the tracks of another railroad.

Where voluntary access agreements are reached through commercial negotiations, the parties file these trackage rights agreements with the Surface Transportation Board for review and approval. Where the parties cannot agree, the STB can set compensation levels. The STB also can require that carriers grant access over their tracks. This normally occurs when the regulatory agency seeks to preserve competition when approving merger applications.

As an industry, railroads are dominated by their largest companies. Of the 531 freight railroads in the U.S., the top 10 carriers, know as Class Is, own about 79 percent of the road miles, generate 94 percent of the revenue ton-miles and 90 percent of freight revenues. They have almost 89 percent of the industry's employees on their payrolls, and comprise 2.3 percent of all U.S. railroads.[14]

The Class I carriers are: Burlington Northern / Santa Fe (BNSF), Union Pacific (UP), CSX Corporation (CSX), Consolidated Rail Corporation (Conrail), Norfolk Southern (NS), Chicago & North Western (CNW), Illinois Central (IC), Kansas City Southern (KCS), Grand Trunk Western (GTW which is owned by the Canadian National), and Soo Line (Soo which is also know as CP Rail and is owned by the Canadian Pacific).

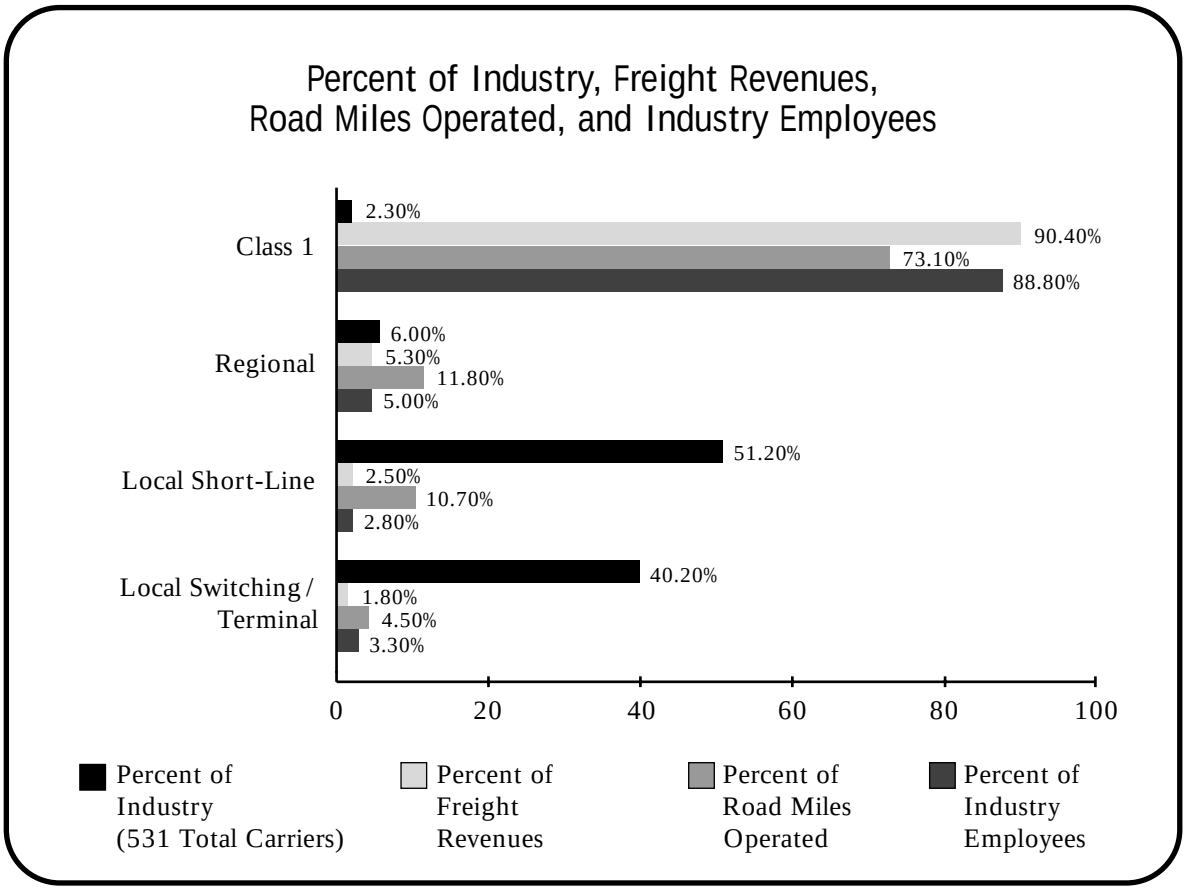
The largest of these railroads — BNSF, UP, Conrail, CSX, and NS — operate systems that generally facilitate the flow of trade on an east / west, west / east basis. For BNSF and UP, their territories generally are bounded by the Pacific Ocean and the Mississippi River. They interchange freight with connecting carriers generally in the metropolitan areas of Chicago, Kansas City, and St. Louis. Both carriers have connections to move freight into Mexico and Canada.

For CSX, NS, and Conrail, their territories generally are bounded by the Atlantic Ocean and the Mississippi River. They interchange freight with connecting carriers generally in the metropolitan areas of Chicago, Kansas City, and St. Louis. CSX and NS compete with one another on traffic flows between the Middle Atlantic states south of Baltimore and the southeastern states. Conrail is the major railroad serving the Middle Atlantic states north of Baltimore and the New England states.

For CNW, IC, KCS, GTW and Soo, their territories generally are bounded by the central states as they provide service basically on a north / south, south / north basis. In certain geographic areas, such as New Orleans, Memphis, St. Louis, Kansas City, and Chicago, many of these Class I carriers both interchange equipment with each other to provide service to their customers, as well as compete with one another for customers.

Regional and short-line railroads often act as feeder services to the Class Is. Many of them were created as the Class Is downsized

[14] *Railroad Ten-Year Trends 1985-1994, Volume No. 12,* Economics, Policy and Statistics Department, Association of American Railroads.



in the 1970s and 1980s and spun off their unprofitable and light density lines. Because of lower operating costs, these smaller carriers have been able to create profitable, more customer oriented operations not possible under a Class I's cost structure and expansive route system.

Of the 531 U.S. railroads, 487 or almost 92 percent are local or short-line carriers. They are divided into two categories—linehaul and switching / terminal. Local linehaul or short-line railroads operate like Class Is but only on a much smaller scale. They account for 51.2 percent of U.S. railroads.

Switching and terminal railroads operate in specific urban areas. Their function is to facilitate the interchange of rail shipments among the railroads in their area, normally Class I carriers, as well as to serve the needs of the rail customers within their territories. It is not unusual for one or more than one Class I railroad to own this type of carrier. These railroads are 40.5 percent of the industry.

The remaining 32 railways, accounting for 6 percent of the industry, are regional operators, which are substantially smaller than their Class I counterparts but operate almost as much mileage as the local short-lines. [15] Because they are smaller than Class 1 railroads, regional carriers can offer cost effective, customer oriented services like short-lines. Because they are larger than short line

[15] *Railroad Ten-Year Trends 1985-1994, Volume No. 12,* Economics, Policy and Statistics Department, Association of American Railroads.

railroads, they have larger territories in which to build a customer base like Class Is.

The majority of the railroads' business is moving bulk shipments of low value commodities for long distances. In 1994, two-thirds (66.3 percent) of its revenues and nearly three-quarters of its tonnage (72.8 percent) comes from hauling:

- 574 million tons of coal;
- 142 million tons of chemicals and allied products;
- 130 million tons of farm products;
- 106 million tons of nonmetallic minerals;
- 87 million tons of food and kindred products; and,
- 30 million tons of transportation equipment such as cars.

Intermodal containers and trailers roughly account for another 15 percent of the revenue total and 6.8 percent of the tonnage number — about 100 million tons.[16] The intermodal segment of the industry will be addressed later in this chapter.

Service for most railroad tonnage is arranged by contract between the carriers and their customers. These contracts are like any other normal business arrangement where rates and services are specified and any performance requirements are detailed. Contracts are normally written on predictable levels of cargo moving at predictable times and under recurring conditions. Estimates indicate that 80 percent or more of total rail tonnage is moved under these business arrangements. Service on the remaining railroad tonnage is handled through what is known as common carrier rates — essentially

COMMODITY	% of Gross Freight Revenues	% of Tons Originated	% of Carloads Originated
Coal	21.7	39.1	24.5
All Others*	15.0	6.8	26.8
Chemicals & Allied Products	13.9	9.6	7.3
Farm Products	7.4	8.9	6.3
Transportation Equipment	10.0	2.0	6.2
Non-Metallic Minerals	2.7	7.2	4.9
Food & Kindred Products	7.5	6.0	6.0

* Much of this category consists of intermodal traffic although some of this traffic is dispersed in other commodity groups.

[16] *Railroad Ten-Year Trends 1985-1994, Volume No. 12,* Economics, Policy and Statistics Department, Association of American Railroads.

price lists that are the same for all users. These rates are often used for spot market loads or for infrequent or low volume users of rail services.

Partnerships

Railroads' relationships with the other modes range from virtually no interaction (air freight) to a sometimes uneasy customer / competitor dichotomy (trucking). There is little interaction with air carriers because of differing products and service needs. Air freight carriers handle high value, light weight shipments which must be moved within very sensitive time frames, often as little as 24 hours. Railroads handle low value, high volume loads that very rarely require completed service within 24 hours or less. In short, the two modes each handle distinct and separate segments of the freight industry.

Railroads and ocean-going international or maritime carriers, by and large, have very cooperative relations. They regularly partner to provide seamless transportation services for their bulk and intermodal customers. It was the cooperative efforts of railroads and U.S.-flag maritime ship operators that created the doublestack train service which spurred the intermodal revolution. Doublestack service is when one shipping container is placed on a rail car and another container is placed on top of it. This allows almost twice the freight volume to be handled with the equipment needed to operate a single train.

Railroads face competition primarily from two sources — trucks and barges. Trucks provide competition on higher value shipments such as intermodal and finished vehicle transport. Barges compete on the more traditional low value goods such as coal and grains. Barge competition is essentially limited to commodities moving in the central portions of the U.S. where there are navigable waterways, such as the Mississippi, Ohio, and Missouri Rivers.

The relationship between railroads and truck lines is probably the most complicated of the modes because trucks have the ability to both generate freight for the railroads and take it away from them. Railroads and trucks are business partners in providing intermodal services. Trucks provide the short haul connections between the firm sending the freight and the railroad as well between the railroad and the customer receiving the freight. Trains provide the long haul service between origin and destination.

When trucks and trains compete, they compete for types of traffic — mostly the goods which give the railroads their higher profit margins — intermodal, transportation equipment (automobiles — finished products as well as assembly supplies), chemicals, and food products. Intermodal freight is subject to competition from long distance trucking companies. As a result, even when there is a rail / truck business relationship with one motor carrier for an intermodal move, there is a competitive tension with other long distance truckers seeking to capture the same business.

The railroads's relationship with government is a long standing one. The federal government's first independent regulatory agency, the Interstate Commerce Commission, was created in 1886 to ensure fair play among railroads and act as a referee between the rail industry and its customers, especially its "captive" customers — entities whose cargoes depend on rail transportation because they cannot readily be transported by other modes, and who have service from only one railroad.

From 1886 through the early 1970s, railroads were subject to increasing levels of government control over the pricing of their services and safety of their operations. In 1980, Congress ended economic controls

over a sizeable portion of rail operations. It limited federal oversight to those matters where there were concerns about a lack of competition. In sunsetting the ICC in 1995, Congress further eased these economic controls. The Surface Transportation Board is the federal entity now administering the remaining regulatory functions. The STB is an independent unit with the Department of Transportation.

Since its creation in 1967, the DOT's Federal Railroad Administration has administered federal rail safety regulations and the programs they generate. Unlike economic regulatory controls, Congress has increased these safety requirements over the last 20 years.

Role of Information Technology

Whether domestic or international, every commercial shipment requires certain supporting documents, such as bills of lading, manifests, and other shipping papers. Data errors as well as lost and / or improper paperwork can hamper the efficient movement of freight just as if the shipment had been damaged or misdirected in transit.

The technology and information revolution has greatly improved the accuracy of shipping data and the speed with which this information can be shared. These innovations, in turn, are allowing information to reduce the amount of on-hand inventory needed for operations. For example, where car assembly plants used to pride themselves on the days or weeks of inventory on hand. Today, they boast about how many minutes there are between deliveries of inventory needed to keep the assembly line working. The ability to have reliable information almost instantaneously is a major reason why manufacturing can operate with this degree of precision.

The railroad industry has been a leader in creating standardized systems for the tracking and monitoring of equipment as it moves over the nation's rail systems. Through RAILINC, a for-profit subsidiary of the Association of American Railroads established in 1982, U.S. rail carriers maintain a centralized information service using computer and telecommunications technology to locate shipments, access bill of lading information, as well as conduct other electronic business. A related industry wide effort begun in the mid-1980s has created an electronic tag and reader system. Tags on 97 percent of the U.S. rail fleet feed location and other information to 1,500 scanners as goods crisscross the nation. As a result of efforts begun in 1992, the AAR also has developed cooperative programs with the U.S. Customs Service to facilitate trade with Canada and Mexico.[17] Individual carriers as well as the AAR have developed systems for the tracing and monitoring of individual shipments.

Motor Carriers

Trucking is the nation's dominant form of freight transportation accounting for between 78 and 79 percent of the nation's 1994 freight bill.[18]

A retailer of transportation services, the industry has increased market share over the last two decades by creating customized transportation services to meet specific

[17] *Intelligent Transportation Systems and Intermodal Freight Transportation*, Joint Program Office, Federal Highway Administration, November 1996.

[18] *U.S. Freight Transportation Forecast...to 2004,* DRI / McGraw-Hill, 1996.

commercial needs. Except in certain circumstances, such as the movement of large shipments of bulk commodities, trucking dominates local and regional freight moves. Unlike the railroads, its rights of way, the nation's highways, bridges, and other roads, are publicly owned and maintained, through a system of taxes and tolls as well as vehicle registration and other fees.

The trucking industry is more specialized than railroading. Trucking companies tend to segregate their services into distinct categories or industries: long distance v. regional / local; private v. for-hire; dry van v. tanker; and, general cargo v. specialized cargoes including hazardous materials.

Although the popular image of the industry is the tractor-semitrailer hauling goods long distances over the Interstate highways, this image is not reality for two reasons. First, truck equipment is diverse, dominated by smaller vehicles and a wide variety of equipment types. Second, the bulk of trucking operations are local. About 66 percent of truck tonnage moves distances of 100 miles or less.

Of the 353 billion miles traveled by trucks for business purposes in 1994, 57 percent were generated by vehicles weighing less than 10,000 pounds. Trucks weighing between 10,001 to 33,000 pounds accounted for another 15 percent of this total. Medium to large combinations such as tractor-semitrailers, weighing 33,000 pounds or more, the popular image of the trucking industry, generated less than a third of these miles — about 28 percent.[19]

In 1992, the Census Bureau surveyed the trucks operating within the U.S. It found that 91 percent of these vehicles were light duty — equipment such as pickups, vans, panel trucks, and station wagons. The remaining 9 percent encompassed a wide variety of body types with the most popular being platform and flatbed (2.65%), dry van (1.36%), and dump truck (1.03%). When light duty vehicles are taken out of these totals, platforms and flatbeds account for roughly 31 percent of truck equipment, dry vans for 16 percent, unspecified 14 percent, and dump trucks 12 percent.

Local and regional hauls account for almost half of all truck revenues and are the dominant arrangement for private carriers.[20] Private carriers are corporations like Frito-Lay and Levis who run their own truck fleets to better coordinate their manufacturing processes or better serve their customers and distributors. These firms have decided that it is better to provide their own services rather than use the services of for-hire motor carriers. Most of their operations are moves of less than 100 miles. This industry segment's average length of haul is 51 miles.

For-hire carriers are corporations like J.B. Hunt, Schneider National, Roadway Services, and Yellow Freight who provide transportation services to the general public. They offer service either on a truckload or on a less-than-truckload basis. For-hires travel much further distances than their private counterparts, with their minimum hauls being about 200 miles. It is not uncommon to have trip lengths of more than 500 miles. This industry segment's average length of haul is more than 400 miles.

Truckload or TL means the goods of only one customer are being carried on the vehicle. There generally are low startup costs associated with these operations because the truck equipment is the primary expense.

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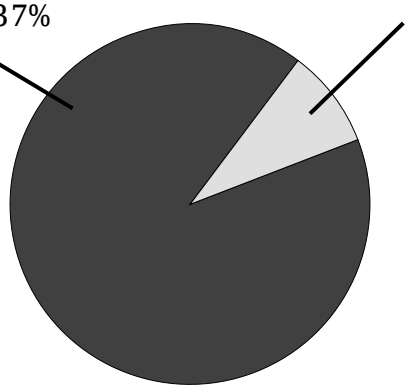
[19] *Standards Trucking and Transportation Statistics*, American Trucking Associations Statistics Department, May / June 1996.

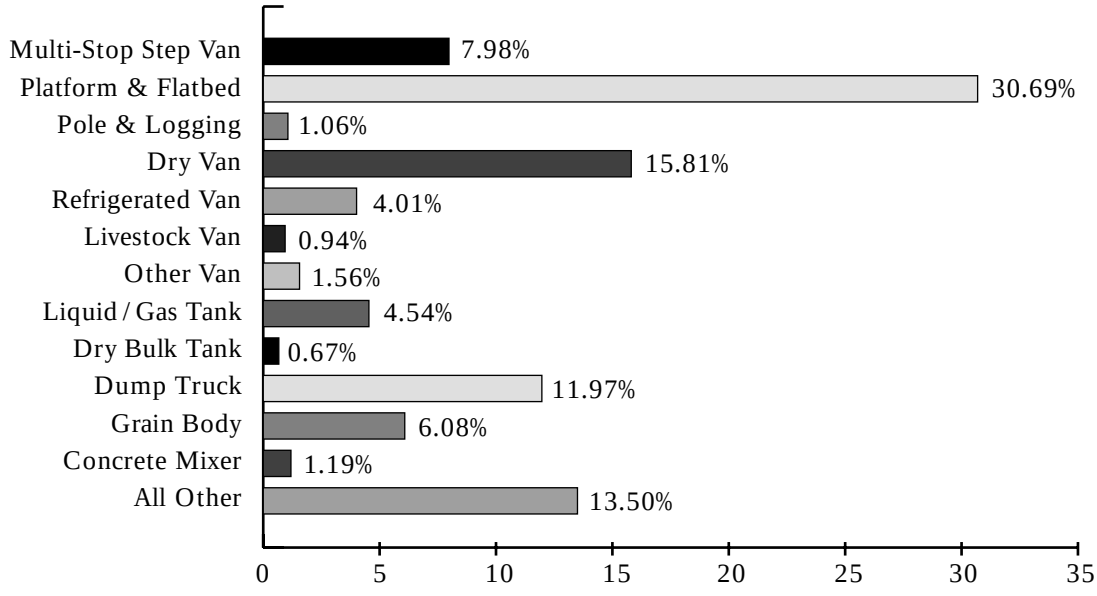
[20] *America's Private Carriers: Who Are These Guys?*, National Private Truck Council and Transportation Technical Services, 1995.

1992 Truck Inventory
Complete Inventory



Light Duty (Pickups, Panels, Vans, Utilities, Station Wagons)	91.37%
Miscellaneous	8.63%
Multi-Stop Step Van	0.69%
Platform & Flatbed	2.65%
Pole & Logging	0.09%
Dry Van	1.36%
Refrigerated Van	0.35%
Livestock Van	0.08%
Other Van	0.14%
Liquid / Gas Tank	0.39%
Dry Bulk Tank	0.06%
Dump Truck	1.03%
Grain Body	0.53%
Concrete Mixer	0.10%
All Other	1.17%

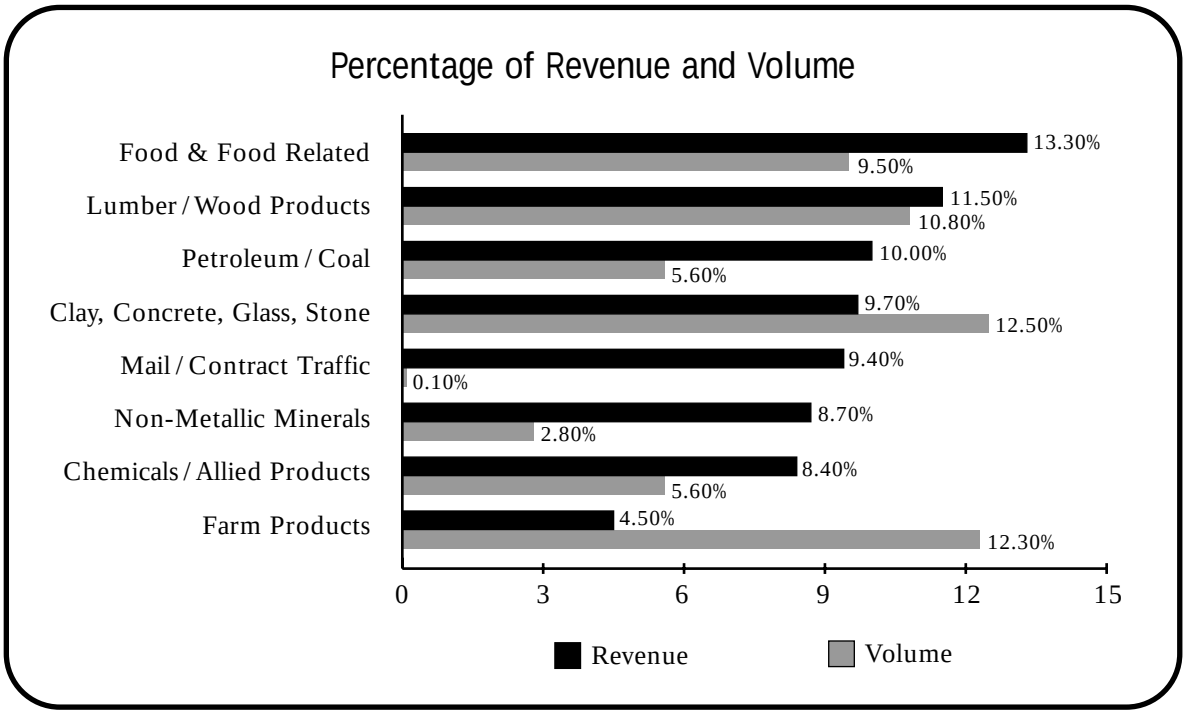
1992 Truck Inventory
Break-Down of Miscellaneous Trucks



SOURCE: *1992 Truck Inventory – U.S.*, U.S. Bureau of the Census
Note: Numbers may not total 100 percent due to rounding

TRUCK BODY TYPE	Number of Units
Light Duty (Pickups, Panels, Vans, Utilities, Station Wagons)	54,089,000
Multi-Stop Step Van	408,000
Platform & Flatbed	1,569,000
Pole & Logging	54,000
Dry Van	808,000
Refrigerated Van	205,000
Livestock Van	48,000
Other Van	80,000
Liquid/Gas Tank	232,000
Dry Bulk Tank	34,000
Dump Truck	612,000
Grain Body	311,000
Concrete Mixer	61,000
All Other	690,000
Total	59,201,000

SOURCE: *1992 Truck Inventory – U.S.*, U.S. Bureau of the Census



SOURCE: *U.S. Freight Transportation Forecast, ... to 2004,* DRI / McGraw-Hill and American Trucking Associations Foundation

They are the dominate form of dry van and refrigerated service. Less-than-truckload or LTL means a vehicle is carrying the goods of many customers. This service has much higher startup costs because in addition to equipment costs, assembly and distribution facilities must be created to consolidate and then distribute the freight.

The local and regional nature of trucking was highlighted in a recent government survey which found that 30 percent of the value and more than 55 percent of the tonnage moves between locations less than 50 miles apart. More than 38 percent of the value and two-thirds of the tonnage moves less than 100 miles.[21] In contrast, only 4 percent of truck tonnage moves more than 1,000 miles. However, this long distance freight accounts for 14 percent of shipment value.[22]

Trucking is pervasive. It serves as the carrier of choice for most small businesses, especially the very small firms, who rely on package express carriers like Federal Express and United Parcel Service to meet their transportation and logistics needs.

By revenue, food and food products, lumber or wood products, as well as petroleum or coal account for 34.8 of truck traffic. By volume, clay, glass, concrete and stone, farm products, as well as petroleum and coal account for 35.6 percent of truck traffic[23]

Trucking's customer focus has played a key role in helping to create the logistics revolution of the past decade. In the early to mid 1980s,

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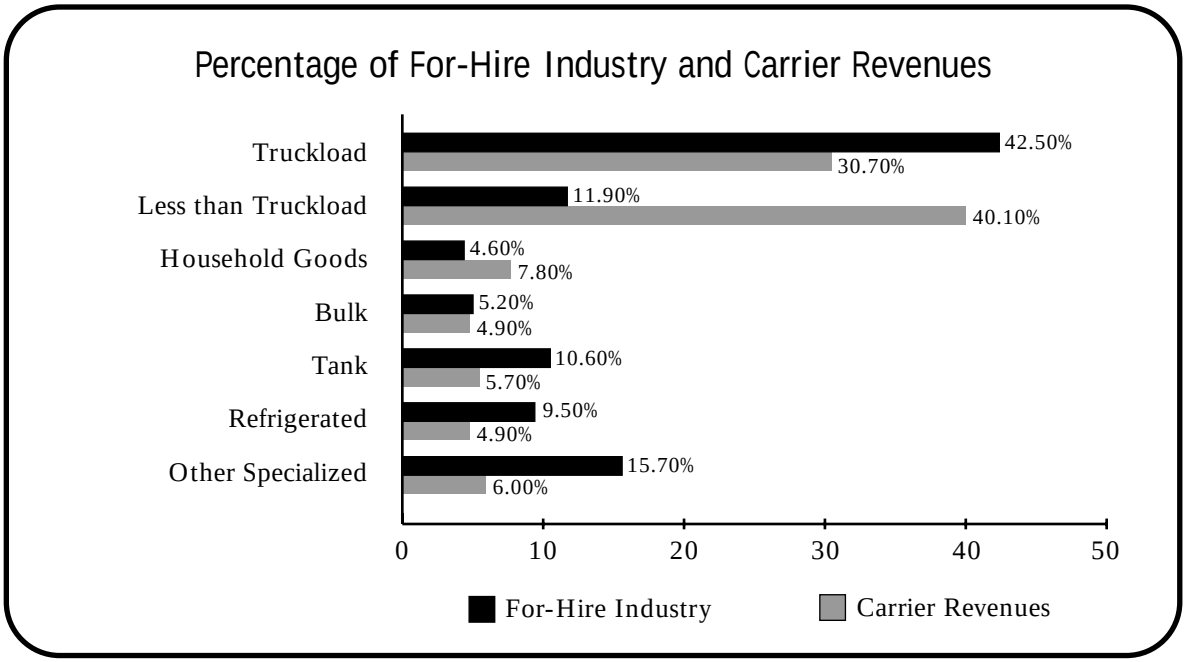
[21] *1993 Commodity Flow Survey State Summaries*, Bureau of Transportation Statistics, U.S. Department of Transportation, September 1996.

[22] 1993 *Commodity Flow Survey, U.S. Preliminary Report*, TC92-CF-52(P), U.S. Bureau of the Census, July 1995.

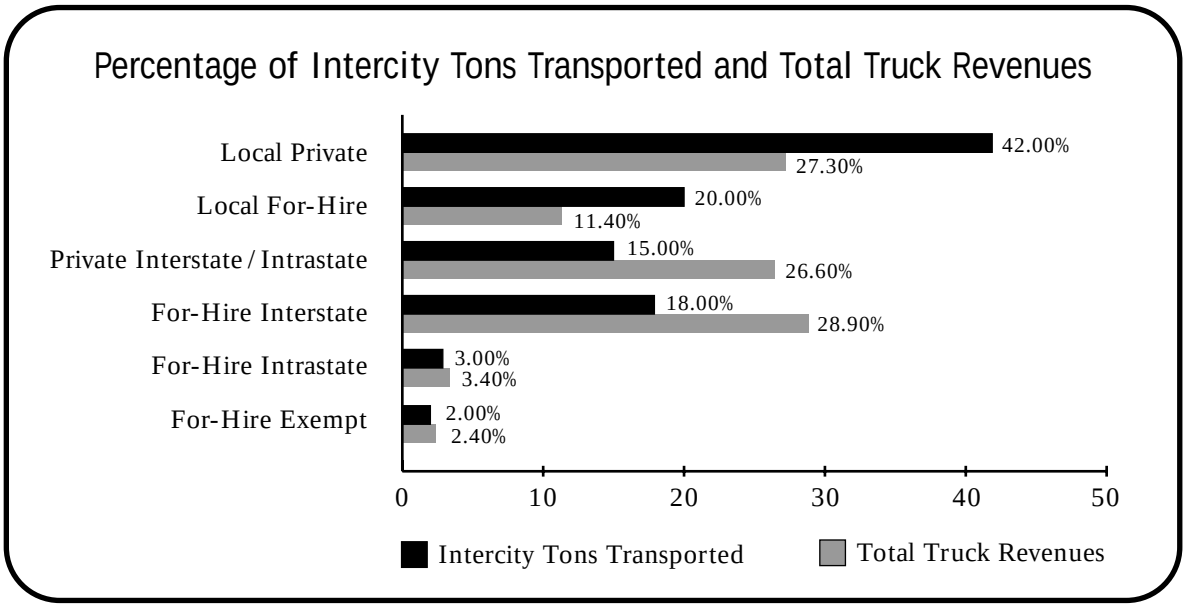
[23] *U.S. Freight Transportation Forecast...to 2004,* DRI / McGraw-Hill, 1996.



SOURCE: ATA Trucking Information Services, *Motor Carrier Annual Report*, derived from reports filed with the U.S. DOT by carriers with $1 million or more in annual revenue.

MODE	Average Length of Haul
Truckload	280 miles
Less-than-Truckload	575 miles
All Class 1 Motor Carriers	410–416 miles
Rail	670–803 miles
Domestic Air	1,262 miles
Crude Pipeline	820 miles
Pipeline Products	374 miles
River	450 miles
Great Lakes	538 miles
Coastal Shipping	1,599 miles

Transportation in America 1995, Eno Foundation.



SOURCE: *America's Private Carriers: Who Are These Guys?*, National Private Truck Council and Transportation Technical Services, 1995.

the just-in-time revolution was spearheaded by trucks. It was motor carriers and shippers who were the first to experiment with set times for pick up and delivery so that less inventory was needed in the overall production process. In essence, their actions began integrating transportation into manufacturing and distribution as another business process.

Motor carriers face competition from air freight for high value commodities and from railroads for lower value goods. On high value goods, the competition pits traditional air freight services against package express or courier services as well as expedited carriers like Roberts Express. Because transportation costs are a small portion of the purchase price of these goods, firms are willing to pay premium rates.

In this segment of the industry, delivery is predicated upon strict time and service requirements. As noted earlier, air freight has an average value of $26 per pound and package express $15 per pound, while general trucking's average shipment value is 35 cents per pound. Here carriers compete for commodities like computers and related goods, fresh flowers and foods, as well as letters and business documents.

On lower value goods, as noted earlier, trucks share a dual natured relationship with railroads (see Railroads). They cooperate in providing intermodal services. They also compete to capture market share on goods like automobiles and auto parts, food and kindred products, and intermodal shipments.

This competition is affected by weight and distance. In general, under 100 miles, competition occurs only on shipments weighing more than 60,000 pounds; at 100-300 miles, shipments weigh between 60,000 and 90,000 pounds; at 300 -500 miles, the freight weighs between 30,000 and 90,000 pounds; and, at 500 miles or more, commodities weigh between 10,000 and 60,000 pounds.[24]

[24] *America's Private Carriers: Who Are These Guys?*, National Private Truck Council and Transportation Technical Services, 1995.

	MODE SEGMENT	Average Miles per Shipment
	All Modes	403 miles
Single Mode Moves	Parcel, Postal Service, Courier	715 miles
	Private Truck	51 miles
	For-Hire Truck	470 miles
	Air	1,390 miles
	Rail	803 miles
	Inland Water	356 miles
Joint Mode Moves	Private & For-Hire Truck	209 miles
	Truck & Air	1,315 miles
	Truck & Rail	1,482 miles
	Truck & Water	1,269 miles

SOURCE: 1993 *Commodity Flow Survey, U.S. Preliminary Report*, TC92-CF-52(P), U.S. Bureau of the Census, July 1995

It should be noted that shipments in excess of 50,000 normally require a special permit to operate configured as a single load. This part of the market usually is served by the heaviest single trucks or longer combination vehicles that run under more tightly controlled conditions than general trucking. Because of these vehicles' ability to compete with railroads, the rail industry is keenly interested in assuring that the current competitive market environment is maintained.

For trips under 100 miles, it is private carriers who are providing the competition. For trips over 100 miles, it is the for-hire motor carriers who are doing so. The only exception is for loads weighing between 30,000 and 60,000 pounds moving between 100-200 miles. Here, private trucking seems to be the carrier of choice.[25]

The reason competition is so fierce between the two modes is that while these goods are not the highest value freight for the trucking industry, they are high return for the railroad industry. Railroads see the returns made from these shipments, as well as those made from intermodal shipments, as key to maintaining their profitability.

[25] *America's Private Carriers: Who Are These Guys?*, National Private Truck Council and Transportation Technical Services, 1995.

Government has played a fundamental role in shaping the trucking industry. This role is pervasive ranging from vehicle design to operator qualification and, for almost half a century, economic pricing strategies. Beginning with the Motor Carrier Act of 1935, the federal government took actions it believed where necessary to foster what was then a fledgling industry. These controls affected entry and pricing requirements for interstate carriers which many states quickly copied for their own intrastate trucking industries. As the trucking industry thrived, safety regulations were adopted.

Economic and safety controls were administered by the Interstate Commerce Commission until the creation of the DOT. Beginning with the Department's creation in 1967, the ICC's role was limited to pricing and licensing responsibilities. Through the FHWA's Office of Motor Carriers and the National Highway Traffic Safety Administration, DOT oversees a wide range of requirements encompassing vehicle operations such as braking standards, driver licensing standards and their maximum work hours, and the overall safety fitness of interstate carriers.

Today, there are very few economic

Truck and Rail Tonnage Distribution for Shipment Weight and Distance

	Under 1,000 lbs	1,000 – 9,999 lbs	10,000 – 29,999 lbs	30,000 – 59,999 lbs	60,000 – 89,000 lbs	Over 90,000 lbs
Under 100 miles		Private Truck				
100 – 199 miles						
200 – 299 miles						
300 – 499 miles		For-Hire Truck			Rail	
500 – 999 miles						
1,000 – 1,499 miles						
Over 1,500 miles						

SOURCE: America's Private Carriers: Who Are These Guys?, National Private Truck Council and Transportation Technical Services, 1995.

Truck and Rail Tonnage Distribution for Shipment Weight and Distance

	Under 1,000 lbs	1,000 – 9,999 lbs	10,000 – 29,999 lbs	30,000 – 59,999 lbs	60,000 – 89,000 lbs	Over 90,000 lbs
Under 100 miles					To Truck	To Rail
100 – 199 miles					To Rail	
200 – 299 miles		TRUCK			To Rail	
300 – 499 miles				To Truck	To Rail	
500 – 999 miles			To Truck	To Truck		
1,000 – 1,499 miles			To Truck	To Truck	RAIL	
Over 1,500 miles			To Truck	To Truck		

SOURCE: *America's Private Carriers: Who Are These Guys?*, National Private Truck Council and Transportation Technical Services, 1995.

controls remaining for the trucking industry. In 1980, the industry was partially deregulated. Deregulation essentially was completed with the enactment of additional legislation in 1994 and 1995. Because of these federal changes which pre-empted the states from regulating the intrastate activities of interstate carriers, many states have either deregulated or significantly eased the economic controls placed over the truckers operating solely within their borders.

Whether domestic or international, every commercial shipment requires certain supporting documents, such as bills of lading, manifests, and other shipping papers. Data errors as well as lost and / or improper paperwork can hamper the efficient movement of freight just as if the shipment had been damaged or misdirected in transit.

Role of Information Technology

The technology and information revolution has greatly improved the accuracy of shipping data and the speed with which this information can be shared. These innovations, in turn, are allowing information to reduce the amount of on-hand inventory needed for operations. Like railroads, motor carriers are using technology to transmit timely

reliable information to assure the prompt movement of their goods. Just in-time service cannot occur unless the pertinent shipping information is just ahead of the load.

Unlike railroads, who have decided to use a single technology for shipment location information—interactive tags and readers, motor carriers are exploring a wider variety of technologies.

Several factors influence this trend. First, there are far more motor carriers than railroads. Over 350,000 interstate motor carriers are registered with the USDOT's Office of Motor Carriers.[26] There are 10 Class I railroads. Second, motor carriers do not operate over a fixed route system. Customer demand requires trucks to travel to a diverse array of sites. As a result, this industry's technology choices have tended to link commercial vehicles with their corporate and customer structures through satellite, cellular, and microwave technologies rather than the railroads' single microwave tag and reader system. This diversity of technologies also is a function of the higher competitive pressures motor carriers face. In today's environment, carriers are competing vigorously on the levels of service they provide including the ability to trace shipment location and pickup / delivery times.

However, tag and reader technology is being explored for industry use for non-commercial purposes. In addition to needing to talk to its customers and suppliers, truckers need to talk to their regulators — the state entities who require operating permits, assess tolls, impose taxes, and enforce safety requirements such as shipment weights. Through USDOT's Intelligent Transportation System and other initiatives, tag and reader technologies are being developed and deployed. By 2005, deployments are expected to cover the nation.

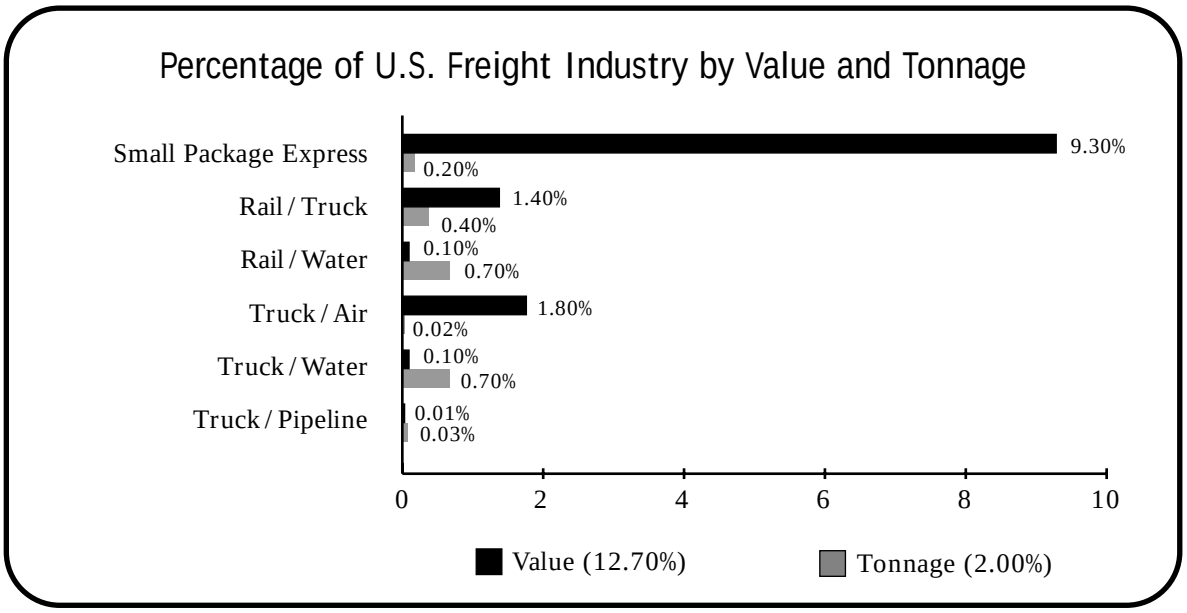
Intermodal

Intermodal is not a mode. It is a process or a way of offering freight services by two or more modes so that the efficiencies of each participating carrier are maximized. As a result, customers receive more efficient service. Carriers profit from business opportunities which would not exist under their more traditional service structures.

Although the first commercial application of rail / truck intermodal service occurred in the 1950s, the service did not become a dynamic industry until the 1980s. Three events are key to this evolution. First, in 1980, railroads and motor carriers were partially deregulated from federal economic controls. For the first time, they were given the right to enter into business contracts and to do so without prior federal approval and the restrictions against railroad ownership of trucking companies was eased. In 1984, international maritime liner carriers received similar but more limited pricing freedoms.

Second, in the early 1980s, the Interstate Commerce Commission, now the Surface Transportation Board, issued a series of decisions exempting rail / truck intermodal service from all federal economic controls. These decisions did not affect how modes offered their own services. DOT-administered safety controls over intermodal service remained in place. Because carriers were freer to experiment with intermodal services, rail and truck freight

[26] *Standards Trucking and Transportation Statistics*, American Trucking Associations Statistics Department, May / June 1996.



SOURCE: *National Transportation Statistics 1996*, Bureau of Transportation Statistics, U.S. Department of Transportation.

carriers used the intermodal industry to create the innovative performance standards and service options that would later help transform their own modes.

Third, in the mid 1980s, at the request of American Presidents Lines (now APL Ltd.), a U.S. maritime carrier, the Santa Fe railroad (now Burlington Northern Santa Fe) created double stack train service. Instead of moving a single container or trailer per rail car, two containers were placed on a car, one on top the other. This innovation allowed the railroads to transport twice the freight with modest increases in motive power and minimal increases in operating expense.

While a truck container or trailer on a railroad car is the oldest and most popular image of this industry, it really is just one segment. Air / truck service, whether for small package express or full size cargo, truck / water, rail / water, and pipeline / truck combinations deliver intermodal freight transport services as well.

Based on the value of goods shipped, intermodal shipments account for about 12.7 percent of the freight industry. These figures include rail / truck combinations, small package express carriers using air / truck combinations such as UPS, FedEx, postal shipments and courier movements as well as other combinations such as rail / water, truck / water, air freight / truck, and truck / pipeline.

Of this 12.7 percent total, almost 74 percent of the value is handled by small package carriers, while the remaining 26 percent is divided: truck / air 14.1 percent, truck / rail 11 percent, truck / water and rail / water 0.7 percent, and truck / pipeline 0.01 percent. On a tonnage basis, however, the picture is quite different. About 70 percent of all intermodal tons are generated by rail / water (35%) and truck / water (35%) shipments, with rail / truck hauls accounting for another 20 percent. Small package express shipments account for about 10 percent of intermodal shipments by volume. Truck / pipeline shipments generate another 1.5

INTERMODAL SEGMENT	Percent Shipment Value – per Pound
All	$1.61
Small Package	$15.08
Rail/Truck	$1.09
Rail/Water	**
Truck/Air	*
Truck/Water	**
Truck/Pipeline	**

SOURCE: National Transportation Statistics 1996, Bureau of Transportation Statistics, U.S. Department of Transportation.

* For all air freight shipments, per-pound value is $26.77.

** The per-pound value of intermodal shipments other than package express and rail/truck has been estimated at $0.05.

of this total, with air/truck freight representing the remaining 1 percent of intermodal tonnage.[27]

On a value basis, the majority of shipments are small package express and air freight traffic which includes high value, perishable, time sensitive goods as well as business documents and small lot shipments. Package express carriers are a major source of freight service for small businesses.

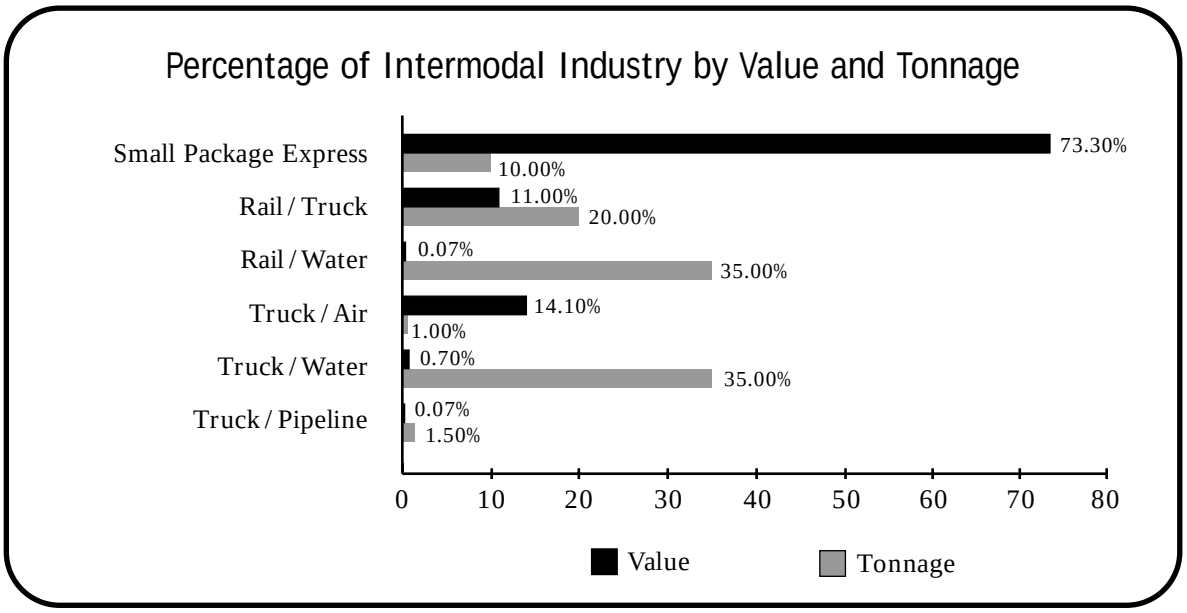
On a tonnage basis, the majority of shipments are general merchandise goods which includes semi-manufactured, manufactured, and packaged commodities that are shipped in containers or trailers that can hold either truckload and less than truckload loads. These goods tend to be higher value and include consumer goods, clothing, other retail merchandise as well as autos, auto parts, and packaged foods. In addition, a growing percentage of this traffic is bulk goods. Flat bed equipment and liquid bulk tanks have been adapted to be used in intermodal service.

In developing a profile of intermodal freight, distance is a factor. Because the interchange of freight equipment between carriers is costly, intermodal service is chosen only in those instances where the economies of scale for changing modes outweighs the expense of doing so. These interchanges, on average, account for 15 - 20 percent of the cost to the shipper and, can run as high as 25 percent.[28]

For general freight, which usually range between 10,000 and 40,000+ pounds, the minimum distance for cost-effective rail/truck interchanges is about 700-750 miles.

[27] *National Transportation Statistics 1996*, Bureau of Transportation Statistics, U.S. Department of Transportation.

[28] *Intermodal Freight Transportation, Third Edition*, Gerhardt Muller, Intermodal Association of North America and Eno Transportation Foundation, Inc., @ 1995.



SOURCE: *National Transportation Statistics 1996*, Bureau of Transportation Statistics, U.S. Department of Transportation.

The economies of scale are more pronounced at distances of 1,000 miles and 1,500 or more miles.

It is this distance factor which makes intermodal such a popular choice in moving international traffic across the U.S. About 70 percent of intermodal tonnage are these international shipments. Fierce competitors on other types of shipments, intermodal is one area where trucking and rail carriers work together to create a seamless service for these customers.

As noted earlier, double stack train service was crucial in developing the international freight flows for this segment of the freight industry. These flows basically are west / east and east / west moves. West / east traffic primarily moves Pacific Rim goods through the major gateway ports of Los Angeles / Long Beach and Seattle / Tacoma. This traffic is destined for delivery in the Midwest and East Coast, with some goods moving in landbridge service to Europe.

East / west shipments come from Europe and Central / South America primarily through the gateway port areas of New York / New Jersey, Hampton Roads, VA, and Charleston, SC. Freight is sent to Midwest and west coast locations, with some traffic moving in landbridge service. As the Pacific Rim's new manufacturing centers move west into India and other countries, some shipments are being routed through the Suez Canal across the Atlantic to the U.S. due to shorter transit times.

Since railroads are privately owned and have regional infrastructure, it is necessary for intermodal shipments to be switched between carriers for delivery to destination. Chicago is the major interchange point, with Kansas City and St. Louis, Missouri as second and third choices respectively. This railroad-to-railroad interchange normally occurs by either a switching railroad moving the goods between carrier yards or trucks transporting containers and trailers from one carrier's intermodal yard to its connection's intermodal facility.

In addition to ferrying goods between rail intermodal yards, trucks are the connections

MODE	Intermodal Truck/Trailer on Rail Flatcar	Truckload by Less than Truckload Carrier	Truckload by Independent Contractor	Truckload by Irregular Route Carrier	Domestic Intermodal Doublestack Container
Load Radio	0.65	0.75	0.85	0.90	0.90
Typical Cost per Loaded Mile	$0.92	$1.17	$0.87	$0.60	$0.50
Cost per Loaded Mile (0.85 load ratio)	$0.71	$1.30	$0.87	$0.64	$0.56

SOURCE: *Intermodal Freight Transportation, Third Edition*, Gerhardt Muller, Intermodal Association of North America and Eno Transportation Foundation, Inc., @ 1995.

between the railroads and the shippers and receivers. At origins, they are responsible for picking the trailer or container up from the shipper and delivering it to the railroad. At destinations, they are responsible for delivering the equipment from the intermodal facility to the receiver. These connecting services also are called drayage. Drayage distances can range from several miles from the intermodal yard to as far as 500 miles or more.

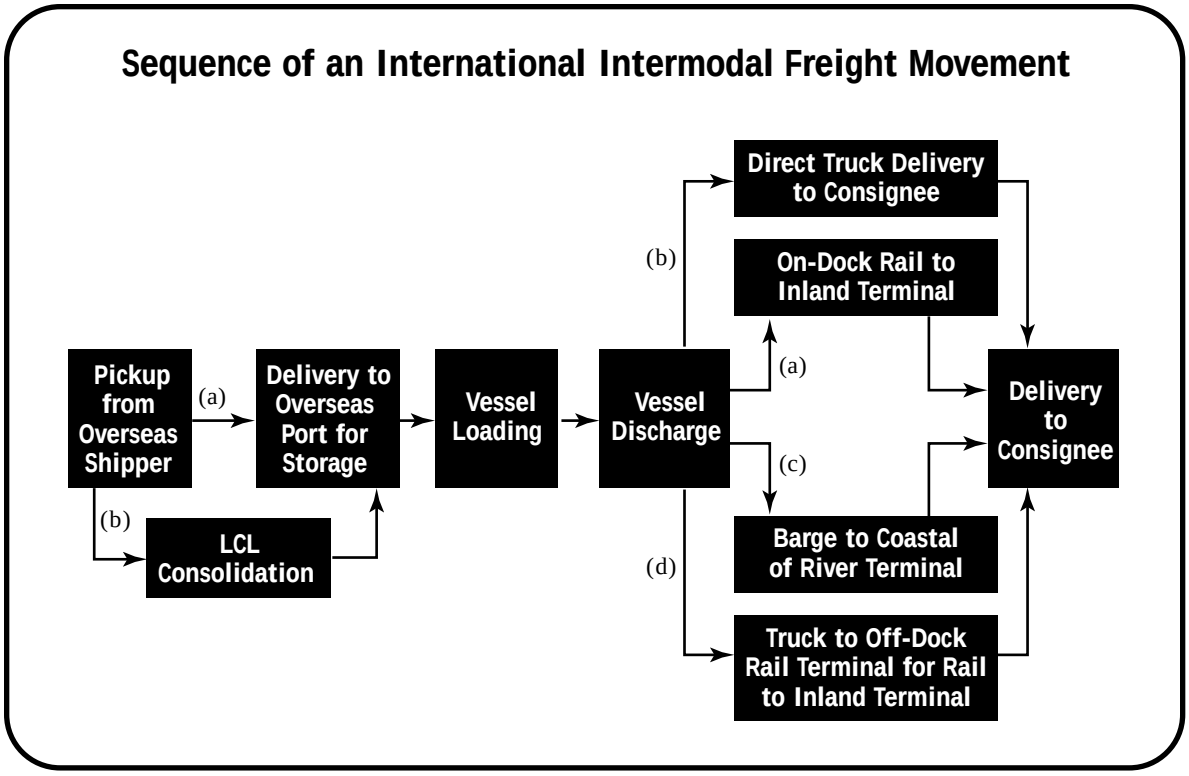
Role of Information Technology

Having timely, reliable shipment information is critical to ensuring the success of intermodal service because of the number of parties to an intermodal transaction — two or more carriers as well as the shipper, receiver, and possibly others. As the diagrams on pages 34-36 show, there are more opportunities to lose or misdirect shipments in this environment than there are in single-mode hauls where the goods are under the control of a single carrier for the entire trip.

As a result, intermodal carriers have been and are leaders in creating the technology and computer systems needed to assure that their freight flows seamlessly as it travels from origin to destination. Creating compatibility among these systems is complicated by the fact they were designed for other purposes.

Rail technology primarily was designed for interaction among railroads or between railroads and their customers, not railroads and motor carriers. Motor carrier technology was designed for operational control or customer service, with truckers often creating systems which would enhance their competitiveness within the marketplace. This means that there are a variety of similar systems each a little bit different from the other and generally not capable of communicating outside their corporate / supplier / customer channels. Like trucks, maritime liner carriers created their technology for operational or customer use. They too built in subtle differences to enhance their ability to compete for market share.

Efforts to create common Electronic Data Interchange standards and protocols for the freight industry can be traced to the late 1960s. By the mid 1970s, the first draft



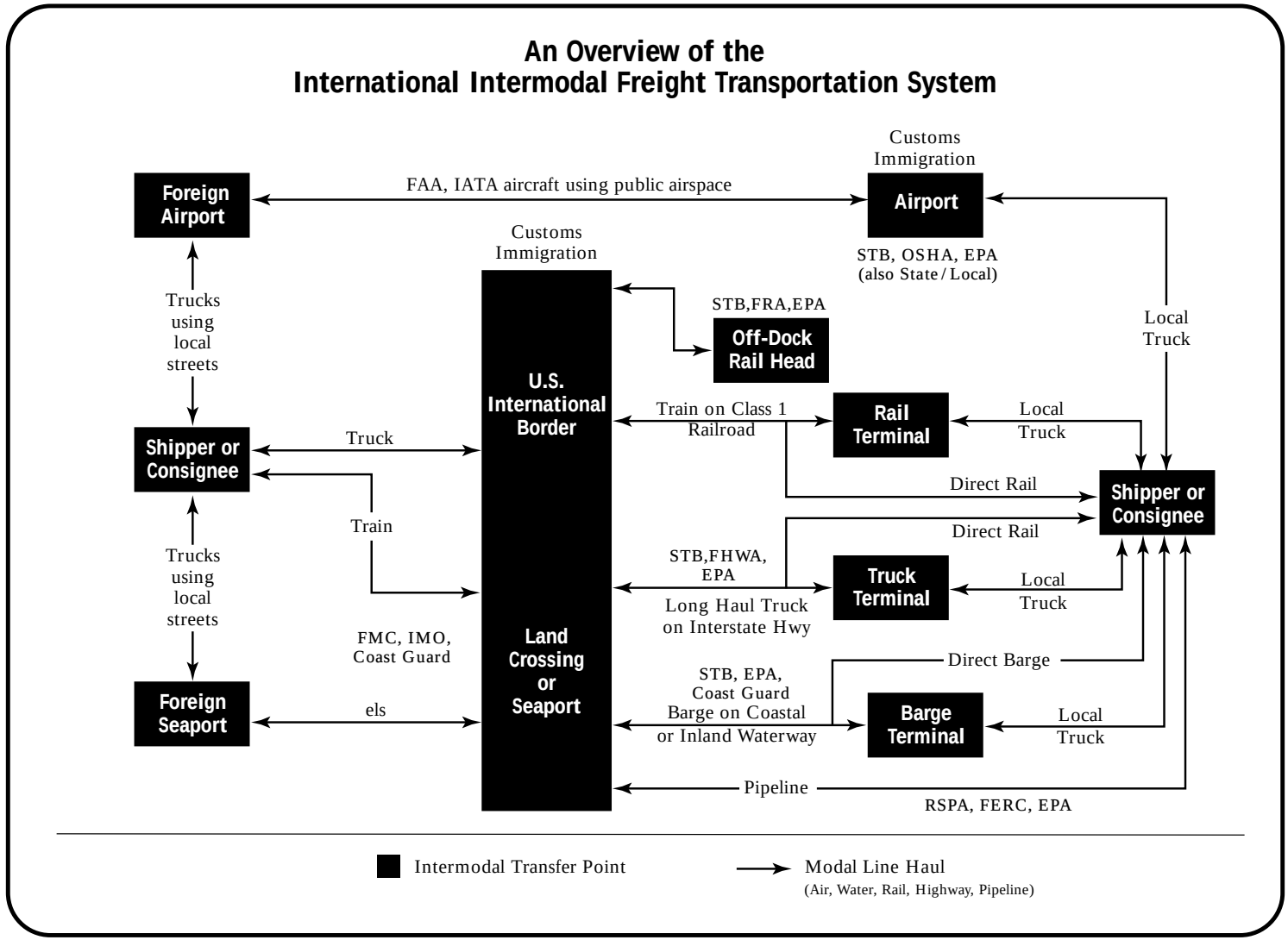
SOURCE: *Intelligent Transportation Systems and Intermodal Freight Transportation, Joint Program Office, Federal Highway Administration,* November 1996; *Intelligent Transportation Systems and Intermodal Transportation,* Volpe National Transportation Systems Center, December 1996; Intermodal Freight Transportation and ITS.

transaction standards were being circulated as external formats for communication documents. They were published by the Transportation Data Coordinating Committee, which is a private sector industry group. This group is now the Electronic Data Interchange Association, which serves as the secretariat for the ANSI X-12 Committee and its freight work.

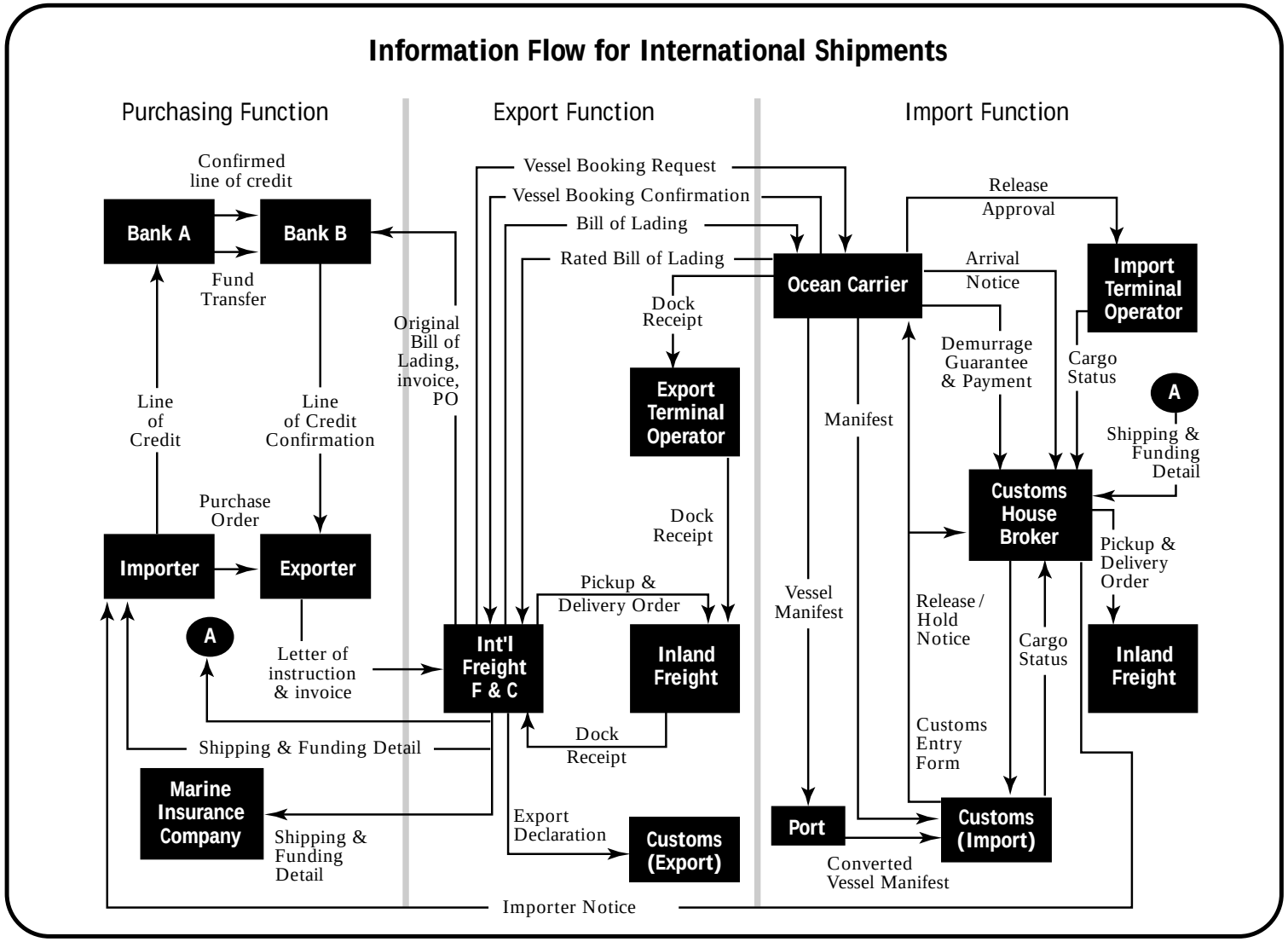
In 1979, the American National Standards Institute chartered the accredited Standards Committee X-12. The first official standard for EDI, ANSI X-12, was released in 1983. In 1987, international EDI transport standards began with the introduction of EDI for Administration, Commerce, and Transport, EDIFACT, a standard formally adopted by the United Nations. EDIFACT's role is similar to ANSI X-12 but with wider application. Today, most U.S. railroads and trucks use ANSI X-12 rules rather than EDIFACT. International carriers tend to use EDIFACT. However translation software is available that allows carriers and shippers to electronically exchange information regardless of format.[29]

On the international front, in addition to these transportation initiatives, the U.S. Customs Service is creating its own automated systems. Since 1984, Customs has had its own EDI system for first ocean, and later air, cargo. It also has introduced an Automated Broker Interface as well as an Automated Manifest System. To deal with

[29] *Intermodal Freight Transportation, Third Edition,* Gerhardt Muller, Intermodal Association of North America and Eno Transportation Foundation, Inc., @ 1995.



SOURCE: *Intelligent Transportation Systems and Intermodal Freight Transportation, Joint Program Office, Federal Highway Administration,* November 1996; *Intelligent Transportation Systems and Intermodal Transportation,* Volpe National Transportation Systems Center, December 1996; Intermodal Freight Transportation and ITS.



SOURCE: Sterling Software; *Intermodal Freight Transportation, Third Edition*, Gerhardt Muller, Intermodal Association of North America and Eno Transportation Foundation, Inc., @ 1995.

these developments, in 1994, ANSI Standards Subcommittee X-12 created a Customs subgroup, I/TG9, to promote cooperation developing transport and commerce EDI requirements.[30]

These efforts are being complemented by a federal initiative where USDOT, Customs, and the Immigration and Naturalization Service are seeking to develop a common framework for the federal EDI requirements companies must comply with in order to move international freight. In the move to state of the art management systems, many U.S. corporations have adopted the ISO 9000 standards, which also have a freight or transport component.

Third Parties & Warehousing

Third Parties

In discussing freight transportation, textbooks generally describe the parties to a transaction as the carriers who own the transport equipment and the shippers and receivers who own the freight. The practice of freight transportation is more complicated because, increasingly, the entity who is arranging and managing the movement of goods owns neither the equipment nor the freight.

These firms generically are known as third parties or intermediaries. Depending on the services they offer the public, they are called intermodal marketing companies, third-party or contract logistics firms, customshouse brokers, domestic freight forwarders, transportation property brokers, domestic airfreight forwarders, international airfreight forwarders, ocean freight forwarders, air cargo agents, air cargo consolidators, non-vessel-owning common carriers or NVOCCs, shipper associations, export management companies, and freight consolidators.[31] It is not unusual for a single entity to offer a variety of these services.

These entities are for-profit businesses which, by and large, earn their income on the difference between what they pay for freight services and what they charge their clients for these services. In certain cases, they receive a fixed percentage of the freight bill. Because third parties can negotiate with larger freight volumes than their customers, they are able to secure better rates and services. Their customers benefit because the transportation services they receive are less expensive and/or more service oriented than what these firms individually can achieve.

Using third parties also allows shippers and receivers to better concentrate on the core businesses as well as to receive the transportation services they need without incurring the expense of retaining professional staff. Just as many firms hire outside auditors and accountants to handle financial matters, they now also are hiring intermediaries and third parties as their transportation professionals.

Third-party firms are the fastest growing segment of the freight industry. They currently account for about 20 percent of the freight shipments and, depending on the industry segment, are experiencing growth rates of greater than 10 percent a year.

Intermodal marketing companies (IMCs),

[30] *Intelligent Transportation Systems and Intermodal Freight Transportation,* Volpe National Transportation Systems Center, December 1996.

[31] *Intermodal Freight Transportation, Third Edition*, Gerhardt Muller, Intermodal Association of North America and Eno Transportation Foundation, Inc., @ 1995.

which also are known as intermodal management companies, essentially are wholesalers of rail / truck intermodal services. They then retail these intermodal or piggyback services to freight shippers. Their services range from arranging the transportation of a customer-owned container or trailer to supplying the customer both equipment and transport services for his or her goods. IMCs choose the carriers, handle the billing, as well as process any loss and damage claims. They also maintain equipment pools which can supply containers and trailers needed to move a customer's goods. Sometimes, they are affiliated with a transport carrier such as a railroad or trucking company.

Like IMCs, third party logistics firms arrange transportation services for their customers. Unlike IMCs, these firms normally offer a full range of services that can be single mode or intermodal. In addition, they perform the functions of an in-house transportation department. This means working as if they were the customer. Often, there is a high degree of integration between the logistics firm and the client because of the need to coordinate with other parts of the customer's operations. In some cases, these firms increase product value through services such as packaging, setting up, and / or stocking retain store displays, tagging and racking goods so they are ready for the store floor, and the like. During the 1990s, many companies outsourced their transportation functions to these entities.

Transportation brokers are independent contractors who match shippers with freight with carriers, frequently truckers, looking for loads. They work either on behalf of shippers looking for equipment or carriers looking for shipments. Typically, they pay their motor carriers 85 percent of the rates charged to their shipper customers.[32]

Domestic or surface freight forwarders were once subject to the control of the Interstate Commerce Commission and had a very defined type of service they could offer the public. However, the industry was freed from detailed federal economic regulatory controls in the late 1980s. Today, they are subject only to registration and insurance requirements. As a result, these forwarders now offer a variety of rate / service packages. One common characteristic is that they normally deal in shipment sizes that require assembly and distribution of the freight like less than truckload lots. They also act as carriers and assume the responsibilities of a common carrier when arranging freight transportation.

Domestic airfreight forwarders originally were licensed by the Civil Aeronautics Board to pick up, deliver, consolidate, and containerize freight moving by plane. With the elimination of federal economic regulatory controls in the mid 1970s, the industry now provides a full range of intermodal air-related services. Because of marketplace forces, there are few clear distinctions among the different players in the U.S. air freight industry — forwarders, cargo agents, and cargo consolidators.

International airfreight forwarders are accredited by the International Air Transport Association. They provide a wide variety of services on international shipments which can range from: supplying the necessary U.S. and foreign documentation; arranging rates and routings as well as storage and warehousing; and, meeting hazardous materials requirements, special packaging or handling needs, or any other licensing or regulatory rules.

Ocean freight forwarders are licensed by the Federal Maritime Commission. They provide a wide variety of services on international shipments which can range from: supplying the

[32] Outsourcing in Distribution: The Growing Importance of Transportation Brokers, *Business Horizons*, November / December 1995.

necessary U.S. and foreign documentation; arranging rates and routings as well as storage and warehousing; and, meeting hazardous materials requirements, special packaging or handling needs, or any other licensing or regulatory rules. They often work cooperatively with consolidators and NVOCCs. They sometimes jointly operate container depots or co-load containers for delivery to inland points.

Non-vessel-owning common carriers or NVOCCs arrange intermodal services for domestic or international shipments whose transportation involves the use of bulk or liner water carriers. They perform services like a carrier — such as billing and processing of loss and damage claims. However, they do not own the equipment they use. Unlike ocean freight forwarders, they are not licensed by the Federal Maritime Commission. However, they must obey any tariff filing requirements or other economic controls imposed by the agency.

Customshouse or Customs brokers are licensed by the U.S. Treasury Department to handle all types of international shipments. They prepare Customs entries, determine the applicable Customs tariff rates and shipment values, as well as file the other necessary Customs documentation. They also are familiar with the requirements of the more than 40 other government agencies that administer the U.S.'s non-tariff requirements. They handle more than 90 percent of all U.S. imports, and also often arrange for the transportation of these shipments.

Shipper associations function like a freight forwarder or consolidator. They put together a number of small shipments. The greater volume allows them to purchase better price and service packages than would be possible for any of the individual shipments. However, unlike freight forwarders and consolidators, their services are limited only to the members of their association. They buy single mode services as well as intermodal, and can handle international as well as domestic shipments. International shipments usually require a business letter from the U.S. Justice Department.

Export management companies not only arrange international transport services for their clients, they also offer a broad range of other services including the creation of foreign sales and distribution networks. Often, they specialize in either particular markets or types of commodities.

Freight consolidators do exactly as their name implies. They take shipments that are less than truckload, containerload, or other size equipment and create full size shipments for transport. They also break down full-sized loads for distribution to various destinations. They offer a fixed range of services, normally with limited liability, and include brokers, warehouse operators, and others.

Warehousing

Warehousing is the storing of goods.[33] Warehouses are owned by shippers, carriers, receivers, intermediaries and independent third parties as well as firms whose sole function is to provide warehouse space and services. They are an important part of the manufacturing and distribution process.

In essence, warehouses are stop-off points as inventory makes the journey from raw materials to semi-finished product to final product to distributed goods. Increasingly, warehouses are being used for more than storage. They are being used to perform value-added services such as the pricing of consumer goods and the repackaging of those goods before they are delivered to stores. An example is clothing. It is not uncommon for

[33] *Words of Warehousing*, Kenneth B. Ackerman, The K.B. Ackerman Company.

a shipping container of sports clothes at a distribution center to be unpacked and priced then put on racks. Once the clothing is priced and placed on these racks, the racks are put in containers for transport to the retail stores. At the retail store, the racks are rolled directly onto the selling floor.

While a separate industry, warehousing is a key driver in the efficient transportation of freight. Consider that in 1995, manufacturing and trade inventories averaged $960 billion. The financial and operating costs of holding that inventory totaled $239 billion, while the costs to transport it ran more than $400 billion.[34] Efficient warehouse services are as critical to controlling the $239 billion total as efficient carrier operations are to controlling the $400+ billion.

Like transportation, technology is an important tool in improving warehouse productivity and in developing the types of innovative services that provide value-added to the customer. Industry innovations span automated picking and sorting of goods for redistribution to sophisticated software programs to more closely manage inventory levels and their distribution throughout the supply chain.

Domestic and International Water Carriers and Ports

The common images of freight are the truck and rail car. However, significant volumes of goods move over the nation's waterways as well as through its ports. Overall, more than 16 percent of the nation's freight tonnage is moved by water. This tonnage accounts for between 3 and 5 percent of total freight value.[35]

Like the nation's highways, there is substantial public investment in the nation's commercial waterway and port infrastructure. The U.S. Army Corps of Engineers dredges our federal navigation channels, builds and maintains the locks and dams of our inland river systems, as well as the support structures needed for the coastal, intracoastal, and Great Lakes waterways. The only exception is the St. Lawrence Seaway, which is maintained by the St. Lawrence Seaway Development Corporation, a part of the U.S. DOT. The U.S. Coast Guard, also part of the U.S. DOT, provides the navigational markings for vessels operating on the inland systems as well as in our ports and harbors. It also provides vessel and port safety inspections and emergency response for all waterborne commerce.

Ownership of our port system is more complicated. There are publicly and privately owned ports. Within public ports, there are publicly and privately owned terminals. It has been estimated that roughly 90 percent of our inland shallow draft terminals and 66 percent of our deep draft terminals are privately owned. Navigation differentiates between shallow draft operations, normally barges and other vessels operating on the inland system, and deep draft operations, normally coastal ports and ocean-going vessels. Shallow draft is defined as 14 feet or less, while deep draft is defined as 14 feet or more.

Public ports authorities, by and large, are state and local entities whose facilities are

[34] *Managing Inventory as "Push" Comes to "Pull,"* Cass Information Systems, National Press Club, June 1996.

[35] *1993 Commodity Flow Survey State Summaries*, Bureau of Transportation Statistics, U.S. Department of Transportation, September 1996.

financed through lease payments, operating revenues, or bonds. They are quasi-public in nature because while the agency or authority itself is run by elected or appointed officials, port properties, such as terminals, warehouses, staging areas, and intermodal transfer facilities, often are leased to and operated by private companies. While it is estimated that there are about 204 deep draft public ports in the U.S., most of the nation's international commerce tonnage moves through the 25 largest.

Domestic Waterways

The nation's domestic waterway system is comprised of more than 25,000 miles of navigable waterways. Shallow draft operations occur on about 11,000 miles of inland river system primarily located in the central U.S. The principal arteries for this system include the Mississippi River and its tributaries, the Gulf Intracoastal Waterway, and the Columbia-Snake River System in the Pacific Northwest. The Mississippi's tributaries include the Ohio, Illinois, Missouri, Arkansas, and Tennessee Rivers. The Tennessee / Tom Bigbee Waterway provides water access in the Southeast. These systems connect to the Gulf of Mexico ports of New Orleans, Louisiana for the Mississippi and Mobile, Alabama for the Tenn / Tom. The Columbia-Snake's port access is at Portland, Oregon.

These waterways are critical links in the movement of dry and liquid bulk commodities. Half the nation's export grain, 20 percent of its coal, and 30 percent of its petroleum products use our river system to get to market.[36] For international trade, about 95 percent of the goods, on a volume basis, enter or leave the U.S. by ship.[37]

In looking at the roughly 2 billion tons of domestic and international goods moved by water, low value, high volume raw materials clearly dominate. More than 93 percent of domestic water cargo, and about 90 percent of international water shipments, are bulk hauls. This means that less than 7 percent of domestic moves and about 10 percent of international freight are general cargo shipments. For international general cargoes, about 80 percent — 80 million tons — is containerized freight. It is these containers that account for about 70 percent of the freight moved in U.S. rail / truck intermodal shipments (see profile on Intermodal).

For domestic water shipments, petroleum accounts for 43.4 percent of the volume, while crude materials are 16.7 percent and coal, 14.2 percent — almost 75 percent of total tonnage. Food and farm products have a 11.6 percent share; chemicals and related products another 6.6 percent. All other commodities make up the remaining 7.5 percent.[38] Crude materials include such commodities as nonmetallic minerals, ore, forest and lumber products, sand, stone, rock, iron ore and scrap, as well as pulp and waste paper. These volumes are about evenly split between goods moving in domestic commerce and those moving in global trade. In 1995, this division was 51.2 percent foreign and 48.8 percent domestic. For 1994, it was 50.4 / 49.6 percent. [39]

Looking at domestic commerce, different commodities dominate different segments of

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[36] *Charting New Horizons*, 1995 Annual Report, The American Waterway Operators.

[37] *A Report to Congress on the Status of the Public Ports of the United States 1992-1993, Office of Ports and Domestic Shipping*, Maritime Administration, U.S. Department of Transportation, October 1994.

[38] U.S. Army Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1994, Part* 5.

[39] U.S. Army Corps of Engineers, Navigation Data Center, Internet Home Page.

Tonnage Profile of U.S. Freight Moved by Water

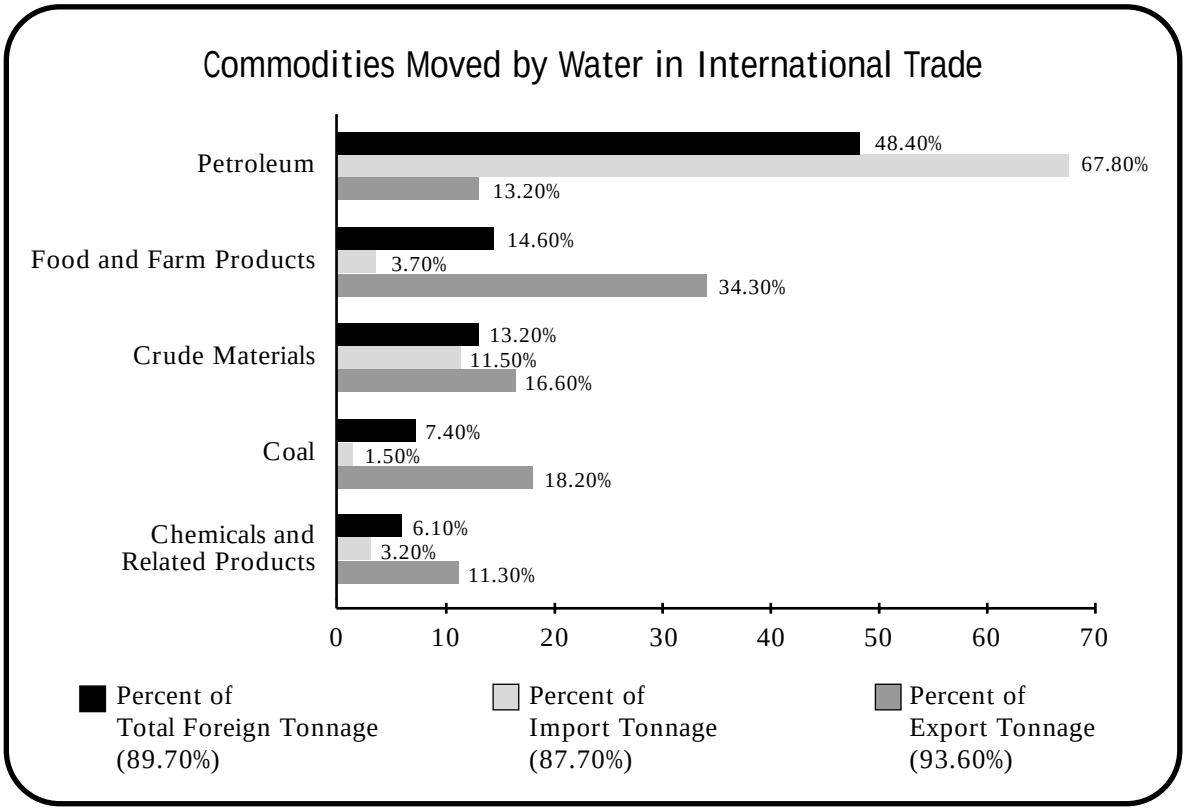
% OF TOTAL WATER TRADE	Import Foreign	Export Foreign	Internal Domestic	Local Domestic	Coastwise Domestic	Lakewise Domestic	Intra Territorial
1995	30.0	21.2	27.7	N/A	11.9	5.1	N/A
1994	32.5	17.8	28.0	3.8	12.5	5.1	0.3
1993	30.4	19.4	28.5	3.5	12.8	5.2	0.2
1992	27.4	21.1	29.1	3.6	13.3	5.0	0.2
1991	26.5	21.9	28.7	4.9	14.0	3.6	0.2
1990	27.7	20.4	28.7	3.9	13.7	5.0	0.2

SOURCE: U.S. Army Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1994, Part 5, and A Report to Congress on the Status of the Public Ports of the United States 1992 – 1993, Office of the Ports and Domestic Shipping, Maritime Administration, U.S. Department of Transportation, October 1994.

Commodities Moved by Water in Domestic Trade

COMMODITY	% of Tonal Domestic Tonnage	% Internal Tonnage	% Coastwise Tonnage	% Lakewise Tonnage	% Intraport Tonnage	% Intra-Territorial Tonnage
Petroleum	38.3	26.0	75.5	1.8	52.1	95.0
Coal	21.0	29.5	4.2	20.2	16.4	Negligible
Crude Materials	20.1	17.5	5.8	74.3	13.4	0.6
Food and Farm Products	8.5	13.5	3.1	0.4	0.5	0.3
Chemicals and Related Products	7.1	8.5	5.8	0.1	11.8	1.8
Total	95.0	95.0	94.4	96.8	94.2	97.7

SOURCE: U.S. Army Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1994, Part* 5.



SOURCE: U.S. Army Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1994, Part* 5.

the nation's rivers and waterways. Coal and petroleum are more than half of the inland river freight — about 55 percent. Petroleum is the major commodity moving in coastwise trade — more than 75 percent of the tonnage, intraport or local trade — 52 percent, and intraterritorial — 95 percent. Crude materials account for about three-quarters, and coal for one-fifth, of the volumes moving on the Great Lakes — totaling about 95 percent of the lakewise traffic.

Ports

In 1994, international freight tonnage was split about 59 percent imports and 41 percent exports. The largest source of imports — 67.8 percent — was petroleum and petroleum products. The largest U.S. exports were food and farm products — 34.3 percent, coal — 18.3 percent, and chemicals — 11.3 percent.[40]

Because of the different values and tonnages for general and bulk cargoes, each yardstick — value and volume — creates a different list of leading ports. As noted earlier, general cargoes generally have a value of $1.05 per pound, while bulk cargoes' value is set at 6 cents per pound.[41]

Based on value, the top five U.S. ports for international traffic are: Long Beach, CA; Los Angeles, CA; New York / New Jersey;

[40] U.S. Army Corps of Engineers, *Waterborne Commerce of the United States, Calendar Year 1994, Part* 5.

[41] *National Transportation Statistics 1996*, Bureau of Transportation Statistics, U.S. Department of Transportation.

On the Gulf coast, the top five international ports are:

RANKING	Based on Volume	Based on Value
1	South Louisiana, LA	Houston, TX
2	Houston, TX	New Orleans, LA
3	New Orleans, LA	South Louisiana, LA
4	Corpus Christi, TX	Port Everglades, FL
5	Port Arthur, TX	Jacksonville, FL

On the west coast, the top five international ports are:

RANKING	Based on Volume	Based on Value
1	Long Beach, CA	Long Beach, CA
2	Los Angeles, CA	Los Angeles, CA
3	Seattle, WA	Seattle, WA
4	Portland, OR	Oakland, CA
5	Tacoma, WA	Tacoma, WA

On the east coast, the top five international ports are:

RANKING	Based on Volume	Based on Value
1	Hampton Roads, VA	New York / New Jersey
2	New York / New Jersey	Hampton Roads, VA
3	Baltimore, MD	Charleston, SC
4	Philadelphia, PA	Baltimore, MD
5	Savannah, GA	Miami, FL

Seattle, WA; and Houston, TX. Based on volume, the top five are: South Louisiana, LA; Houston, TX; New Orleans, LA; Hampton Roads, VA; and, New York / New Jersey.[42]

The domestic and international water carriers which operate over this infrastructure each have distinct operating profiles. For domestic shallow draft shipments, the most common operators are the barge carrier for dry bulk goods and tankers for liquid bulk. For deep draft trades, domestic and international, dry bulk goods use bulk ships. Liquid bulk moves in ocean-going tankers. General cargoes move in container ships or break bulk ships. Ocean-going barges also are used to transport these commodities.

Barges, which haul large quantities of freight, mostly operate on the inland river systems. They generally carry dry bulk goods, but can transport liquid bulk shipments as well. A single barge holds about 1,500 tons, which is the equivalent of 15 100-ton rail cars or 60 25-ton trucks. On the Upper Mississippi and Ohio Rivers, there are normally 15 barges in the standard "tow" or operating unit. On the lower Mississippi River, 40-barge tows are not uncommon. Barges compete with railroads for goods like coal and grain.

Tankers, both barge and ship, are used to carry liquid bulk shipments, most often petroleum and chemicals. The Gulf Intracoastal Waterway and Gulf of Mexico are their main routes. However, they also operate along the west and east coast. While liquid cargoes can be moved by rail, the competition between these two —tanker / rail — is less intense than between dry bulk barges and railroads.

U.S. law requires that all ships which operate in domestic commerce or between the U.S. mainland and our possessions and territories be U.S. built and owned, be registered in the U.S., and their crews be U.S. citizens (with some exceptions). These requirements are known as the Jones Act. Similar rules apply to airline operations.

However, these construction, ownership, and crewing rules do not apply to international maritime commerce. In fact, U.S.-flag carriers carry less than 4 percent of U.S. waterborne bulk tonnage and about 16 percent of the higher value liner goods.[43] At present, there is only one major U.S.-flag maritime liner carrier—Sea-Land Services. In 1997, the other major U.S.-flag liner carrier—APL Limited—was sold to Neptune Orient Lines, a Singapore-flag carrier. However, APL does continue to operate some U.S.-flag ships.

International Cargoes

For international bulk cargos, dry bulk ships are used to move commodities like grain, scrap iron, and waste paper. Like domestic operations, tankers are used to move goods like petroleum and chemicals. These operations are distinct from general cargo carriers.

General cargo carriers use liner ships to move containers and break bulk ships to move other general cargoes. Because about 80 percent of general cargo moves in containers, liners are the most common type of ship used to transport these higher value goods. Break bulk ships are used for non-containerized freight or for mixed loads where containerized and non-containerized freight is being hauled.

In looking at where these carriers operate, different major trade lanes emerge depending on whether the yardstick is tonnage or cargo value. Based on tonnage are major trading

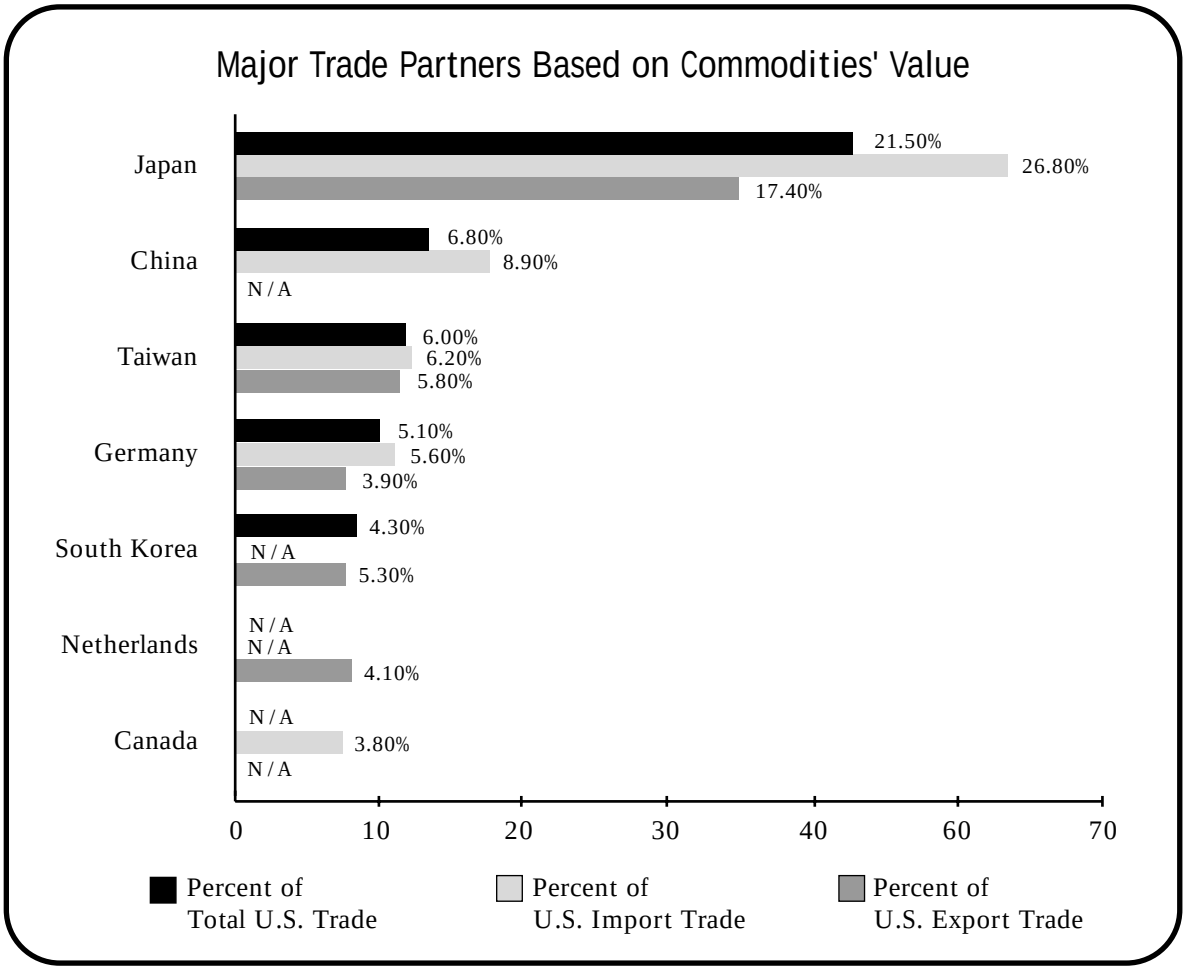
[42] *AAPA Advisory*, September 2, 1996, American Association of Port Authorities.

[43] U.S. Maritime Administration Home Page.

partners are Japan, Venezuela, Mexico, Canada, and Saudi Arabia. Based on value, these partners become: Japan, China, Taiwan, Germany, and South Korea.[44]

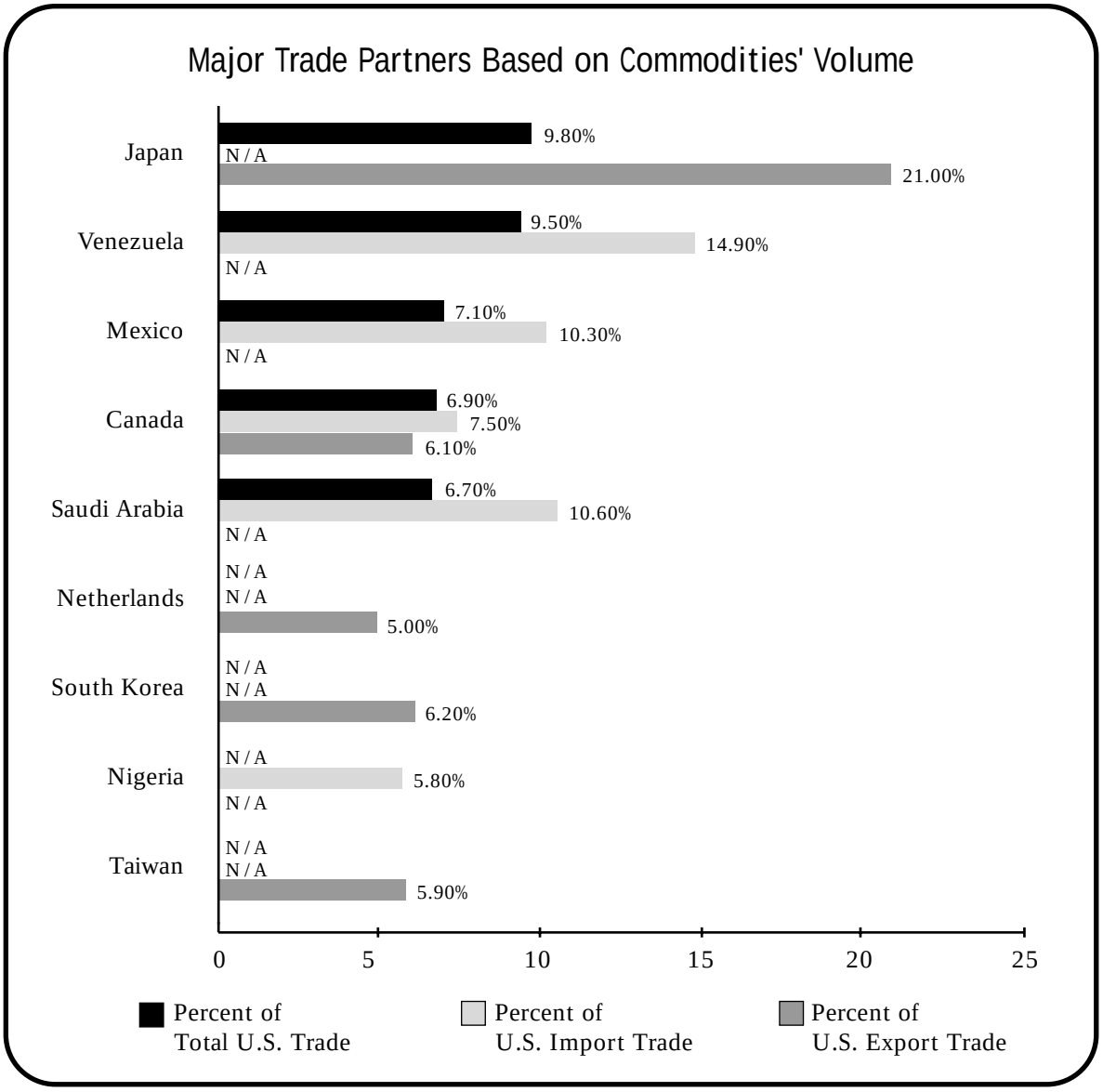
Overall, there is substantial federal involvement in and oversight of waterborne commerce. As mentioned earlier, there are the infrastructure and safety activities of U.S. Army Corps of Engineers and the U.S. Coast Guard as well as Jones Act or cabotage requirements for vessels operating in U.S. domestic service. In addition, the Maritime Administration of the U.S. DOT manages a subsidy program for the U.S.-flag fleet to help them compete more effectively in international trade. MARAD also helps promote ship construction in U.S. facilities.

The federal government also oversees certain economic activities of water carriers. Prior to the sunset of the Interstate Commerce Commission in 1995, about 10 percent of barge traffic was subject to ICC economic regulatory controls. However, as a result of the sunset legislation, these goods



SOURCE: *A Report to Congress on the Status of the Public Ports of the United States 1992 – 1993, Office of Ports and Domestic Shipping*, Maritime Administration, U.S. Department of Transportation, October 1994.

[44] A *Report to Congress on the Status of the Public Ports of the United States 1992-1993, Office of Ports and Domestic Shipping*, Maritime Administration, U.S. Department of Transportation, October 1994.



SOURCE: *A Report to Congress on the Status of the Public Ports of the United States 1992 – 1993, Office of Ports and Domestic Shipping*, Maritime Administration, U.S. Department of Transportation, October 1994.

were deregulated. The remaining 90 percent of barge traffic never was under federal economic regulatory controls.

For international operations, the Federal Maritime Commission allows carriers, U.S. and foreign-flag, to engage in collective ratemaking subject to certain restrictions. The FMC requires that these collectively set or conference rates be filed with the agency in tariff formats. It also mandates the public disclosure of the essential terms of all business contracts between carriers and their corporate customers. In addition, the agency allows carriers to operate collectively outside a conference structure through vessel sharing agreements.

Until 1995, the FMC oversaw the rates of carriers operating in the domestic off-shore trades, which serve Alaska, Hawaii, and the

U.S. possessions and territories. These include Puerto Rico, the American Virgin Islands, Guam, American Samoa, and the Northern Mariannas. This authority was transferred to the Surface Transportation Board and its more market oriented regulatory system as part of ICC Sunset legislation. At present, there are legislative efforts underway to loosen the FMC's economic control over international shipping including provisions which would allow shippers and carriers to enter into confidential contracts.

Role of Information Technology

In addition to government, technology plays a very important role in water commerce. Beside the crucial roles played by sonar, Global Positioning Satellites, and other technologies for navigation and weather conditions, computers play an important role in the efficient routing and processing of freight. For international freight, especially the higher value containerized freight, the communications systems developed by U.S. Customs Service and carriers' land based interchange partners, as discussed earlier, also allows goods to more efficiently. Also, there are voluntary public / private organizations, such as Terminal Operators Port Authorities Subcommittee (TOPAS), which create EDI implementation guidelines to help standardize the waterside partners in these electronic communications. However, for the movement of lower value bulk goods, use of this technology is less wide spread.

Air Cargo

Air freight service is complex and diverse. Like water carriers, air carriers must have intermodal terminals and access links to serve their customers. Trucks are air freight's most common connection to its origins and destinations. Third parties, especially freight forwarders, play an important role in how service is marketed and procured particularly in international markets.

In its simplest form, the decision to fly the freight requires that the commodities being shipped either are extremely valuable or time sensitive because this mode is the most costly way to transport goods. Air service spans a variety of needs from delivering the overnight business letter to expediting the shipment of computers or other high tech equipment to rushing fresh flowers and foods to market.

At present, the air freight industry accounts for about 2.4 percent of nation's freight bill by value but only 0.02 percent of this total based on volume.[45] Its revenue ton-miles have almost tripled from 7.9 billion in 1980 to 21.5 billion in 1994.[46] If package express services (truck / air intermodal) are included in these totals, the air cargo industry's market share by value has increased from 1.9 percent in 1980 to 4 percent in 1994.[47]

Like trucking and maritime, there is a high degree of federal involvement in the air industry's infrastructure. The Federal Aviation Administration certifies equipment, sets operating requirements, provides capital assistance to airports, and operates the nation's air traffic control system. In addition, like maritime ports, airports require modal connections.

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[45] *1993 Commodity Flow Survey State Summaries*, Bureau of Transportation Statistics, U.S. Department of Transportation, September 1996.

[46] *National Transportation Statistics 1996*, Bureau of Transportation Statistics, U.S. Department of Transportation.

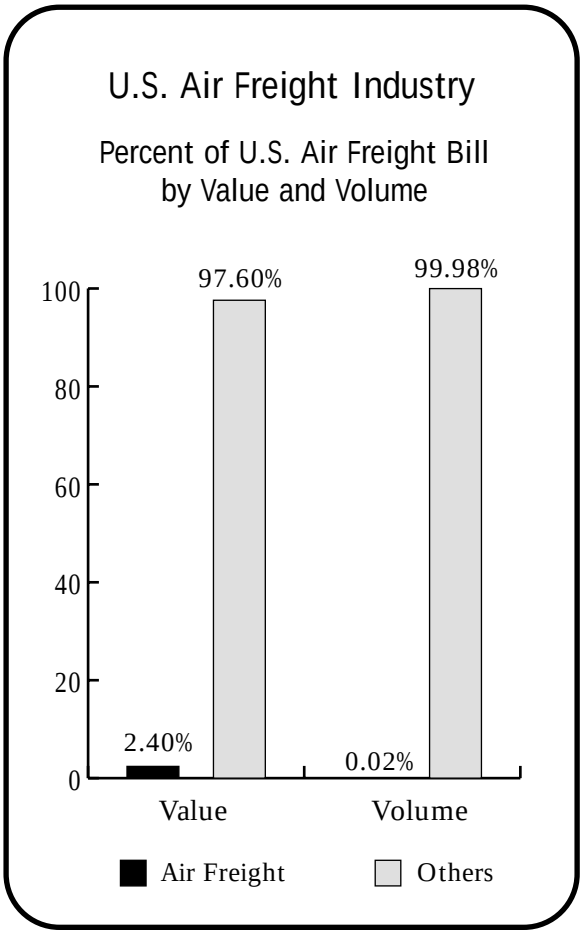
[47] *Transportation in America 1995*, Eno Transportation Foundation, Inc.

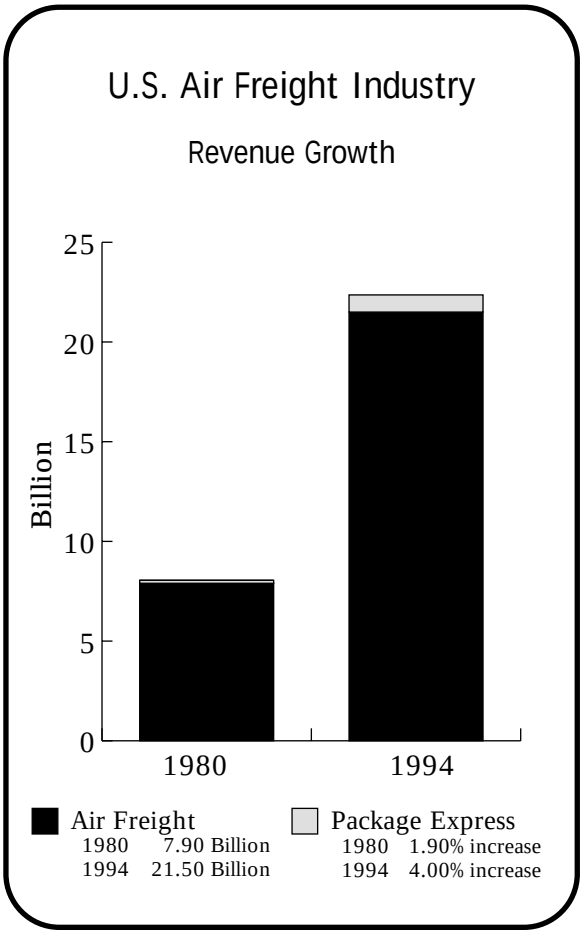
The majority of the traffic moves through public airports which are really quasi-public in nature because while the airport itself is run by locally elected or appointed officials, the operations these properties, such as terminals, warehouses, staging areas, and intermodal transfer facilities, often are leased to and operated by private companies.

Types of Air Freight Services

There are several ways to categorize air freight operations. One way is to divide services into express, mail, charter, and scheduled. Another is to sort them by the degree to which they are expedited — very time sensitive / less time sensitive — and whether they are transported by integrated and non-integrated entities. This second scenario, in essence, divides air freight into two categories — package express which are the very time sensitive expedited cargoes moved by integrated carriers, and more traditional air freight shipments which are less time sensitive hauls moved by non-integrated carriers. Non-integrated operations often involve a variety of parties, such as carriers and intermediaries, to complete the move.

Under the first scenario, freight is sorted by functional type. Express carriers offer time certain services to more than one customer on a time-certain basis. Federal Express and United Parcel Service are examples of these types of carriers. Mail carriers transport letters and packages tendered by the U.S. Postal System. Charter carriers sell space on a planeload basis





to meet a specific market need. Scheduled carriers operate planes over certain routes at fixed times. Passenger airlines, such as American and United, are examples of this market segment.

By these definitions, express carriers account for more than 60 percent of the domestic U.S. air freight industry, with scheduled carriers comprising the next largest segment — about 25 percent. Charter operators account for less than 1 percent, with mail carriers hauling the remaining market share, about 12 percent.[48]

Under the second scenario, an expedited shipment is one weighing less than 10,000 pounds that is delivered within four days. It includes shipments that could be moved by less than truckload carriers but not those which would be moved in planeload or truckload lots. Many move on a time-definite basis, with delivery promised on a specific day or, even more precisely, at a specific time. Time variable shipments are those where no delivery date is specified.

An integrated carrier is one that controls all aspects of the transportation. FedEx, UPS, and other package express carriers would fall into this category. An independent freight forwarder or truck line as well as a scheduled air line would be a non-integrated carrier since they do not have control the full range of transportation services.

Using these yardsticks, integrated carriers generated 96.4 percent of revenues and 97.5 percent of the volume for expedited shipments in 1993. In looking at these shipments in terms of whether they moved under time-definite or time-variable requirements, time variable is still the predominant way to move these goods, but time-definite is clearly the preferred way to move high value shipments. In 1993, expedited time-definite shipments accounted for only 9.3 percent of the industry's tonnage, yet it generated 36.7 percent of its revenues.[49]

As the air cargo industry increasingly sells second day and third day delivery of goods, an interesting anomaly is developing for certain markets. Operating costs dictate that most of these goods will "fly" to their destinations in trucks operating on the nation's highways. The shipper is willing to pay the higher rates of air service even when goods are moved by truck because of the air freight industry's ability to deliver on time and damage free.

To illustrate, on a 350-mile route, a high-cube truck hauling a 53-foot trailer can haul about 40,000 pounds of cargo for about $1.25 per mile or $437.50. To move a 41,000 pound payload in a 727-100F airplane the same distance, the transport cost jumps to about $15 per mile or $5,250.[50]

Even overnight shipments in certain short-distance traffic lanes move by road. Over the past 20 years, the number of "truck flights" has increased from about 400 per week to almost 16,000 per week. In certain U.S. market segments, air cargo operators "fly" 10 percent or more of their cargoes by truck.[51]

Because trucks are the most common connection to their origins and destinations, the air cargo industry shares many of trucking's concerns and issues. However, trucks and air freight carriers also compete for traffic. Where trucks and railroads compete for the lower value goods transported by truck, trucks and air carriers compete for higher value freight moved by commercial motor vehicle. For international shipments, there is very little competition between air lines and maritime

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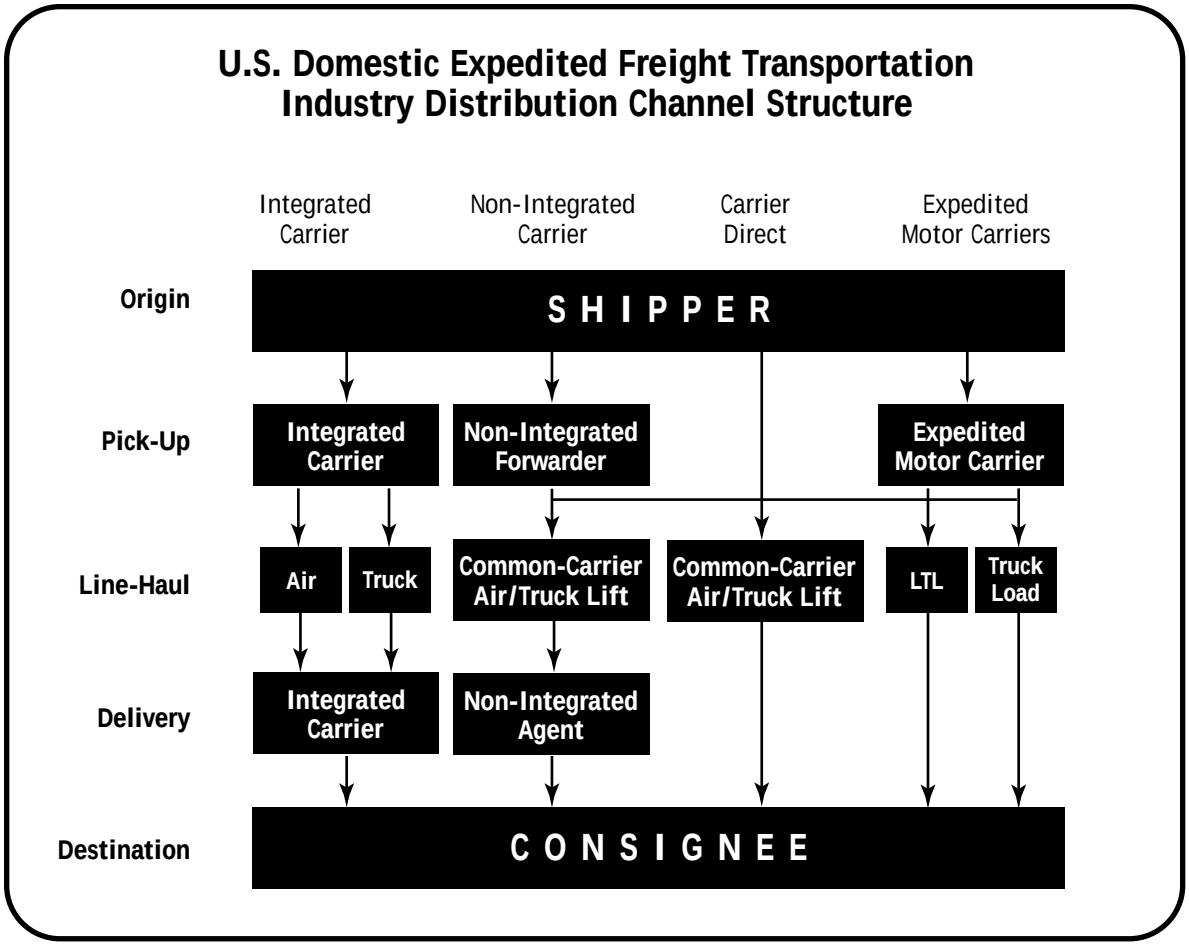
[48] *Boeing 1996/1997 World Air Cargo Forecast*, Boeing Commercial Airplane Group Marketing, October 1996.

[49] *Statistical Spotlight, MGI Cargo Analyst*, January/February 1995.

[50] *Statistical Spotlight, MGI Cargo Analyst*, January/February 1995.

[51] *Boeing 1996/1997 World Air Cargo Forecast*, Boeing Commercial Airplane Group. Marketing, October 1996



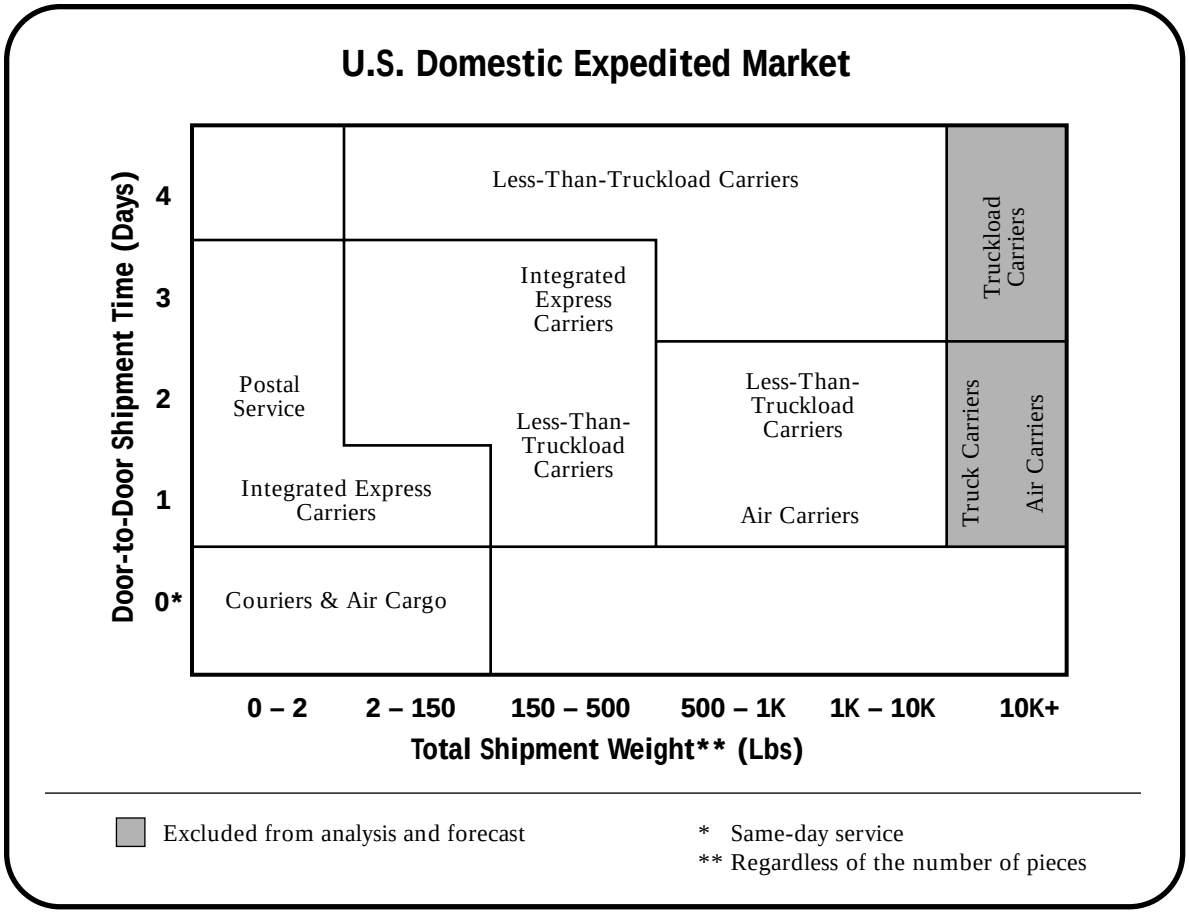
SOURCE: MergeGlobal primary research.

carriers. To the extent competition exists, it is for the highest value goods moved by container ships (see profiles of the other modes).

Although air freight service has been available since the 1920s, the industry, as it is known today, has its roots in the Airline Cargo Deregulation Act of 1977. Like the revolution which occurred in the intermodal industry, today's air freight services began with the ending of federal economic regulatory controls. Freed of these governmental restrictions, carriers experimented with rate and service packages that created new business opportunities.

Like air passenger service, the federal government continues to regulate safety for air cargo operations. This control covers equipment and maintenance as well as operations. In addition to USDOT's Federal Aviation Administration, the International Air Transport Association and the International Civil Aviation Association have promulgated operating and other standards that must be obeyed. IATA is a self-policing industry group, while ICAO is a United Nations's agency with a similar mission.

Technology and information systems have played a critical role in this industry. Because of the premium placed on service as well as timeliness of information, the air cargo industry has been a pioneer in using EDI and other technologies to track and quickly move



SOURCE: MergeGlobal primary research.

shipments. Like the maritime industry, air cargo carriers, their customers, and third parties have developed information sharing data bases which improve their ability to move goods quickly through the supply chain.

Pipelines

Pipelines are an important but often overlooked part of our national transportation system. They are important because of the significant quantities they move, more than 10 percent of total freight volume. They are overlooked because the goods they move are mostly low value and energy-related. Pipeline commodities have a value of between 6 and 9 cents per pound and account for less than 3 percent of the nation's freight bill.[52]

Unlike trucking which carries a wide array of freight, pipelines generally transmit natural gas, crude oil, and petroleum products. Some hazardous liquids such as anhydrous ammo-

[52] *National Transportation Statistics 1996*, Bureau of Transportation Statistics, U.S. Department of Transportation.

nia and carbon dioxide also are moved. Like the railroads, pipeline rights of way and equipment are privately owned and operated.

The national pipeline network is extensive - about 2 million miles. The network for interstate natural gas pipelines spans about 250,000 miles, while the crude oil and petroleum product system totals about 200,000 miles. The interstate natural gas network is supported by 100,000 miles of intrastate pipelines and 1.4 million miles of gathering, distribution, and storage pipelines.[53] Crude oil gathering and trunk lines total 112,990 miles, while finished product trunk lines account for 86,033.[54]

The transmission of natural gas, which accounts for 25 percent of the nation's energy supply, is the lion's share of this industry.[55] About 30 pipeline companies transport more than 90 percent of the natural gas sold in interstate commerce.[56]

The nation's crude oil and finished petroleum product pipelines generated more than half of the ton / miles for their commodities in 1994 — 56.5 percent. Water carriers were responsible for 39.3 percent of total ton / miles, with trucks and railroads carrying 2.7 and 1.5 percent respectively.[57]

Gas and oil pipelines are very similar, with the greatest operational difference being the methods used to moved the goods within their systems. Gas pipelines use compression. Oil pipelines use pumps to transport their crude and finished liquid products. Both pump and compressor stations as well as pipes and retention vessels must be consistently monitored to prevent infrastructure failure and protect against accidents. For liquid pipelines, pumping stations are located at 50 to 70 mile intervals.

Most pipelines are categorized as gathering, trunk / transmission, or distribution. Gathering pipelines use flowlines. Small diameter flowlines are owned by the producer and connect individual gas or oil wells to central treatment, storage, or processing facilities located in the field. Larger diameter flowlines, normally owned by the pipeline company, connect these field facilities to the long distance, large pipe trunk or transmission lines, what we commonly call pipelines. In some cases, wells are connected directly to larger flowlines or pipelines.

For gas shipments, these pipelines move the commodities to city utilities and other customers for distribution. Utilities use a distribution network of flowlines and metering facilities to serve their commercial, industrial, and residential customers.

Crude oil pipelines carry product from the field to the refinery for processing. Once refined, products like kerosene, gasoline, home heating oil and jet fuel, are carried from the processing plant to market in product pipelines. As with crude oil and gas pipelines, gathering and distribution flowlines complete the distribution process.[58] About 26 percent of all oil pipeline mileage is gathering / distribution flowlines.

Crude oil and finished product pipelines are mirror images of each other. Where crude lines start with the smaller gathering flowlines and increase in pipe size until they reach the refinery, the product lines start from the

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[53] *Natural Gas Pipelines The Safe Route to Energy Security*, Interstate Natural Gas Association of America.

[54] *Fact Sheet: U.S. Oil Pipe Line Industry*, Association of Oil Pipe Lines.

[55] *Going The Extra Mile for Safety*, Interstate Natural Gas Association of America.

[56] *Natural Gas Pipelines The Safe Route to Energy Security*, Interstate Natural Gas Association of America.

[57] *Fact Sheet: U.S. Oil Pipe Line Industry, and 1994 Shifts in Petroleum Transportation*, Association of Oil Pipe Lines.

[58] *EPA Office of Compliance Sector Notebook Project, Profile of the Transportation Industry, Office of Compliance*, Office of Enforcement and Compliance Assurance, U.S. Environmental Protection Agency, December 1996.

U.S. Pipeline Network

Interstate Natural Gas Pipelines	250,000 miles
Intrastate Natural Gas Pipelines	100,000 miles
Natural Gas Gathering, Distribution & Storage Pipelines	1.4 million miles
Crude Oil & Petroleum Product Systems	200,000 miles
Crude Oil Gathering & Trunk Lines	112,900 miles
Finished Product Trunk Lines	86,033 miles
Total National Pipeline Network	Approximately 2 million miles

refinery in large trunk pipelines and decrease in pipe size to smaller distribution flowlines until they reach the customer.[59]

Pipelines are subject to safety and economic regulatory controls. Safety oversight is performed by the U.S. Department of Transportation's Office of Pipeline Safety (OPS), which is part of the Research and Special Projects Administration. Safety standards encompass design, construction, operation, and maintenance. There is an on-going effort to make regulatory and compliance programs more performance oriented and risk based. As a result of the Accountable Pipeline Safety and Partnership Act of 1996, OPS can approve risk management demonstration projects where operators are allowed to substitute risk management plans for compliance with minimum federal safety standards as long as the management plans meet or exceed federal minimum requirements.

The Federal Energy Regulatory Commission administers the industry's economic regulatory controls. Like other transport industry segments, these controls are being loosened to allow greater competition among energy suppliers. This increase in competition is allowing companies to create varied price and service options. It also is allowing companies to limit their market participation so that instead of being full service companies —exploration, commodities at well head or refinery, transportation, etc. — they can choose the segment or segments that best suit their market strengths.

As in the other modes, information technology plays a very important role in the monitoring and transmission of these commodities. The industry has invested heavily in computer technology because of the safety issues associated with the movement of oil, chemicals, and gases. Increasing customer sophistication about energy demands and usage is another factor driving industry investment in computer and other information technologies.

[59] *Oil Pipelines of the United States: Progress and Outlook*, Association of Oil Pipe Lines, August 1991.

WHAT FORCES OF CHANGE ARE AT WORK?

The operational and modal profiles created in this study show how global competition and the technology revolution, as well as other forces, changed U.S. business and manufacturing. They highlight the key roles logistics and transportation play in the safe and efficient sourcing, transporting, and distributing of the goods and materials our economy produces. Maintaining and enhancing the world class transportation system the U.S. currently enjoys also requires us to understand and address the forces of change at work today as well as identify those which will shape tomorrow.

As with all segments of society, logistics and transport can expect more customer demand for increasing levels of performance under tighter deadlines with slimmer margins for error. This section of the freight study attempts to explore some of the other forces that are influencing logistics and transportation. The study will look at some of the infrastructure, operational, regulatory, and institutional forces shaping freight movement in the U.S.

New Connections

Sometimes, one of the best ways to see where we are going is to look at how far we have come. Prior to the Intermodal Surface Transportation Assistance Act of 1991, there was very little communication between the planners and builders of our public infrastructure and the freight community. ISTEA began to bridge this gap when it required state departments of transportation and metropolitan planning organizations to consider, among a number of factors, freight and the impact of their actions on commerce.

This action began to connect those responsible for goods movement and those responsible for our roads and bridges. In a world where performance was once measured by how well the roads and bridges meet peak passenger demand, how well they accommodate home to work trips, and what is the functional condition of this infrastructure, a new dialogue began between the private and public sectors.

Local business development groups and others recognized they needed the support of public planning officials to develop the transport infrastructure necessary for their companies, and the economies they create, to stay competitive in an increasingly global marketplace. This dialogue has not always been easy and has met with different degrees of success. The following are examples illustrating how the new connections within the public and private sectors are able to work together effectively:

ISTEA Success Stories

Greater Inland Port of Columbus, Ohio

Forming an alliance of the local metropolitan planning organization, chamber of commerce, and Ohio State University (OSU), the City of Columbus identified its transportation strengths and began to market them as the Greater Inland Port of Columbus, Ohio. This effort involved the creation of a free trade zone, manufacturing facilities located on or near intermodal freight facilities, and a public planning process that seeks commercial sector input. One of its first efforts was to identify how congestion at major freight centers affected Columbus's ability to deliver efficient commercial transport services. Using ISTEA funds, a study by OSU estimated that congestion in the Ports of Los Angeles and Long Beach added $5 million annually to Columbus' transport costs.

Kansas City Intermodal Freight Study

Seeking to retain and enhance Kansas City's position as the nation's second largest rail / truck intermodal interchange center, the local chamber of commerce and the Mid-America Regional Council (the area's metropolitan planning organization), undertook a study that analyzed and identified infrastructure improvements in the area which would be most beneficial to this goal. Like Columbus, this study was funded by the Missouri and Kansas departments of transportation through their ISTEA funds.

The Intermodal Freight Study analyzed the different parts of the metropolitan area and came up with an infrastructure investment program which improved access to and from the various intermodal facilities. It also identified projects and activities that facilitate the flow of freight traffic between parts of the city as well as through the region. It identified both short-term and long-term freight projects.

Heartland Freight Coalition (HFC)

Kansas City followed this study, which was completed in Spring 1995, with another cooperative effort know as the Heartland Freight Coalition. Founded in October 1995, HFC is a group of private sector interests and local public officials who meet on a regular basis to discuss area freight needs, as well as assess the progress of freight infrastructure projects and other initiatives.

Using the Intermodal Freight Study as a baseline, the HFC has suggested improvements to the plan to improve regional freight mobility. It also helped to identify a series of low-cost, low-tech "jump start" programs which would make modest improvements to transportation infrastructure that would yield appreciable freight benefits. These projects included activities like turning lanes, turning widths, signage to and from intermodal facilities, and installation of traffic lights. The adoption of short-term, small to moderate cost projects helped to solidify private sector support for the coalition.

In its early days, the HFC received technical assistance from the Freight Stakeholders National Network to create effective public / private dialogue on how to include freight in public transportation planning. The Network is a group of eight national freight oriented trade associations working with the U.S. Department of Transportation and its Federal Highway Administration. Its goal is to create local coalitions dedicated to achieving better regional freight mobility and HFC was one of its first efforts. The national group recently produced resource materials which can help public and private interests in areas concerned with freight mobility form their own local coalitions.[60]

[60] The Network's associations include the American Association of Port Authorities, American Trucking Associations, Association of American Railroads, Cargo Airline Association, Intermodal Association of North America, National Association of Manufacturers, National Industrial Transportation League, and National Private Truck Council.

New Alliances Coast to Coast

Cities like Chicago, New York, Los Angeles, Long Beach, St. Louis, New Orleans, Houston, Philadelphia and others across the nation are beginning to forge the alliances with the private sector. They seek to assure that public infrastructure planning and investment activities address freight mobility needs and are aware of related private sector investments. These alliances are being complemented by those between the states and the private sector on planning and infrastructure activities including elimination of rail / highway grade crossing hazards. The projects coming from these activities include Los Angeles's and Long Beach's Alameda Corridor, New Orleans's Tchopatoulis Corridor, and Houston's Barbour's Cut Intermodal Project.

In addition, the I-95 Corridor Coalition encompasses state departments of transportation and other state and local governments from Maine through Virginia. Using intelligent transportation systems to increase mobility on Interstate 95, these agencies are coordinating their communications systems and sharing information to alert travelers as promptly as possible about traffic conditions. They are working closely with the U.S. DOT in these efforts.

Problems remain to be solved. However, with varying levels of success, ISTEA's intent to foster public / private partnerships on infrastructure planing and other activities is being realized, and the transition to a more intermodal, efficient national transportation system is underway.

Challenges to be Met

1. Infrastructure

Population and Congestion

As new forces of change reshape the freight industry, other factors also are at work affecting infrastructure supply and financing. These challenges include population increases, the process of building infrastructure, and the vital need for financial resources to repair and augment the current supply of public transportation facilities. Each factor will play a role in how efficiently and safely freight moves.

Regarding population, current transportation resources have and will continue to serve a growing population that needs mobility both for themselves and the goods and services which support their lifestyles. Based on past experience, transport demand could significantly exceed projected population gains.

According to the U.S. Census Bureau, there will be an increase of 60 million citizens between the years 1990 and 2020—a 24 percent gain in population. This 24 percent rise in population will not necessarily translate into a similar jump in the demand for transport services. It could result in much higher demands for these services.

Consider what happened the last time we added 60 million citizens. It happened between 1965 and 1992 when U.S. population rose by 61 million or 31 percent. During the same period, the total number of freight tons in the economy increased 63 percent, while the number of freight ton miles traveled expanded by 52 percent and the number of freight ton miles per person increased 37 percent.[61]

Another way of looking at the impact of population growth is to use vehicle hours

[61] *National Transportation Statistics 1996,* U.S. Department of Transportation, Research and Special Programs Special Programs Administration and Bureau of Transportation Statistics.

General Trends

	Infrastructure	Operational	Regulatory	Institutional
Today	Increasing levels of congestion in ever larger areas of the country Rising infrastructure costs due to more complex social / environmental / program requirements Continuing deterioration of physical plant with a replenishment rate that does not meet current or future needs	Increasing demand for goods and services under tighter performance standards in more difficult operating environments Greater emphasis on seamless services and shipment's ability to move efficiently regardless of mode	Changing emphasis of economic regulatory controls to safety and environmental regulations Increasing interest in negotiated rulemaking and consensus solutions to problems	Greater government interest in funding flexibility and performance standards as an alternative to more traditional financing and control measures Greater interest in intermodalism and other solutions that will allow public sector transport investments to provide the greatest return in terms of overall system mobility
Tomorrow	Less mobility within increasingly sprawled urban / suburban areas increasing costs for facilities and longer timelines / stricter standards for completion of projects Greater use of information technology to reduce demand for additional capacity	Continued integration of transportation and supporting information systems into production processes under increasingly stricter performance standards Greater use of information technology to manage and improve logistics systems	Greater government and industry interest in multinational standards and requirements to facilitate international trade and meet other social goals Increased emphasis on seeking cooperative solutions to problems	More coordination among public and private sector interests Ongoing efforts to reinvent government at all levels and to create efficient public / private partnerships to advantage U.S. role in global commerce

Increased Population

	Infrastructure	Operational	Regulatory	Institutional
Today	Increasing levels of congestion in ever larger areas of the country	Expanding peak use of infrastructure	Greater emphasis on technology and demand management techniques to meet congestion, safety, and other problems	Growing interest in intermodalism and other solutions that yields public sector transport investments the greatest return in terms of overall system mobility
Tomorrow	Decreasing area available for traditional solutions Growing need for technology to better manage congestion in ever more sprawled urban / suburban areas	Increasing emphasis on coordination of freight and passenger operations to maximize system efficiency	Greater concern with safety and environmental rules as population struggles to do more with fixed land area	More coordination among public and private sector transport investments as each side continues streamlining processes and personnel

of delay that occur each day. Between 1985 and 1993, delays jumped 41 percent in the Washington, DC area, 39 percent for Greater New York City, 30 percent for Metropolitan Chicago, 21.5 percent for San Francisco, and 16 percent for Los Angeles.[62]

While it is difficult to predict whether historic rates of growth will repeat themselves, it is not unreasonable to anticipate that an increasing population will continue the trend toward more consumption of both domestically and internationally produced goods possibly at rates higher than projected population growth. These growth projections also hold interesting ramifications for congestion and environmental mitigation efforts.

Congestion and population have other impacts as well. As major cities become increasingly congested, new population centers are created with competing demands for transportation infrastructure. The growth in the last 20 years of cities like Phoenix, Atlanta, Dallas / Fort Worth, and Miami are examples of how shifting populations reshape transportation infrastructure needs. In addition, there is the growth which occurred in and between the suburbs of major cities—the so-called outer beltway and cross-beltway economies. These patterns focus development on the fringes of major areas and are independent from the activities of the core city. These changes are occurring at times when traditional urban centers are requiring equal amounts of attention to stretch the useful life of their aging transport systems. Whether road, bridge, or transit, demand is going to outstrip supply for the foreseeable future.

In assessing the future forces of change affecting infrastructure, population shifts and the need to provide new capacity while

[62] *National Transportation Statistics 1996*, U.S. Department of Transportation, Research and Special Programs Special Programs Administration and Bureau of Transportation Statistics.

maintaining existing systems is just one aspect. Population growth and the freight demands its generates is another. As noted earlier, population growth can have significant transportation impacts.

Infrastructure Investment

In addition to population growth, another trend affecting the freight transportation is the disparate processes used to invest in infrastructure, in particular how these processes are handled in the public and private sectors. Traditionally, Federal, state, and local governments made capital investments along modal lines with varying degrees of cooperation and consultation.

On a federal level, transport infrastructure investments are controlled by different trust funds—air, land, and water. They have different allocation formulae and requirements, and mandate little, if any, consultation with the other public systems outside their modes, or with the private sector systems. Until ISTEA, there was no clear Federal mandate linking surface transportation investments to freight needs.

Water and air freight activities are not included in these efforts unless they are identified as intermodal connections for the National Highway System. In fact, air freight facilities are identified only if they are on-airport and are contained in the facility's master plan.

Under the Airports and Airways Trust Fund, the Department's Federal Aviation Administration can deal directly with the airports and can make payments to individual facilities as long as the work is on an approved master plan. Under the Highway Trust Fund, revenues are collected from and distributed to the states through formulae administered by the Department's Federal Highway Administration. Since ISTEA, certain of these funds are dedicated to local government entities. The Harbor Maintenance Trust Fund is administered by the U.S. Army Corps of Engineers where Congressionally approved projects are selected after nonbinding consultation with ports and other affected parties.

Addressing our nation's ever larger backlog of infrastructure demand has required the public sector to take new approaches to infrastructure financing. Among these approaches have been innovative partnerships with the private sector to improve the efficiency and connectivity of our national transportation systems.

Alameda Corridor, the largest and best known of these efforts, is estimated to eliminate 15,000 hours of delay per day caused when cars wait for trains that block roadways as they travel from the Ports of Los Angeles and Long Beach to points across the nation. Delay would be ended through the creation of a 20-mile, high speed, suppressed, grade separated right of way that eliminates more than 200 current grade crossings.

In addition to improving mobility in the Los Angeles Basin, this project has ramifications for all parts of the country as freight is able to more quickly reach its destinations. As noted earlier, a Ohio State University study found that port delays were increasing transportation costs for the Columbus, Ohio area by $5 million annually.

Public / private partnerships are changing how major public infrastructure projects are being funded. The creation of federally funded state infrastructure banks, the proposed federal credit enhancement program, as well as companion efforts in certain states, are providing opportunities for coordinated investment activities that would have been either unthinkable, illegal, or extraordinarily difficult a decade ago.

These new financing approaches are providing the mobility needed to assure the U.S. remains an effective global competitor. They

Infrastructure Financing

	Infrastructure	Operational	Regulatory	Institutional
Today	Increasing costs reduce the amount of new or repaired facilities purchased for each dollar invested	Better planning and coordination in the development of public infrastructure More public / private partnerships and other innovative techniques to fund costly, high priority projects	More flexibility in program requirements Increased interest in streamlining approval and review processes Increased state / local involvement and control over projects	Increased political pressure to constrain federal transportation spending Increased interest in using public transport funds for a wider variety of activities
Tomorrow	Increasing interest in containing costs for new facilities and repairs Longer time lines for project completion Stricter standards for projects	Increased integration of technology with infrastructure Expanded public / private partnerships and other innovative techniques to fund costly, high priority projects	Possible new interactions between transport and finance rules as innovation program expands Continued interest in streamlining approval and review processes Continued state / local involvement and control over projects	Mounting pressure to increase the revenue sources for public transport investment Growing linkages between public and private sectors on assessing and assigning financial risks and benefits

also are helping to forge a more common vision about the needs of freight as well as raising new issues and questions as to the proper role of government in meeting infrastructure needs. Transitioning from a grant maker to a quasi-commercial banker will shape and reshape traditional public financing practices. Program successes and failures will redefine the proper public sector roles in these endeavors.

Investment Needs

The need for public / private partnering increases as infrastructure costs and transport demand exceeds anticipated public expenditures. Industry experts estimate that there is a $300+ billion investment shortfall for highways and bridges alone. Increased demands for aviation infrastructure and the need to repair and replace inland waterway locks and dams that are more than 50 years old significantly add to this total. At current federal investment rates, we face decades of unmet needs. There are no new public sector or legislative initiatives pending now or in the foreseeable future which would deal with this backlog.

As a result, repair and rehabilitation will take on larger importance to assure the levels of reliability needed for world class freight transport services. Preserving current systems, many of which are at or very near the end of their design life, will require both

dollars and careful exploration of new and emerging techniques and technologies. It is through these innovations that we will be able to better control repair costs and find new ways to extend these systems' useful life.

Dramatically rising cost is an important element in understanding infrastructure needs. In the case of roads and bridges, at the heyday of building the Interstate Highway System, the rule of thumb for highway infrastructure costs was about $1 million to build a mile of this high quality road. By the mid to late 1980s, however, costs had risen geometrically with the last 150 miles of the Interstate system having an average cost of about $30 million per mile.

This dramatic price rise reflects the high price associated with creating and repairing urban infrastructure, which is where the bulk of this construction occurred. Driven by a variety of factors ranging from compensation for adverse community impacts, environmental mitigation, wage rates, to land values, meeting city transportation needs is a complex and costly process.

Actually the $30 million / mile estimate is conservative. In the case of the Century Freeway in Los Angeles, the price tag on this 17.3 mile long road was about $127 million per mile. The total cost for the Alameda Corridor is projected to be about $100 million a mile. Boston's Central Artery Project has a price tag of more than $1.5 billion per mile, and it is possible that the final cost on this infrastructure project could reach $2 billion per mile.

Given current budget and tax pressures, indications are there will be no new public investment program to close these investment gaps. Streamlining federal procedures as well as developing private sector partnering opportunities may prove important in times of constrained spending.

2. Operational

Looking at today's market forces one of the key change agents is the integration of transportation into the production processes and the partnerships between carriers, third parties, and customers that is needed to make this change a reality. Known by many names — supply chain management, enhanced logistics, integrated logistics—the intent is to integrate and streamline the actions of transportation into the production processes in the same way that functions like product design and manufacturing are controlled.

As logistics and supply chain management become commonplace rather than state of the art, newer techniques with different names are beginning to emerge—demand chain, integrated supply chain, and reverse logistics to name just a few. In addition, there are industry-specific initiatives like efficient customer response and quick response that are being used to leverage and amplify current efficiencies and time savings. As these become successful and commonplace, newer bolder, yet-to-be defined techniques will become state of the art.

Exactly what form these future initiatives will take remains to be seen. However, they will share the current imperative to do it faster, smarter, cheaper, and better. They will be focused on shortening time / order cycles and improving performance reliability. Improving system reliability, including transport system reliability, and focusing on doing it right the first time every time will be their guideposts as the world continues to reinvent and refine manufacturing and distribution processes and the transportation systems which support them.

Shipment Size

As larger portions of the freight community scale back the amount of goods placed in a

single order to a single destination, they will be generating more orders of smaller sized shipments at greater frequency. As a result, freight interests can be expected to make greater use of transportation infrastructure including already stressed areas such as urban and suburban population centers.

The one offsetting factor to help alleviate this increase, as noted earlier, is the change in the structure of inventory systems from "push" to "pull". Logistics' ability to eliminate inventory from the production process has focused attention on how inventory is treated generally, not just in transportation. The traditional approach to inventory is called "push." Under a "push" scenario, a vendor estimates, sometimes months in advance, what its customers want. These estimates often cover a range of outcomes. They are put into production with finished goods sent to outlets for sale and / or distribution centers for storage and subsequent release. Once distributed to outlets, the customers buy the goods they want. Unwanted and surplus goods are repackaged and returned to the manufacturer for subsequent disposal.

As an alternative to this "push" model, many companies are designing their inventory systems based on actual consumer demand. Known as a "pull" system, inventory decisions are made on what customers are actually buying. This more market-oriented approach is possible because of the information revolution, as well as innovative use of strategic alliances with suppliers, transporters, and vendors.

Coordinated long-range planning among shipper, carrier, consignee, and other partners in the transport transaction is key to the success of a "pull system." As never before, these independent entities are sharing strategic operating information so that inefficiencies throughout the movement of goods can be eliminated. In the Just-In-Time delivery revolution of the mid-1980s, each partner worked on their individual business processes and benefited from finding ways to operate better without considering the impacts on other entities. However, today, re-engineering experts are focused on integrating each partner's processes to generate new savings.

Industry's ability to more precisely predict inventory needs will be an increasingly important innovation in assuring that our transportation infrastructure will be able to keep pace with the demands faced by U.S. business and industry as they compete in a global economy.

In this context, there also is the ability for certain segments of the freight community to make large purchases of transport capacity. While purchases will be for increasingly discrete and smaller per facility loads of supplies and finished products, these shippers, carriers, and third parties will control freight flows totaling hundreds of millions and possibly billions of dollars.

As consolidations and strategic alliances proliferate throughout transportation, there will be more and more entities with this sort of economic leverage. Some industry experts have speculated that just as shippers, carriers, and others routinely purchase truckload lots of capacity, it will possible for these firms to purchase service on trainload and shipload bases.

Changing Market Patterns

Changes in market patterns also will play a role. The trade patterns of today may not necessarily be those of tomorrow. As new markets emerge and old ones diminish or fall away, transport services will adapt themselves to business demands. Whether international or domestic, production shifts will be mirrored by transport shifts.

For example, as the production centers now in the Pacific Rim move southwest from Japan and Korea into the countries along the Indian Ocean, the flow of international trade is migrating to match these changes. Five years

ago, virtually all Pacific Rim trade moved eastward to west coast U.S. ports. In the last several years, the freight generated by these Indian Ocean nations has made a Suez / Atlantic link to the U.S. east coast ports competitive. This means that depending upon location, Pacific Rim countries will have a choice routing shipments to the U.S. by either West Coast or East Coast ports. American ports once more identified with European and South American traffic may find increased business from this Indian Ocean trade.

System Reliability

Within the last 10 to 12 years, the logistics revolution has shrunk inventory levels to from hours of goods on hand to minutes of goods on hand. It also has all but eliminated acceptable margins of error for nonperformance due to equipment failure, weather, theft, loss, damage, traffic congestion, etc. Logistics is increasing in popularity as a cost control technique and spreading to ever larger shares of the freight transportation marketplace. Within the next 10 years, many industry experts expect that 50 percent or more of U.S. manufacturers will be using these techniques and the improvements which are expected to follow.

A recent survey of leading corporate transportation professionals predicts that by the year 2000 order cycle time will shrink to 69 hours from today's level of 123 hours—a 44 percent performance improvement. Transit times are expected to drop from today's average of 57 hours from start to finished product to 42 hours—a 26 percent decrease. Those using just-in-time deliveries as part of their logistics and supply chain management strategies are expected to rise from the current 16 percent to 47 percent, both inbound and outbound—a jump of 194 percent.[63]

This means in that a major consideration in choosing to retain or build manufacturing sites is the ability of goods to move predictability and damage-free. As one senior transportation industry leader has noted: "It is not so much that it takes 10 minutes or 30 minutes to cross the bridge; it is that it takes 20 minutes every day, every time." As a result, system reliability can be expected to play an increasingly important role in decisions on where the nation's future manufacturing and distribution centers will be located.

Competing in a Global Economy

The globalization of commerce has another impact on traditional government freight transport activities. Whether strategic alliances like Sea-Land / Maersk, United / Lufthansa, and Kansas City Southern / Ferrocarriles Nacionales de Mexico or the decision of U.S. companies to expand globally (like UPS, FedEx, and the Wisconsin Central Railroad) traditional definitions of national carrier and geographic barriers are blurring. As equipment and personnel are used interchangeably in these operations, they no longer are truly the province of a single country, rather they become multinational entities where seamless service becomes "flag blind."

As the role of the global marketplace affects greater portions of our lives, worldwide sourcing will play a greater role in where business and industry decide to locate plants and facilities as well as from whom they decide to buy goods and services. Today, a car can have its motor built in Canada, its chassis in the U.S., its electrical system in Mexico, and its seats and accessories in half a dozen other places. Tomorrow, the mix can be expected to be even more complicated,

[63] *LaLonde: Ante Up,* Traffic World, April 7, 1997.

Global Competition

	Infrastructure	Operational	Regulatory	Institutional
Today	Improving modal connections and other fixed facilities to handle increasing volumes of freight	Improving overall production cycle times so goods are made and distributed with the minimum amount of delay and inventory possible	Greater interest in consensus solutions and negotiated rulemaking	Continued tension between economic efficiency and other social goals especially where technology cannot yet provide solutions
Tomorrow	Fully integrating technology into intermodal and other facilities to maximize capacity	Increasing reliance on technology and other innovations to provide transport capacity and reduce overall cycle times	Greater interest in multinational standards and requirements	Harder social choices as corporate operating margins continue to narrow and social compliance costs continue to rise

especially with the U.S. losing to Asia the distinction of being the world's largest market.

Commerce's increasing blindness to nation of origin or flag has repercussions in several areas including cabotage laws and defense readiness. Cabotage laws require national, in our case U.S., ownership, operation, and manning of equipment used in either domestic commerce. As commercial interests seek arrangements based on flag-blind economic interests, compliance will be harder to achieve and there could be diminished support for these rules.

3. Technology and Information

In understanding the forces of change surrounding freight, a very important aspect is the nature of the technologies being used to improve transport system reliability in times of increased congestion and constrained infrastructure. Computers and information technology play an important role in this effort. The success of the logistics revolution is due, in large part, to technology's ever faster ability to transmit freight's supporting information. It is this flow of information which makes the speedier handling of freight and inventory possible.

A freight system cannot move without supporting information. Without shipping information, a carrier has no way to track what is moving where and when. Without product data, businesses have no idea what stock is where or, more importantly, where goods need to be. Without import / export and other documentation, governments have no way to track the freight which crosses their borders so that the necessary taxes and revenues can be levied and generated.

Point of sale and other "pull" inventory systems, real-time tracking of shipments and supplies, bar-coding, electronic payment and auditing, and other innovations are all tools the freight industry uses to make the information move faster. Faster information means shorter inventory cycles and transit times. In the business world, time is money, and the pressure to refine and enhance these tools is certain to continue.

In a way, time also is capacity. The less time goods need to travel in a production or distribution process, the smaller the amount of cargo required to meet a particular need. In

turn, at least theoretically, the less stress is put on the transport infrastructure. Increasing freight volumes generated by economic and population growth, however, often make it difficult to identify or appreciate the incremental savings generated by these per-shipment or per-facility reductions.

Time and Size Versus Shipment Cost

Another factor influencing this trend is the tension between shipment size and shipment cost. Driven largely by shipment value, this tension is a factor in deciding how much freight to move in a single haul and how often to do so. For example, compare shipments of computers and coal.

With high value goods like computers, transportation costs are a small to moderate part of the final price. The dollars involved in carrying the inventory makes it cost effective to move the goods as promptly as possible. The trade off between these two considerations is that price of making one or more air shipments daily may not be as great as the price of not selling the goods.

With a low value commodity like coal, transportation costs are a large part of the final price so controlling these costs is key to keeping the product competitive. The cost effective solution here is to move large amounts of the product in a single haul to reduce transport's share of the final price. As a result, it may make more economic sense to move trainload shipments weekly or over some longer time frame.

Computers and other technology have transformed the freight industry. Rate and routing decisions, bill payment, shipment tracing once were labor intensive activities. Today, they are significantly automated. Corporate transportation departments that once had large numbers of personnel, now are functioning with handfuls of staff or are outsourced to independent entities. Carriers and warehouses increasingly require loading dock and other staff to be computer literate so they can interact with the automated systems that speed freight from origin to destination. Transportation rate and service packages now can be ordered on the Internet.

Electronic Commerce Technologies

The use of Electronic Data Interchange has allowed shippers and carriers to function in a virtually paperless environment. Industry groups continually seek ways to improve the speed and accuracy of these information exchanges. In addition, the popularity of the Internet and the creation of intranets have interesting implications for buying, selling, and tracking of freight including the currently used, specialized transport EDI transaction sets and protocols.

The innovations in memory storage and equipment downsizing as well as its decreasing cost are putting technology at all levels of the transport and logistics process including the loading dock and warehouse. Whether as simple as bar-code readers or as complicated as robotic pickers, technology is transforming freight down to its simplest tasks and will continue to do so.

Information technology will take on greater importance as firms seek to minimize the amount of inventory and infrastructure now used in today's business environment. More compact cycle times will require stricter monitoring and control of inventories so that deadlines are met, not missed. These cycle times also may require the use of more frequent, smaller shipment sizes with technology being the only effective tool for coordinating these flows.

Since it is unlikely that new major public infrastructure initiatives will be undertaken to improve overall transport performance times, companies are looking to fine-tune the transportation services as they are being performed, including the ability to make quick decisions based on actual conditions. Increased

Information Technology

	Infrastructure	Operational	Regulatory	Institutional
Today	Developing the fiber optic and other networks to make ITS and CVO possible	Assuring interoperability among competing systems and technologies	Promoting interoperability of systems and technologies as well as effectively deploying them for enforcement and taxation activities	Integrating transport infrastructure with information and technology innovations to yield increased system efficiencies
Tomorrow	Maintaining and upgrading these investments to maximize efficiencies from new technologies	Integrating these systems and technologies and future ones under common or compatible operating standards or parameters	Greater interest in multinational standards and requirements	Encouraging transport infrastructure innovations to keep pace with information and technology tools to yield maximum system efficiencies

congestion, higher freight volumes, and more complex and time sensitive transportation arrangements all add to operating pressures.

Private sector tracking and tracing systems as well as the Geographic Information System (GIS) and Intelligent Transportation Systems (ITS) being deployed across the nation by the public sector will help form this future network for exchanging real-time information. Assuring that these systems function in a seamless, safe, and efficient manner is one of the challenges future public and private decisionmakers face.

The technology used to follow cargoes ranges from stationary and handheld readers and other microwave systems, to Global Positioning and low orbit satellites, to on-board computers to cellular communication links. Used by different segments of the freight industry, they form a network that allows shippers to find their freight wherever it is traveling in nearly real time.

Created by different entities to meet distinct service needs advances in technology create a friction between those seeking to use the innovations for commercial gain based on competition advantage and those seeking to capture the additional efficiencies these changes generate through standardization. These advances also create an interesting challenge—promoting system interoperability for a seamless service while allowing derivations for experimentation with new and potentially more efficient ways of doing business.

ITS Information

Just as information technology is expected to play a critical role in reducing the amount of inventory needed to run future manufacturing and distribution processes, it also will play a pivotal part in mitigating the need for new infrastructure. Using the real-time information generated by ITS technology, delays, accidents, and other impediments to mobility can be more readily identified and addressed.

In addition to coping with the immediate problems, the data Intelligent Transportation Systems generate can be used to fine tune long term strategies for maximizing the productivity of existing infrastructure. For the public sector, feeding ITS information

into demand management, congestion mitigation, and long range planning models can increase the usefulness of these tools. For the private sector, this data can improve tracing and tracking tools as well as supply the information needed to avoid bottlenecks and other impediments as goods flow from origin to destination.

Closely linked with the use of ITS is the larger issue of emerging technologies that can be used to enhance freight mobility and general transportation operations. Greater use of low orbiting satellites, microwave and cellular communications systems, and smaller, faster computers as well as the replenishment and updating of current technologies create an ever moving landscape of change for freight operations and state of the art practices.

On a more practical level, technological innovations both increase the opportunity to facilitate the flow of information between the public and private sectors and complicate that exchange. As computers make it easier and cheaper to collect and quantify data, there is an opportunity for the public and private sector to create partnerships that supply information to improve public decisionmaking. Whether this promise is realized will depend, in large part, on the ability of the public and private sectors to develop a more common vision of useful information.

4. The Changing Role of Government

As operations, infrastructure, and technology change so does the role of government. Over the last two decades, freight has transitioned from an industry subject to strict economic regulatory controls to one where marketplace forces largely set competitive conditions. In addition, there also is and continues to be an increased the emphasis on improving transport's safety and mobility as well as on mitigating its environmental impacts.

As federal and state governments ended their role as the arbiters of freight transportation pricing and routing decisions, rate and service packages offered to the shipping public diversified significantly. This diversity and freedom to experiment created the business climate which fostered the explosion of technology applications. These choices and innovations helped freight transportation transition from a highly specialized technical expertise into a service similar to all of those offered in the world of general business. As global competition and allied pressures continue to drive marketplace decisionmaking, the forces of change will continue to proliferate the array of services offered the shipping public.

Alliances and Mergers

These forces will also drive the current realignment of carrier configurations happening both within industries and between industries. While the number of participating carriers increases in each industry (domestically in some cases, internationally in others) these numbers are being tempered by how the largest competitors are aligning themselves.

Amidst these competitive forces is the tendency for certain large companies to improve their economies of scale and related operating efficiencies through a concentration of market power. These concentrations accomplished through loose operating confederations like alliance or through direct mergers occur both as a deliberate corporate strategy for market share as well as a response to increased globalization of all services. For certain companies, long-term survival has been defined in terms of the ability to operate worldwide.

An industry segment comprised of carriers, shippers, and third parties is emerging where transport purchases and sales are measured in the hundred of millions and

billions of dollars. These highly specialized state-of-the-art entities are needed for effective U.S. participation in a global economy. However, they are not tailored to fit the patterns of U.S. traditional regulatory structures—smaller, modally defined companies operating in fixed areas often in cooperation with competitors all subject to relatively the same pressures of competition.

New techniques will be needed as government addresses the concerns created by these entities as they compete in the global marketplace as well as for more traditional companies who also will be operating both as competitors and allies of these entities. Today's innovations in government, like increasing use of performance standards and negotiated rulemakings, may prove to be important tools as the public sector seeks to more effectively monitor, measure, and control the activities of emerging and more traditional private sector entities. In addition, new solutions will have to be devised so that we continue to enjoy a safe and efficient transportation services.

Safety and Environment

Government's focus on safety and environmental matters has increased as it has reduced or eliminated its earlier economic controls. Rather than rate and price rules as the primary mechanisms by which government influences the structure and delivery of transport freight services, safety and environmental requirements are now largely the public sector's tools.

How these tools are used plays a major role in determining the efficiency of our transport services. As vehicles, roads, air, and water become safer and cleaner than in the 1960s and 70s when standards were first imposed, the costs for ever higher safety performance and environmental compliance rise. Whether air quality standards, safety devices, or disposal of dredged material, there is no inexpensive way to reach from 80 to 85 to 90 to 95 to 100 percent compliance. Each new level has a price and an impact on efficiency. In some cases, small gains in compliance carry substantial increases in compliance costs.

Finding new, more efficient ways, whether high-tech or low-tech, to meet these important social goals will be an important key to forging the private and public support and partnerships needed to make them a reality. Low-tech solutions can include process changes which homogenize standards and increase coordination among and between public entities—federal, state, and local. The time and complexity of public process is as much a drain on efficiency as the purchase of costly technical products and devices.

Safety and environmental concerns will continue to dominate the types of regulatory controls imposed by government. Balancing the goals of zero transportation accidents and a pollution free environment with effective U.S. participation in global commerce will create a dynamic requiring the best minds in the public and private sectors.

Growing populations, increased accident exposure through expanding traffic volumes, continued encroachments on ever more environmentally sensitive areas, and stricter controls on mobile pollution sources are all forces which affect the structure and price of future freight transportation and logistics services. Finding ways to combine efficiency with compliance will be an important key in assuring accomplishment of all these objectives. The work being done by the private sector in the field of reverse logistics may hold useful clues for these future endeavors.

Regulatory Standards

As important as negotiated rulemaking and performance based compliance are in adjusting to today's forces of change, they will be

Safety Enhancement

	Infrastructure	Operational	Regulatory	Institutional
Today	Mitigating stresses on aging physical plant as volumes rise	Increasing potentials for incidents as traffic volumes rise	Greater emphasis on enforcement and education	Continued tension between goals of economic efficiency and safety performance especially where technology cannot yet provide solutions
Tomorrow	Identifying ways to incorporate safety enhancements physical design of new and repaired facilities	Developing technology and other innovations to better monitor and control vehicle / driver performance as well as enforcement activities	Greater interest in prevention and mitigation	Developing safety enhancements that are cost effective and user-friendly

Environmental Mitigation

	Infrastructure	Operational	Regulatory	Institutional
Today	Fewer areas on which facilities can be built	Increasing stresses on freight facilities as they balance higher environmental standards with pressures for better operating efficiencies	Greater emphasis on mitigation and preservation of existing assets	Continued tension between goals of economic competitiveness and environmental preservation especially where technology cannot yet provide solutions
Tomorrow	Greater pressure to use sensitive areas like wetlands for project sites and higher costs for environmental compliance in these areas	Increasing reliance on technology and other innovations to balance competitiveness and preservation goals	Greater interest in multinational standards and requirements	Harder environmental choices as more sensitive lands become the only available sites for new projects and activities

even more valuable in the future. Using the synergy of public and private expertise to resolve common problems helps to create the common vision needed for attaining these complicated and often difficult goals.

Additional techniques also will be needed, such as the adoption of international standards in both the public and private sectors. Standards create a common framework for compliance and generate economic efficiencies not obtainable in a conflicting patchwork of regulations.

Today, the U.S. operates under a U.N. Code of Conduct for hazardous materials packaging and transport. These standards, which apply to interstate, intrastate, and international shipments, require packages to meet certain performance standards and generally comply with the paperwork and marking rules now used worldwide. Unlike most other U.S. regulations, these standards are set in Geneva, Switzerland, not Washington D.C., although federal lawmakers and the Department are free to modify these standards where necessary to meet domestic needs. The states, however, are required to comply with federal standards unless they can demonstrate a compelling need to deviate from these requirements.

In addition, many U.S. businesses require that they and their transport carriers comply with the requirements of the International Organization for Standardization (ISO), a worldwide non-governmental federation of more than 90 countries, which sets performance standards for business and industry. As part of the Quality Revolution, many corporations set their baseline for benchmarking performance as compliance with the ISO 9000 standards.

ISO 9000 is a set of generic standards providing quality assurance requirements and quality management guidance including quality system elements. Essentially, these standards require a company to: (1) document what it does; and, (2) do what it has documented. They provide a foundation for a full-fledged total quality management system and provide guidance on various aspects of transportation.

In seeking new and more efficient ways to regulate in a global economy, these international standard-setting entities could become important resources in identifying emerging trends and challenges as well as serving as forums for promoting consensus. Even if the ties between U.S. governments and these entities are not improved, their activities will have important impacts on shaping future freight operations.

Impact on Defense

For the military, the concern is a bit different in that the internationalization of transport companies affects its ability to respond. In times of emergency, the military is empowered to use all nationally owned assets to fulfill its mission. If the desired assets are owned by the foreign, not U.S., partners in these business relationships, the assets are beyond the reach of the U.S. military. Increasingly dependent on commercial capacity to meet surge demands, the U.S. military is concerned about this trend's impact on the U.S.'s ability to effectively undertake future missions. The President's powers to act in times of a national emergency / disaster or non-military need also could be affected for similar reasons.

5. Institutional Values

Divergent Private & Public Investment Policies

What drives private sector investments are corporate needs that, by and large, are not integrated into the public processes or, at best, are tangentially linked to them. This

occurs because the strongest private / public links in developing private transportation infrastructure are the local or state rules governing land use or state and / or local incentives for economic development. They are not state and local transport planning requirements.

Corporate decisionmaking also is markedly different from public policymaking. Corporations expect less useful life from their assets and are more willing to depreciate them or take tax and other losses. They also are more accustomed to changing conditions and objectives because of the competitive environment in which they operate. Their actions are not subject to same level of media or legal scrutiny and review as their public sector counterparts.

Since ISTEA, however, government investment policy has begun to focus on the overall mobility of our national transportation systems as well as on facilitating freight's ability to flow seamlessly across transportation systems. While some progress has been made, a better understanding by each side of the dynamic forces governing the public and private sectors as well as more work on actual infrastructure and regulations are needed.

As the National Commission on Intermodal Transportation reported, "The weakest links in the current transportation system are the points of transfer between the modes. And, because the current system is funded and managed separately by each mode, responsibility for strengthening these links is unclear." It recommended that Federal policies "foster the development of the private sector freight intermodal system and reduce barriers to the free flow of freight, particularly at international ports and border crossings."

The tensions between public and private information needs, as well as their differing uses of data both within and between these sectors, generate synergies for a very dynamic environment. The public sector's imperative to maximize investments, provide commonality, predictability, and stability, and to take measured actions based on past experience provides an interesting counterpoint to the private sector's imperative to maximize operating efficiencies and profits, provide ever greater levels of time sensitive customer service, and to act based on current and anticipated market needs.

These imperatives create very different requirements for technology use and investment. Reconciling these diverse needs and requirements will become increasingly complicated as choices proliferate in the future. For the public sector, it may require a reassessment of its research and development efforts including whether it is more effective for its investment dollars to be focused on complimenting and enhancing existing public and / or private systems for its purposes and allowing the private sector to pioneer cutting edge technologies. For the private sector, it may require a greater sensitivity to the public sector and a more aggressive approach to identifying how commercial technologies and applications can be adapted for or made compatible with governmental needs and requirements.

Planning and Time Cycles

An important indication of the gulf between private and public transportation sectors is the timelines used for strategic planning. In the private sector, strategic investment decisions are made in an environment where 5 to 10 years is a long time. More and more companies are defining their strategic outlook windows at 3 to 5 years, while other companies are setting their windows at 18 months to 3 years. Implementation strategies are developed to occur on much faster timelines—months and weeks. Progress is measured in quarters and pay periods.

In the public sector, the strategic view for infrastructure investment is 20 years, with

implementation strategies running on three year to five year cycles. For aviation and surface transportation, planning is done on a 20-year basis with projects identified based on these perceived needs. Once identified, priorities are developed. The most pressing projects are placed on lists which expect implementation within the next three to five years. Different organizations use different time lines.

It is not unusual for significant public infrastructure improvements to take decades from conception to opening. The Boston's Central Artery Project, Los Angeles's Alameda Corridor, and New Orleans's Inner Harbor Navigation Canal Lock Replacement Project are excellent examples of this. For more routine projects, even noncontroversial ones, as a matter of practice, it can be a matter of three to seven years before all the necessary planning and environmental requirements can be accomplished and construction can begin.

Bridging these differences in perspective is an important element in creating the public/private partnerships needed to address present and future infrastructure demand. There are no easy answers to this dichotomy. These different approaches appear to be institutionally ingrained. However, there are public policy benefits to be gained from exploring the current processes and identifying possible reforms to make better use of investment dollars and facilitate the private sector's ability to effectively partner in these endeavors.

The Challenge of the Future

Because of these and numerous other factors, the freight industry described in this study is changing. The industry of today will not be the industry of tomorrow or the industry of the next decade. As operations, infrastructures, technologies, and regulations change and adapt to meet current pressures, so does the freight industry. The forces of change identified here will continue to reshape and recast the industry as it adapts to tomorrow's imperatives.

These forces will have their roots in the innovations we are undertaking today to assure the continued mobility of goods in domestic and international commerce. This mobility, reliable and error free, will become an increasing important piece of the strategy to maintain our country's economic competitiveness in an increasingly global marketplace.

Keeping America "an economy in motion" will take ever deeper levels of private and public cooperation as we face ever tougher challenges from increasing freight volumes, global competition, and constrained public resources. However, these are challenges that the federal government and the Department of Transportation, in particular, must meet if we are to serve the public with vision and vigilance into the next century.

UNDERSTANDING OUR PARTNERS

In explaining how transportation and logistics shape today's patterns of commerce and how the forces of change are reshaping them for the 21st Century, there also is a need to understand what the freight industry values and how it defines progress: What factors are used to judge success and failure? How often are they reviewed and analyzed? What are the challenges these diverse interests anticipate both for themselves and their public sector counterparts?

This section explores these questions based on a sampling of an array of transportation interests. A representative, rather than in-depth, effort, it offers a flavor of the types of information that provide value to these Departmental customers, as well as a better understanding of the rhythms of time that drive their highly competitive world. It also looks at the influences and pressures they believe the nation must address in the next millennium.

In addition, the section provides a more customer focused context for examining the role of public sector agencies—federal, state, and local—in how well they are meeting the needs of the freight industry in managing these forces of change. It is meant to serve as a basis for further examining the role of public sector agencies in addressing these emerging forces that are shaping the transport needs of industry. A more thorough understanding of freight professionals' challenges and points of view can provide a useful point of departure in more effectively defining the appropriate role of government in the provision, operation, and oversight of publicly provided transport systems that form such an integral part of corporate strategies.

Defining Performance

The statements in this section reflect views from major railroads and trucking companies, large manufacturers of retail and specialty goods, leaders in the intermodal marketing and third party intermediary industries, port and maritime liner interests, as well as substantial users of air freight services.

There is no single measure that defines performance for all segments of the freight and logistics industry. Whether shipper, carrier, port, or intermediary, each has their own way of defining success for each business unit as well as their entire operation. All use a matrix of factors to judge how well their organization is operating and to identify areas for innovation or remedial action.

In response to questions about performance evaluation, one company said it analyzes "people, customer satisfaction, property and equipment, safety, communications and

information systems, financial strength, and market share." Logistics expense as a percentage of revenues, safety incidents, and service performance such as on-time delivery are the yardsticks used by another. Still others look at "the service we promise by using specifically defined, committed, point to point transit times" and "expense, safety, and customer service."

One firm noted, "Although the safety of workers, cargo, and equipment is the primary concern in all dock operations, net profit is the primary measurement standard—and motivator—in assessing performance. Other key measurement factors are productivity, shareholder satisfaction, customer satisfaction, on-time delivery, commodity turnover, railcar and / or truck and / or ship turnaround times, and market share."

While approaches to defining productivity differ, there are some common themes about what constitutes good performance. These themes *emphasized* on-time performance and service reliability, customer satisfaction, safety, and profitability. The degree to which any one of these elements is stressed more than the others is a function of that particular corporate culture. This diversity of opinion in part reflects the freight industry's own complex structure.

In their own words, freight professionals defined key performance elements as:

"Revenues, expenses, profitability, on-time customer and unit performance, asset utilization"

"Safety record, net profit, customer satisfaction, productivity, on-time delivery, board / shareholder satisfaction, and market share"

"Safety, service, and costs"

"Weekly loadings and asset utilization"

"Customer requirements and expectations, Carrier requirements and expectations, data accessibility, and strategic links"

"Revenues, expenses, on-time performance, cycle times, and operational measures evaluating use of equipment and personnel"

"Transit times, service reliability, service cost or price, timely, accurate information on shipment location, and damage free service"

"Return on assets, return on sales, customer retention, employee turnover, and other varied Total Quality Management benchmarks."

"On-time reliability, safety, efficiency such as cost per mile or load, innovation, and customer service"

"Safety, customer satisfaction, load factor, platform and dock efficiency"

"On-time performance and cost"

"Customer service, expense control, people satisfaction, safety performance, and profitability from innovation"

Assessing Performance

There are many ways to assess how well a firm is meeting its performance measures. Each method or metric functions to give particular information about a specific part of a given operation. This information taken *in toto* creates the performance matrix that allows corporate management to decide if they are doing a good job and where additional effort is needed to improve performance.

To understand how diverse each of these tools can be, look at the matrix for the company whose measures were based on people, customer satisfaction, property and equipment, safety, communications and information systems, financial strength and market share:

People

1. Turn over rate (full time, part-time -combined).
2. A comprehensive annual employee survey that generated three measures for every leadership associate evaluated—percentage of reviews favorable, score on human resource index, and score on the leadership index.

Customer Satisfaction

1. On-time delivery with transit time compared to a strict standard and the percentage of shipments delivered by noon.
2. Deliveries free of loss and damage claims including the ratio of claims to net revenue and percentage of claims settled within 30 days.
3. Individual components of transit time looking at each service center involved in the haul including outbound and inbound times, outbound closeout time, and destination delay time.
4. Invoice accuracy including shipments handled per invoice error and percentage of invoices that were accurate.

Property & Equipment:

1. Optimum fleet composition based on equipment age.
2. Maintenance cost per mile.
3. Equipment use measured by tractors and trailers.

Safety

1. Vehicle accidents both on the road and at loading areas.
2. Personal injuries.
3. DOT compliance.

Systems

1. Communication / information systems development cycle time by type.
2. Systems interruptions by month.
3. Systems cost per shipment.
4. Communications cost per shipment.

Financial Strength

1. Earnings compared to budget.
2. Return on transport investment.
3. Operating ratio.
4. Load average.
5. Platform and dock cost ratio.
6. Platform efficiency.
7. General terminal efficiency.
8. Clerical efficiency.

Market Share

1. Revenue growth based on shipments, yield, gross and net revenues.
2. Market share percentage looking at existing as well as new and potential markets.

For another company, the matrix is created by comparing corporate goals to measures such as on-time performance by its various operating units from pick-up through delivery; unit performance as compared to customer expectations; equipment on-time performance, and other asset-based measures.

A third firm notes that strategic planning goals, Total Quality Management (TQM) Practices, International Standards Organization (ISO) Series 9000 and 9002 standards, equipment acquisition and renovation schedules, rate and price adjustments, direct employee involvement, and specific industry or transport segment standards are all ways used in its industry.

Customer requirements and expectations, carrier car location messages and electronic data interchange remittance, delivery confirmation reports, and transit times are the tools of another company.

These corporate performance evaluation methods are deployed over a variety of time lines depending on particular corporate needs. Review of this information occurs as often as daily or weekly to understand operating performance, while monthly, quarterly, and annual reviews are used in making strategic considerations. Only one responding company made strategic decisions on a longer time frame—every two to four years.

Assessing Transportation and Infrastructure

Just as corporate performance is measured, many companies (especially carriers) have systems for reviewing the performance of transportation and infrastructure. For many companies (especially shippers) transport services are reviewed similarly to the full range of services discussed earlier. However, for carriers and others owning infrastructure additional standards are employed.

One carrier takes a systems approach where the current and projected costs are weighed with current and projected capacity and service performance considerations. Another evaluates present and projected costs against present and projected returns on investment as well as possible time / cost savings if different services or technologies are used. This information is then considered in conjunction with the activities of competitors.

Another carrier takes both a bottom / up and a top / down approach. The bottom / up effort involves individual service centers and departments evaluating their own data to identify areas of improvement, while the top / down approach uses national or regional data to address longer term strategic considerations.

Still others do cost / benefit analyses in which consideration of the interaction of equipment and facilities become the focal points. In other words, how do equipment changes impact the facilities they service and how do facility changes impact equipment operations. Often these assessments include environmental impacts and other compliance criteria not directly related to providing transportation services.

The time frames used to analyze transport and infrastructure activities are somewhat longer than those used for other corporate operations. Here, the shortest-term view is quarterly or semiannually, with many firms taking at least a year between operational reviews. Strategically, the short to medium term is viewed as one to five years, with the long-term view being about a decade. In many cases, the five-year outlook is updated on an 18-month to 24-month basis. Other factors that would trigger an infrastructure review is the emergence of new markets or competitors or changes in demand forecasts or governmental requirements including those not directly linked to transportation such as environmental quality.

Linking Performance Information to Strategic Planning

Once information from these performance measurements is gathered and analyzed, the next step in the process is deciding whether to incorporate the data into a company strategic planning activities, and, if so, how to do it in order to maximize the success of that particular corporate strategy. It is clear that—whether the company is a shipper, carrier, or intermediary—transportation services plays a role in strategic planning considerations.

Infrastructure's role appears to be of greater concern to carriers than to shippers or intermediaries. This reflects, in part, the increasing intermodal nature of freight transport services. Shippers and intermediaries more and more appear to define carrier service in terms of the reliable movement of goods from origin to destination, rather than methods used.

Strategically, transport and infrastructure information is used in helping to determine the siting of facilities, the type(s) of carriers to be used, indicators as to where improvements can be made in transit times, safety performance, and customer satisfaction. It also is used to better understand the impact of equipment on facilities and facilities on equipment.

As one carrier noted, transportation and infrastructure data is used "to predict on-time customer and train performance, revenue growth, potential operating expense reductions, and the overall productivity potential of the company." He added it was an integral part of his company's strategic planning process.

For an intermediary, the information is used "to confirm that we are meeting our customers' valid requirements. The data collected is used to identify 'gaps' in the current services we provide to our customers. This analysis will enable us to move forward and develop a better product that adheres to the current and future needs and requirements of our customers."

Another carrier noted, "Obviously, our strategic planning processes are heavily impacted by the need to expand our facilities or grow geographically, so the [transport and infrastructure] developed to support these decisions is a key driver in our planning process."

Future Influences—Private Sector

In addition to looking at how the freight transportation professionals measure and value performance, it is important to understand the issues they see shaping future policy debates, whether private or public sector. Freight companies identified several common themes as they catalogued the influences and pressures shaping and reshaping their operating environment. They include unmet needs such as:

- Developing more accurate information about economic growth as well as better tools for forecasting how and where this growth will occur.
- Achieving continual improvements in productivity while balancing safety and capacity concerns.
- Maintaining a work force responsive to their transport needs, especially with respect to commercial motor vehicle drivers.

Mike Kendall of the Burlington Northern Santa Fe addressed the need for more accurate information most succinctly when he saw the greatest private sector challenge as "the availability and management of information and the capacity to accurately project growth."

Tom Hardin of HUB Group, Inc.

identified "the greatest challenge" as maintaining "a balance between industry productivity and the needs of our customers while providing safe, reliable transportation. Additionally, the private sector faces the challenge of providing our customers with productivity enhancements taking into consideration safety requirements and the need to satisfy possible labor constraints of the transportation industry."

Richard Mikes of Ruan cautioned, "We must examine all aspects with an open mind and beware of our paradigms." He saw the growth of international trade as "enhanced by improved intermodal systems."

Russ Burleson of Southeastern Freight Lines saw many great challenges. With respect to work force issues, he noted "as baby boomers start to age, driving a truck is not going to compete as easily with other jobs in a tighter labor market. We have to find new ways to make our industry more attractive."

"High and rising wages in the transport sector," Arnie Wellman of United Parcel Service said, "cannot be justified unless new products, new services, new features, and new processes are created. Prosperity in freight logistics will depend on our remaining an innovation center, a moving target, at the forefront of meeting the new needs of the future."

Steve Rodabaugh of The Limited emphasized that communications between private and public sector organizations is an important consideration. "We [the private sector] tend to complain when government takes actions that make our jobs more difficult. However, we do not spend the time needed to educate public officials about our needs, nor do we take the time to understand theirs. Establishing these communications links will become increasingly important as time goes by."

Future Influences—Public Sector

In identifying the influences and pressures facing the public sector, the companies echoed the concerns they also saw as shaping and reshaping their own private sector futures:

- Maintaining and improving an infrastructure that has more emphasis on freight with processes that reflect private sector time lines.
- More accurately projecting growth using market driven information to improve the U.S.'s ability to compete in the global marketplace.
- Taking a more modally blind view to infrastructure investment and finding strategies to allow this investment to more effectively compete with other social goals for federal funding.
- Fostering a work force that will meet the nation's future transportation needs.

J. R. Munsey of E.I. du Pont de Nemours and Company saw the balancing of people and freight movements as the public sector's greatest challenge. This includes, he noted, creating a "legislative / regulatory system that provides adequate protection to U.S. citizens without compromising the ability of U.S. businesses to compete globally." He saw the on-going policy debates over environmental requirements, such as the Clean Air Act and noise controls, and economic regulatory controls, such as deregulation of the maritime liner industry, as examples of where this balance is critical.

Davis Helberg of the Seaway Port Authority of Duluth said that as a public entity, his

port's greatest challenge was twofold: "(1) to be able to anticipate future logistics needs of private carriers, shippers, and receivers, and (2) to determine how to (or who will) pay for desired improvements."

Financing these improvements, he added, "has become increasingly difficult in the face of merger-created 'mega-carriers' who, like some professional sports teams, may hold nations / states / cities / ports and sometimes customers hostage to satisfy their demands on threat of taking their business elsewhere. All of this is played against a backdrop of the federal government and, in turn, state governments devolving financial responsibility to lower units of government."

Geraldine Knatz of the Port of Long Beach echoed Mr. Helberg's concerns. "The view by many that the mitigation of all subregional and regional impacts associated with the movement of waterborne cargo should be the sole responsibility of the ports," she noted, "makes it difficult to obtain other public / private funds." She cited the Alameda Corridor as an example of an improvement that "integral and vital" impacts on national goods movements.

Tom Davidson of Sea-Land also saw infrastructure as an important public priority. "From an ocean carrier's view, the public sector needs to assure that there sufficient deep water, efficient U.S. ports," he said.

In addition, Warren Erdman of Kansas City Southern Industries, Inc. targeted infrastructure and regulatory concerns as the public sector's biggest challenges. He defined them as "Finding economically efficient methods of freight interchange among the various transport methods in an evolving intermodal transport system and preserving competitive options for shippers in an environment of consolidation and merger in the [rail] transportation segment."

For Walmart, a key public sector challenge is "generating enough interest in the transportation profession, particularly driving, to keep enough of the work force supporting the industry."

In summing up his view, Dave DeBoer of Greenbrier Intermodal noted, "The greatest challenge for the private sector is getting the attention of the public sector. After that, the challenge is to do realistic planning with major impact on the freight sector and finally, to move the process along on a private sector time frame rather than the very long time frames used by the public sector."

Looking to the future, it is clear that measuring productivity and relating it to transportation and infrastructure will become increasingly important. Both the public and private sector will need to forge partnerships that better identify the common information we need, and implement ways to more effectively exchange what we measure so that we create a transportation system that allows the public and private sector to interact more strategically.

It is a job that neither side can do alone. It will require increasingly levels of interaction and coordination between and among the freight industry and public sector governments and agencies. Given the escalating pace of change and trade growth, all owners of our national transportation system will have to create the communications mechanisms that allow these strategic alliances to occur.

As Secretary Slater has said, to meet the demands of the 21st Century the nation needs "a transportation system that is international in reach, intermodal in form, intelligent in character, and inclusive in nature."

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