FHWA FREIGHT OPERATIONS CONFERENCE
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Long Beach, California

"Building Freight Capacity through Better Operations: Defining the National Agenda"

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In cooperation with:
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FHWA FREIGHT OPERATIONS CONFERENCE

"Building Freight Capacity through Better Operations: Defining the National Agenda"

Memorandum

Date: July 10, 2001

To: Invited Conference Attendees

From: Christine Johnson, Program Manager, FHWA Operations Core Business Unit, and Director, ITS Joint Program Office

Subject: **Briefing Paper Purpose and Intended Use**

An advance welcome to the FHWA's Freight Operations Conference! As you know, our conference will convene July 26-27, 2001 at the Long Beach Hyatt, Long Beach, CA. We are looking forward to working with you to define a national agenda for future freight operations.

The briefing paper that accompanies this memorandum provides an overview of the issues and opportunities for "building freight capacity through better operations." We hope that you will take the time to **review the paper prior to the conference**. The issues and policy options sketched out in the paper will be the starting point for our discussions. The paper is not comprehensive; we hope that you will bring additional issues and ideas for improving freight productivity to the conference.

The briefing paper has been prepared in a landscape "flip chart" format— graphics are on the top page and the accompanying explanatory notes are on the bottom page.

You will be pre-assigned to one of five breakout groups for the conference. The breakout groups are organized into three freight-operations focus areas as follows:

National and Global freight operations issues:	2 breakout groups—**National 1, National 2**
Regional and Corridor freight operations issues:	1 breakout group—**Regional 1**
Metropolitan and Local freight operations issues:	2 breakout groups—**Metro 1, Metro 2**

Each breakout group will be asked to review and discuss the preliminary policy options identified in the briefing paper (see the colored pages in the last section of the paper) and use, discard, or create new policy options. The product of the conference will be a revised list of policy options for the national freight operations agenda.

Thank you in advance for participating in the conference and helping to shape a national freight operations agenda.

Freight transportation influences every aspect of our lives and keeps our industries competitive in the global economy.

Freight operations are the practical work of moving cargo freight from a shipper to a receiver.

■ Freight Transportation and Freight Operations

Freight transportation influences every aspect of our lives. Freight transportation shapes our cities, underpins our economy, and determines our trade patterns. Better freight transportation reduces the cost of doing business and improves our standard of living.

Freight transportation is our link the global economy. Without efficient, coordinated freight operations using trucks, trains, ships, and planes, many goods on which the United States and our trading partners throughout the world rely would be unattainable at today's costs and quantity. Our economy depends on freight transportation to bring us textiles from India, fruit from Mexico, computer chips from Asia, engine pistons from Germany, and automobiles from Japan.

Freight operations are the practical work of moving cargo freight from a shipper to a receiver. Freight operations are a subset of the activities that constitute logistics (or supply chain) management. Freight operations are a critical part of all freight logistics transport systems: highway, rail, inland waterway, air, marine, and pipeline.

There are four major participants in freight operations: shippers, carriers, infrastructure managers (e.g., state and local DOTs, port and terminal owners and operators, railroads, etc.), and receivers. (See Figure 1.) For the purposes of this paper, we are interested primarily—but not exclusively—in the freight operations activities of carriers and infrastructure managers.

The private sector is responsible for most freight operations, but leadership from both the private and public sectors is required to improve the productivity of the nation's freight transportation system.

■ Private Sector Role in Freight Operations

In the United States, the private sector is responsible for most freight operations. (See Figure 2.) However, the public sector and public authorities—though their ownership and management of the nation's highway system, ports, and inland waterways, and their regulation and taxation of freight movement—have a major role in freight operations. This briefing paper focuses on how federal and state actions might help private-sector carriers and public-sector infrastructure managers improve the productivity of their freight operations to the benefit of shippers, receivers, and the public.

Federal and state actions could be applied to many facets of freight operations. This paper explores issues and opportunities for defining a national agenda for freight system operations. The paper:

- Describes the significant pressures reshaping freight transportation;
- Argues that capacity and congestion problems are eroding the effectiveness and productivity of our freight system;
- Explores opportunities for building freight capacity through better operations and the application of information technology; and
- Suggests some initial strategies that might be considered in the reauthorization of the federal surface transportation legislation.

Changes in the world and U.S. economies have increased the demand for freight transportation. U.S. freight shipments today contain lighter, higher-value freight than they did 10 and 20 years ago, and the shipments are moved over longer distances.

■ Changing Economy and Trade Patterns

Changes in the world and U.S. economies have increased the demand for freight transportation. U.S. freight shipments today contain lighter, higher-value freight than they did 10 and 20 years ago, and the shipments are moved over longer distances.

Service sector employment has increased dramatically. (See Figure 3.) Contrary to public perception, the growth of the service sector has created a huge demand for freight services, especially in courier, air cargo, and truck service areas.

Manufacturing employment has decreased, but because of automation, manufacturing output remains high. Massive warehouse inventories and large consolidated shipments have given way to just-in-time (JIT) manufacturing and smaller, more frequent shipments. As a result, manufacturing has sustained and expanded its demand for truck, rail, marine, and air-cargo freight services.

With the collapse of the Soviet bloc and the expansion of free trade agreements, the U.S. has seen a resurgence of traditional east-west trade flows, the emergence of new north-south NAFTA trade with the growth and stabilization of Latin America, and a sharp growth in intermodal freight movements.

Freight volumes will increase as trade barriers fall. The Free Trade Area of the America (FTAA), now being discussed, would be the largest free trade zone in the world. By 2005 FTAA would stretch from the Bering Straits to Cape Horn, encompass a population of 800 million people, and have a combined GDP of $11 trillion.

The freight transportation system is under pressure to improve service and productivity.

■ Increasing Freight Service Demands

The freight transportation system is under pressure to improve service and productivity. (See Figure 4.) Businesses are moving toward customized, mass-market products and services. This has expanded the demand for highly tailored and reliable freight services.

E-business and e-commerce are accelerating this trend. Recent advances in information technology and business-to-business (B2B) e-commerce via the Internet are driving dramatic changes in the freight transportation. Businesses have come to expect twenty-four-hour-a-day, seven-day-a-week freight service as the norm rather than the exception. Traditional relationships will change with direct Internet communications between buyers and sellers. Freight services in all transport modes will be redesigned, possibly reducing the role of intermediaries through secure web site access. This service redesign will tend to accommodate frequent faster cargo delivery when the customer order is placed.

Businesses have responded to these economic changes with new logistics strategies, shifting from "push" to "pull" systems—from manufacture-to-supply to manufacture-to-order.

■ New Business Logistics Strategies: From Push Logistics …

Businesses have responded to these changes with new and evolving supply-chain logistic strategies. Businesses are in the midst of an evolutionary shift from "push" to "pull" logistics systems. They are moving from "manufacture-to-supply" or inventory-based logistics to "manufacture-to-order" or replenishment-based logistics.

In a "push" system (see Figure 5A), suppliers push materials to a manufacturer, who pushes the completed product to a distributor, who supplies the retailer, who fills the customer's order. Each element in this logistics chain usually maintains a large and expensive inventory of parts and products as a buffer against fluctuations in supply and demand.

Pull logistics systems are cost-effective, but they place tremendous demands on the transportation system for timely, reliable, and visible door-to-door freight transportation.

■ New Business Logistics Strategies… to Pull Logistics

A "pull" system relies less on expensive inventory and more on accurate information and timely transportation to match supply and demand. (See Figure 5B.)

Point-of-sale data is used to pull products through a system that may involve two or three tiers of suppliers; a manufacturer that has spun-off design and marketing functions to other firms; and a third-party-logistics provider (3PL) who coordinates the movement of parts and products to distributors or directly to customers. Some industries now employ a fourth-party-logistics provider (4PL) to provide businesses and 3PLs with sophisticated tools to manage supply chain inventories and track shipments door-to-door.

Pull systems are cost-effective for shippers and receivers, but they place tremendous demands on the transportation system. Shippers want timely, reliable, and visible door-to-door freight transportation. An accident, congestion, strikes, late arrival of ships and trains, storms—even unanticipated spikes in supply and demand—can unravel these tightly strung systems.

Consider how the service interruption at United Parcel Service a few years ago rippled through the economy within days. Or consider the service problems surrounding the 1997 merger of the Union Pacific and Southern Pacific railroads, which greatly delayed shipments through the Ports of Long Beach and Los Angeles. These experiences illustrate dramatically the importance of precise and reliable freight transportation systems.

The military also is adopting pull logistics techniques. Major military deployments in the future will stress tightly strung commercial freight systems that are at or near capacity.

■ New Military Deployment Strategies

The military also is adopting "pull" logistics techniques and integrating their supply-chain logistics systems with commercial freight systems to reduce deployment time and cost.

The military's goal is to utilize information technology, business process reengineering, and new transportation technologies to ensure delivery of the right materiel and forces at the right place at the right time.

Major trends in military's logistic strategies:

- Deployment time frames are becoming more ambitious;
- Rapid surge and sustainment of military forces must move through commercial gateways without significant disruption.
- Defense and commercial supply chains are becoming more integrated; and
- Sensitivity to safety and force security issues is increasing.

The Army wants to substantially reduce its deployment time by 80 percent. (See Figure 6A.) This means that future military deployments will likely occur as short, sharp surges. The freight system must be capable of supporting military deployments without bringing civil commerce and defense-industry production to their knees.

Collaborative supply-chain management promises to reduce freight-transportation costs and improve business productivity.

■ Increasing Supply-Chain Collaboration

Collaborative supply-chain management promises to reduce freight transportation costs and improve business productivity. Through collaborative planning, forecasting, and replenishment (CPFR) agreements and procedures, industry partners reduce the uncertainty and costs of matching demand and supply. (See Figure 6B)

Supply-chain collaboration is considered so crucial today that more than two dozen of the world's largest shippers, including Wal-Mart, K-mart, J.C. Penny, Eastman Kodak, Hewlett-Packard, Nabisco, Proctor & Gamble, and Sara Lee have formed the Voluntary Inter-industry Commerce Standards (VICS) group to advance the science and practice of collaborative supply-chain management.

The amount of money being invested in supply-chain management tools and especially in technology for tracing and tracking freight shipments is an indication of the increasing importance supply-chain logistics and freight operations. It is estimated that the market for shipment tracking tools that make freight visible door-to-door (freight visibility technologies) will quadruple from $125 million in 2000 to more than $515 million in 2005. i2 Technologies, Manogistics, Menlo Logistics, and Transentric are examples of private-sector suppliers of this technology.

An estimated 10 billion tons of freight valued at $10 trillion moved into, out of, and within the U.S. in 1998.

■ Large Freight Volumes Today

These changes in the economy, trade patterns, and logistics strategies have increased the volume of freight being moved. It is estimated that 10 billion tons of freight valued at $10 trillion moved into, out of, and within the U.S. in 1998. (See Figure 7.)

Domestic freight tonnage is expected to double by 2020. The volume of freight moving through the major U.S. ports may double or triple in the same planning horizon.

■ Larger Freight Volumes Tomorrow

Domestic economic growth, expanding international trade, and new business logistics strategies are expected to double the tonnage of freight moving into, out of, and within the U.S. by 2020. (Footnote 1) (See Figure 8.)

At moderate rates of economic growth, preliminary estimates indicate that the total tonnage of freight carried by all freight systems—truck, rail, air, water, and marine—may increase by 100% in the West; by 89% in the Central states and the South; and by 79% in the Northeast.

The volume of freight moving through the major international trade ports may grow ever faster. The volume of freight moving through the Ports of Los Angeles and Long Beach is forecast to triple by 2020. Similar increases are expected on the East Coast at ports like New York and New Jersey and Hampton Road. Gulf Coast ports like Houston and New Orleans will likewise experience significant increases as the U.S. to Latin America trade matures.

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[1] Preliminary forecasts prepared by DRI/WEFA for the Federal Highway Administration's Multi-Modal Freight Analysis Framework Project, January 2001.

The U.S. has added very little freight system mileage over the last decades.

■ Decreasing Freight System Mileage

The U.S. has added very little freight system mileage over the last decades. (See Figure 9.) Highway, pipeline, and air mileage have increased modestly. Class I railroad mileage has decreased as the railroads have restructured their systems, and the amount of waterway navigation channel has remained largely unchanged. Our highways, rail lines, and ports are increasingly congested because increasing demand has absorbed most of the readily available freight system capacity.

Truck freight depends on a densely developed highway network with major intercity corridors.

■ Highway Truck-Freight Volumes Today

The U.S. highway system carries about 65 percent of domestic freight by tonnage and over 75 percent of domestic freight by value. (See Figure 10.) Truck freight depends on a densely developed highway network with major intercity corridors.

Truck travel is expected to double in the next twenty years.

■ Highway Truck-Freight Volumes Tomorrow

Truck vehicle-miles-of-travel (VMT) doubled in the last twenty years and is forecast to double again in the next twenty years. (See Figure 11.)

The problems of growing freight volumes and decreasing capacity are particularly acute in metropolitan areas where increasing congestion has increased trucking costs and reduced delivery reliability.

■ Growing Highway Congestion and Deteriorating Reliability

The problems created by growing freight volumes and decreasing highway capacity are particularly acute in metropolitan areas. Growing metropolitan congestion has increased trucking costs and reduced delivery reliability. Nationally, total vehicle-miles-of-travel has increased 72 percent over the last 15 years, while total highway mileage has increased only one percent.

The cost of highway congestion to the trucking industry is moderate today, but if the volume of freight traffic doubles over the next decade, the cost will rise significantly. Large trucks are a small percentage of the vehicles on highways—typically, less than 5 percent of total vehicles on urban highways during congested peak periods—but a doubling of truck volumes on already saturated access roads will add appreciably to congestion. (See Figure 12.)

When highways are saturated, traffic flows are unstable; the frequency of incidents such as minor accidents, flat tires, and overheated engines increases; the time required for traffic flow to recover increases exponentially; and reliability vanishes.

Whether the cause of delay is an accident, bad weather, or delays related to a highway repair project, the effect is the same. A one- or two-hour delay can mean a missed delivery window or a missed intermodal train connection and a delay of a day in a domestic shipment. A missed connection on an international move can mean a delay of a week or more. For a freight system trying to serve just-in-time manufacturing and retailing businesses, reliability is critical. Poor reliability means lost business, diminished economic value and higher costs of living.

The rail system carries about 8 percent of the domestic freight by tonnage and about 40 percent by ton-miles.

■ Rail Freight Volumes Today

The rail system carries about 8 percent of the domestic freight by tonnage and about 40 percent by ton-miles. In 1999 ton-miles increased by 4.1 percent from the prior year to 1.43 trillion, while tonnage jumped to 1.72 billion, a record high. U.S. railroads also hauled a record 9.0 million intermodal trailers and containers in 1999. However, the route structure of the nation's mainline rail system has been changed only modestly since 1975. (See Figure 13.)

Since deregulation of the rail industry in 1980, the focus has been rail network rationalization. A succession of mergers and acquisitions has left the nation with a handful of very large (Class I) railroads operating on a significantly consolidated mainline network with connections to many light-density lines. The Class I railroads have reportedly increased the volume of freight they carry by 50 percent while reducing trackage by 35 percent, locomotives by 32 percent, railcars by 25 percent, and employees by 60 percent.

Rail freight volumes are expected to grow by __ percent by 2020.

■ Rail Freight Volumes Tomorrow

(Bruce Lambert/HOFM to provide chart showing growth in rail freight volumes. Text to be added.) (See Figure 14.)

Despite major restructuring, the rail industry is short of capacity in certain key lanes and at key rail hubs such as Chicago.

■ Rail Freight System Choke Points

Despite major restructuring and rationalization, the rail industry now finds itself short of capacity in certain terminal areas and along key lanes.

Chicago is the critical example of terminal-area congestion. Twenty-five percent of the nation's rail freight originates or terminates in Chicago. On a typical day, 1,200 locomotives, 33,000 rail cars, and 44,000 pieces of intermodal equipment are routed through heavily congested connecting lines, yards, and terminals that were designed to 19th century rail standards. In late 2000, the Association of American Railroads reported that the connection time for rail-bound carload traffic through Chicago was approximately 40 hours. While a significant improvement over the 90 to 100 hours reported a decade or so earlier, Chicago is still a major choke point.

Along some intercity rail corridors, rail freight service must compete for space and time with commuter-rail trains and intercity-passenger trains. In some corridors such as the Mid-Atlantic rail corridor, volumes are growing but critical chokepoints limit capacity. (See Figure 15.)

An increase in rail traffic alone can bring rail and truck operators into conflict. In a number of cities, longer freight trains (some exceeding 10,000 ft) and more frequent freight trains block key highway-rail grade crossings used by truckers to move containers from port terminals to trains waiting at intermodal rail terminals.

Trade through the nation's international marine—and land—gateways has grown from 11 percent to 27 percent of U.S. GDP.

■ International Gateway Freight Volumes Today

The major international marine- and land-gateways and their share of import and export freight tonnage are shown in Figure 16.

U.S. international trade in goods and services has grown from 10.7 percent of the gross domestic product (GDP) in 1970 to 26.9 percent in 1999 (constant 1996 dollars). Trade with NAFTA partners Canada and Mexico grew from 26 percent of total U.S. trade in 1990 to almost 33 percent in 1999.

The U.S. Marine Transportation System (MTS) comprises 25,000 miles of navigable channels, 300 ports, and 3700 marine terminals. Annually, the MTS moves more than a billion tons of domestic and international freight. In addition to freight, the MTS and the inland waterways serve 134 million ferry passengers, 5 million cruise-ship passengers, and 110,000 commercial fishing vessels annually.

In the last 25 years, there have been major improvements to U.S. coastal ports and to coastal and inland waterways, primarily in response to the container revolution and the general growth in trade, but also in response to competition among ports and states seeking the economic benefits associated with trade. While almost all coastal ports experienced growth over the last 25 years, the ports on the west and southeast coasts experienced the greatest growth, reflecting the growing trade among the Pacific Rim countries. Emerging new trade flows westerly through the Suez Canal are increasing growth through the East Coast port range and the Northeast in particular.

Containerized cargo and containerships (including roll-on/roll-off vessels are the fastest growing segments of the maritime freight market.

■ Types of Marine Cargo Vessels

Maritime cargo is classified into two general categories—general cargo, which includes break bulk, neo-bulk, and containerized cargo; and bulk cargo, which includes liquid bulk and dry bulk. The five vessel types illustrated in Figure 17 carry most of these cargoes.

Containerized cargo and containerships (including roll-on/roll-off (Ro/Ro) and lift-on/lift-off (Lo/Lo vessels) are the fastest growing segments of the maritime freight market. Containerized shipping represents one of the highest return-on-investment (ROI) cargoes handled by U.S. ports and waterways.

Worldwide and U.S. container volumes in ports will double or triple in the next two decades.

■ Marine Port Container Volumes Tomorrow

Worldwide container volumes are growing at an 8.5 percent compound annual growth rate (CAGR). U.S. marine container traffic is predicted to grow at a CAGR between 6 percent and 7.5 percent over the next ten to twenty years. (See Figure 18.)

Assuming current market shares and port productivity stay about the same as they are today, every major U.S. container port and terminal will double or triple the volume of containers that it handles over the next twenty years.

Key U.S. ports are typically located in developed major urban areas. These urban ports and terminals, like the urban truck and rail systems that serve them, are experiencing significant congestion and capacity problems.

Constructing major landfills for port expansion and implementing major channel deepening projects is a long, difficult and costly process with the potential for major environment and community impacts.

■ Port Capacity Bottlenecks

Accommodating the predicted growth in container traffic is a major challenge for East, West and Gulf Coast ports. Ports and marine terminals must expand their capacity and improve their productivity.

The problem is particularly acute at the Ports of Los Angeles and Long Beach. (See Figure 19) To accommodate the most conservative (lowest growth) container forecast for 2010 at their current (2000) container-throughput rates, the two ports would need to add 5,000 acres of new terminal space to their existing acreage. By 2020 they would need over 9,400 acres of new terminal space, an increase of almost 7,000 new acres of terminal space between 2000 and 2020.

The Southern California ports are not alone in facing this challenge. On the East Coast, the Ports of New York and New Jersey will see a two-fold increase in container volume by 2020 and a four-fold increase by 2040. (See Figure 20.)

However, future expansion is problematic. Constructing major landfills for port expansion and implementing major channel deepening projects is a long difficult, and costly process with the potential for major environment and community impacts.

The inland waterway system also faces major challenges. Much of the inland waterway infrastructure is aging, with many of the locks more than 50 years old and beyond their design life. Renewal of the system will be a major concern over the next 20 years.

Mega-containerships capable of carrying 5,000 or more TEUs will dominate the high-volume trade routes among Asia, Europe, and the U.S. They will generate correspondingly large volumes of truck and rail traffic into and out of their ports-of-call.

■ Impact of Mega-Containerships

Of particular concern at ports is the impact of mega-containerships. Megaships are capable of carrying 5,000 or more 20-foot equivalent container units (TEUs). The largest megaships in operation today are capable of carrying 4,500 to 6,700 TEUs while the typical containership carries between 2,000 and 4,000 TEUs. (See Figure 21.)

Despite very low financial returns, ocean carriers are continuing to invest in megaships to meet growing demand and drive down freight costs. In 1999 megaships were one percent of world containership vessels, but megaships were eight percent of new containership orders.[2] In 2000, 62 percent of the new-build vessel orders were for vessels over 5000 TEUs. (See Figure 22.) China Ocean Shipping has recently placed a shipyard letter-of-intent order for two 9,800 TEU container ships to be delivered in 2004. Many in the maritime shipping industry are predicting that a 15,000 to 18,000 TEU containership will be constructed within the next two decades.

Megaships will likely dominate the high-volume trade routes among Asia, Europe, and possibly the U.S. At those ports that have the waterside capacity to handle them (i.e., channels 50-53 feet or more in depth; berths 1,100–1400 feet long; high-capacity cranes; on-dock intermodal rail terminals; and adequate container storage areas), the megaships will generate large volumes of landside truck and rail traffic in very short time periods.

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[2] *The Impacts of Changes in Ship Design on Transportation Infrastructure and Operation*, U.S. Department of Transportation, Office of Intermodalism, Washington, D.C., February 1998, pages 3-4.

Most freight is destined for congested metropolitan markets. Freight will not be able to avoid congestion by moving around metropolitan areas.

■ Freight Cannot Avoid Congestion

Most freight is destined for the metropolitan markets shown in Figure 23, and most of these metropolitan areas are heavily congested.

Some freight traffic will be reallocated or redirected to areas with less congested highways, rail lines, ports, waterways and terminals. Diversion of this freight to outlying ports and terminals may reduce traffic pressure on the most congested metropolitan transportation facilities. However, most freight is destined for the major metropolitan consumption markets, and diversion may generate more truck and rail miles of travel in other corridors, many of which also are congested and nearing capacity.

It is unlikely that the freight industry will be able to move around and thereby avoid its congestion and capacity problems.

> **Building freight capacity in metropolitan areas is very capital and time intensive. Freight will not be able to build its way out of its congestion and capacity problems in the foreseeable future.**

■ Freight Cannot Easily Build Its Way Out of Congestion and Capacity Problems

Building freight capacity in metropolitan areas is very capital intensive. New capital investments in freight projects are planned—and some are underway—to fix highway and rail choke points, expand or refurbish ports and waterways, rationalize terminals, and improve intermodal connectors. However, building freight capacity in metropolitan areas is expensive and time consuming.

Most freight projects in metropolitan areas are constrained by space, cost, and environmental impacts. The projects are usually in direct competition with residential, commercial and retail projects for scarce urban land. And, the largest and most complex of projects may take decades to plan, design, and build. (See Figure 24.)

It is unlikely that the freight industry will build its way out of its congestion and capacity problems in the near future.

After two decades of improvement, logistics costs appear to be stalled at about 10 to 11 percent of GDP. The industry is seeing diminishing returns from deregulation, larger vehicles, and mergers.

■ Stalled Freight Productivity Growth and Increased Freight System Complexity

Freight productivity improved significantly over the last two decades. (See Figure 25.) Total logistics expenditures dropped from about 18 percent of GDP in 1980 to about 10 percent today. However, after two decades of improvement, logistics costs appear to be stalled at around 10 percent.

Economic deregulation of the freight industry in the 1980s resulted in a massive restructuring and reorganization of the freight industry and huge gains in productivity. However, the industry is seeing diminishing returns from deregulation, and there are few remaining opportunities for economic deregulation of the industry.

The freight industry also improved productivity over the last 20 years by increasing vehicle capacity—introducing larger, more efficient trucks, double-stack-container trains, and containerships. However, it is not clear that the freight industry will see similar size and capacity increases in the next decades, except perhaps in mega-containerships.

Today, carriers are looking to improve productivity by increasing their economies of scale and scope through consolidation, alliances, consortia, pooling arrangements, and collaborative logistics. But industry observers argue that the industry has largely exhausted the opportunities for increasing productivity through mergers and consolidation. Moreover, these changes have significantly increased the complexity of freight movements and freight operations.

There are significant social costs, labor issues, and environmental impacts to moving more freight in an increasingly complex freight system.

■ Rising Social Costs and Heightened Environmental Concerns

Safety

There are significant social as well as economic costs—from accidents and fatalities—to moving more freight in an increasingly complex freight system. Although fatality rates have declined over the last decades, the absolute number of fatalities has not declined significantly. (See Figure 26.)

Labor Agreements and New Technology

Labor is a critical and essential partner in any agenda to improve the freight operations capacity of the U.S. Increasing freight volumes and shrinking freight system capacity are creating new problems for labor as well as for carriers and infrastructure managers. The trucking industry is debating changes in truck-driver hours-of-service safety regulations and is concerned about low pay rates, driver shortages, and driver training. The West Coast maritime longshore unions and waterfront employers will soon begin collective bargaining discussions centered specifically on the labor and productivity impacts of integrating new technologies, particularly information technology, into marine freight operations.

Environment

Industry leaders and policy makers are concerned about the expanding list of freight system environmental issues—fuel economy, efficient location of freight facilities, air and water quality, hazardous materials, dredging of channels, global warming, vehicle and vessel emissions, etc.

At issue today is whether the nation's freight systems have the capacity to handle the growing volume of freight

■ The Freight Challenge

At issue today is whether the nation's freight systems have the capacity to handle the growing volume of freight and still meet shippers' and receivers' demands for Assume for the moment that the share of freight carried by each mode remains the same. (See Figure 27.) Does the highway system have the capacity to absorb its share of projected freight growth? The rail freight system? The marine freight system?

In the near-term, capacity and congestion problems may not shut down the nation's freight systems, but they can have devastating and disproportionate operational impacts by degrading the predictability and reliability of freight service for shippers and receivers. Reliability and predictability are the shipper's most important criteria for freight transportation in an era of tightly integrated operations and just-in-time manufacturing and retailing.

Unless the issue of freight transportation productivity is addressed aggressively, the safety, reliability, and responsiveness of our national freight system will deteriorate, and its contribution to the nation's economic growth and national security will surely be diminished.

A major opportunity for the freight transportation community to improve freight operations may be in the application of information technology to freight operations.

■ Building Freight Capacity through Better Operations

Meeting the challenge of improving freight productivity will require the leadership and cooperation of freight carriers, the shipping community, labor, and the public sector.

Solutions must come through: (See Figure 28.)

- Renewed national freight mandate and vision;
- Cooperative public and private leadership;
- Better freight operations;
- Investment in freight infostructure (information technology) and infrastructure;
- Improved freight system performance data; and
- Collaborative freight operations research.

A major opportunity for the freight transportation community to improve freight operations may be in the application of information technology to further optimize freight operations.

The development of a national freight operations agenda to advance this and other solutions is an enterprise-wide undertaking that deserves immediate attention.

> **Public-sector infrastructure managers have improved highway operations through ITS systems. Motor carriers have improved operations through real-time asset management.**

■ Examples of Highway/Truck Operations Improvement Strategies

The enactment of ISTEA in 1991 marked the close of the Interstate construction era and the beginning of a highway management era. ISTEA created the intelligent transportation systems (ITS) program and initiated a focus on highway operations.

Public-sector infrastructure managers have improved highway operations through ITS systems. (See Figure 29.) Motor carriers have improved operations through real-time truck and fleet management. Examples of these strategies include:

- Traffic Information Services. Metropolitan areas have developed traffic operations centers to monitor congestion and provide information on congestion and highway conditions. State DOTs and corridor coalitions are now looking at ways to provide similar information to truckers and other traveling on intercity highways and in rural areas.
- Incident Management. The first incident management programs focused on metropolitan beltways. The FHWA and state DOTs are expanding these programs to intercity corridors and improving techniques for clearing incidents involving heavy trucks.
- Work Zone Management. Concerns about safety and congestion are prompting a new look at strategies to reduce delays and accidents around highway construction sites.
- Truck Clearance. The Federal Motor Carrier Safety Administration and its state and trucking industry partners are automating border and weigh-station clearance to reduce delays and costs to commercial vehicles operators.

The railroads have improved operations by integrating information and physical systems.

■ Examples of Rail Operations Improvement Strategies

Improved rail operations have been addressed through service rationalization, a quest for greater speeds, interchangeability of equipment, and on-line booking.

- Rail operational improvement strategies, similar to capital-intensive water carrier strategies, seek to maximize returns on this capital-intensive industry. Therefore, we have seen a wave of rail mergers, which rationalized services and built efficiency as rail systems focused on key lanes. (See Figure 30.)
- To increase speeds on key lanes, operations research is underway on positive train control systems.
- To increase the interchangeability of domestic containers, domestic interline pools have been created by various carriers. Interchangeability adds speed and reduces re-positioning costs. Large investments in collaborative information systems enable this.
- Open booking platforms allow customers easy access to information on shipments. Again, large investments in collaborative information systems drive this operational improvement.

Ports, waterways and marine terminals have greatly improved marine transportation operations by investments in terminal design, equipment, information technology, and labor management agreement.

■ Examples of Port and Terminal Freight Operations Improvement Strategies

US ports, waterways, and marine terminals have substantially increased marine transportation operational capabilities by investing in improved terminal layout and design, state-of-the-art handling equipment, integration of information technologies and changes in labor and management agreements. Many emerging new strategies for future improvements are being explored. The following examples are but a few: (See Figure 31.)

- Remote Inland Empty Container Depots. Empty containers can account for up to 70% of the total volume in many terminals. Locating a remote empty container storage depot at centroids of regional/local warehousing and distribution can reduce truck trips to and from the terminal.

- Trailer/Container Utilization and Productivity Standards. Dwell time and turn times for trailers and containers is increasing. With average dwell times in terminals estimated at 6 to 8 days, use of information technology (IT) integration on terminals and advanced gate notification/reservation systems can increase while reducing total system cost.

- Port and Rail Terminal Access Improvements. Queuing and delays at marine and rail terminals. Automation of gate clearance procedures information on cargo availability and gate conditions, expanded gate and terminal hours may significantly improve terminal productivities.

- DOD Agile Port Technologies. DOD wartime deployments call for substantial surge movements through U.S. ports. Agile port information technologies may significantly improve terminal capacities at peak flow and benefit commercial flows.

Carriers and infrastructure managers must push for "collaborative freight-operations management"— seizing opportunities to link information systems and share data that will optimize freight flows and better utilize equipment and facilities.

■ System wide Freight Operations Improvement Strategies: Productivity through Collaboration

Freight and information must move seamlessly between modes and among carriers and infrastructure managers to improve freight operations. The flow of accurate and timely information through the freight system is just as important today as the movement of freight. It provides the thread the binds individual operations into an efficient intermodal system.

The world of intermodal freight is fragmented and complex with numerous stakeholders, diverse priorities, and impediments to collaboration. "Islands of information" and barriers to data exchange are all too common. The lack of accurate timely, shared information about shipment location, vehicle and equipment availability, gate queues, and highway congestion increases costs and undermines reliability and productivity across the intermodal freight system.

Shippers and receivers are pushing for collaborative supply-chain management. Carriers and infrastructure managers must push for "collaborative freight-operations management"— seizing opportunities to link information systems and share data that will optimize freight flows and better utilize equipment and facilities. (See Figure 32.) But to realize this opportunity, the freight community must move more aggressively to define their data interchange needs and agree on an intermodal information system architecture.

The state and MPO focus since ISTEA has been metropolitan and local. The private sector focus is increasingly national and global. The gap between public and private transportation perspectives must be closed through a new national freight agenda.

Defining a New National Freight Agenda – Closing the Gap

Congestion, the lack of freight capacity, and deteriorating freight productivity are emerging as significant national problems, but freight issues are not yet understood by the layperson as urgent and compelling. In part, the reason for this is the differing perspectives of the public and private sectors. The state and MPO transportation focus since ISTEA has been metropolitan and local. The private-sector freight transportation focus is increasingly national and global. The gap between public and private transportation perspectives must be closed and a consensus agenda advanced. (See Figure 33.)

ISTEA gave state and local government a mandate to address freight issues, but provided few specific tools to do so and left open the question of an appropriate federal role. TEA-21 began to redress the shortfalls of ISTEA, providing new resources and tools to address freight needs at the federal, state, and local levels.

TEA-21 expires in the September 2003. The reauthorization of the federal surface transportation legislation is an opportunity for the freight community to proactively address congestion, capacity, and productivity issues. These issues warrant an aggressive federal response in partnership with state and local government and the private sector. A new national freight agenda must recognize the importance of freight operations to the well being of the nation's economy; recognize that freight needs extend beyond the boundaries of states and metropolitan areas; and provide new resources and tools to address freight operational problems.

The last section of this paper sketches out some possible policy options for a new national freight agenda.

Policy options to improve freight operations at the national and global levels.

■ National/Global

Some possible policy options to improve freight operations at the national and global levels (options are not rank ordered): (See Figure 34.)

- Extend the congressional freight-planning mandate to operations (e.g., Building on the ISTEA and TEA-21 mandates that "Freight is important and a required factor in the planning process," add "Freight operations is important.").
- Establish a national freight operations council to advise on nationally significant freight operations needs.
- Develop a freight data base capable of providing timely, valid, reliable, information on freight flows (e.g., "national freight-flow pictures"), focusing primarily on North American/national flows and secondarily on regional/corridor flows, with the objective of providing background information to support state and local freight operations planners and managers.
- Establish and fund a national freight operations research and development program focusing on operations research, systems engineering, logistics, and benefit-cost analysis tools for freight operators (e.g., a freight program within or adjunct to NCHRP, SHRP, TCRP, etc).
- Expand Federal-aid program eligibility to cover intermodal freight operations projects, including information technology and intelligent transportation (ITS) projects.
- Establish and fund university, professional, and continuing education programs in freight operations to complement existing traffic engineering, management, and logistics programs.

Policy options to improve freight operations at the national and global levels *(continued)*.

- Encourage and support the freight industry's development of freight-data-interchange capabilities across within and across modes. (The federal role should be to convene and catalyze this activity, not to design, develop, or operate data interchange services. The federal government should participate in international and national standards organizations setting freight-data-interchange data standards and provide credit support for implementation through secure, neutrally managed (e.g., third-party) "utilities."

Policy options to improve freight operations at the regional and corridor levels.

■ Regional/Corridor

Some possible policy options to improve freight operations at the regional and corridor levels (options are not rank ordered): (See Figure 35.)

- Provide funding to states and MPOs to participate in multi-state and multi-jurisdiction trade-corridor and trade-area transportation consortia that build consensus on common freight-systems operational needs and strategies.
- Measure freight-movement performance at the regional and corridor levels (e.g. relative improvement or deterioration of travel times and reliability of shipments and vehicles, etc.)
- Create a borders and corridors program operations component to the existing borders and corridors planning and project development program. The operations component would cover traffic engineering, traffic flow management, provision of information focused specifically on freight movements, and highway/rail work zone management targeted at regional freight operations. The program should provide grants to fund the management of traffic operations (e.g., regional public/private-sector TOCs/TMCs, etc.), incentive grants to develop IT/ITS operations-support systems, and tax incentives to shippers and carriers to participate.

Policy options to improve freight operations at the metropolitan and local levels.

■ Metropolitan/Local

Some possible policy options to improve freight operations at the regional and local levels (options are not rank ordered): (See Figure 36.)

- Establish a terminals and connectors program, providing funding for states and MPOs to participate in local terminal and connector capital and operational improvement projects through grants and credit support.
- Provide dedicated funding or other incentives for private-sector rail-freight-terminal operational improvements that improve terminal productivity, support economic development, enhance public safety, reduce congestion, and meet air quality goals.
- Measure freight movement performance in metropolitan areas (e.g. relative improvement or deterioration of travel times and reliability of shipment and vehicle trips, etc.).
- Require that freight operations issues and alternatives be fully explored and considered in state and MPO planning processes.
- Expand metropolitan traffic operations programs to explicitly consider and address freight movements (e.g., apply traffic engineering, routing information, work-zone management, incident management, etc., to freight-vehicle flows).
- Provide preferential and premium service options through truck-only lanes and truck-accessible fare-value lanes.
- Provide dedicated funding to state DOTs and MPOs to hire and train freight operations specialists.
- Provide credit support for the development and implementation of freight-data-interchange services through secure, neutrally managed (e.g., third-party) "utilities."