Intermodal

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Volpe National Transportation Systems Center
Economic Analysis Division

DRAFT MATERIAL

Enhanced Freight Movement at Domestic and International Gateways

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This document is a working paper that contains draft and background material. It supports preparation of an investment plan for a Partnership Initiative proposed in the Transportation Science and Technology Strategy developed by the Transportation R&D Committee of the National Science and Technology Council. Distribution is solely for the purpose of eliciting comment from stakeholders in the transportation community. Funding estimates are preliminary and subject to change.

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PREFACE

The National Science and Technology Council (NSTC) was created in 1994 to ensure that the Federal investment in R&D is (1) coordinated to ensure efficient use of Federal funds aimed at this mission; (2) focused on projects identified by users, industry, and other stakeholders as being the most critical to achieving success in agencies' missions; and (3) limited to areas where it is clear that major public benefits can only be achieved through cost-shared Federal research.

Through its initial planning efforts-with major involvement of the transportation and research communities-the NSTC Committee on Transportation R&D has developed the first *Transportation Science and Technology Strategy* to help Congress, the White House, and Federal agency heads to establish national transportation R&D priorities and coordinated research activities. The Strategy is based on the results of numerous outreach events, environmental scans, and an analysis of the transportation system's current and future strengths, weaknesses, opportunities, and threats.

The Strategy document is essentially complete and is expected to be released in September 1997. It includes as a key element the identification, based on broad public and private sector input, of twelve transportation partnership initiatives that address recognized national needs, have a technology focus, and, if successful, could rely on existing market forces and the private sector for widespread implementation. In all cases, the initiatives would benefit the Nation as a whole and could not proceed in *a* timely fashion without some cost-shared Federal support of the overall efforts. The initiatives are intended to incorporate and guide ongoing activities that are relevant to their goals. Any new Federal components of the initiatives will be developed under the overall funding limits and constraints already established.

One of the twelve identified initiatives is *Enhanced Goods and Freight Movement at Domestic and International Gateways,* which has the goal of contributing to US economic growth by expanding the overall share of global and domestic trade and markets through advances in transportation technology and systems. This document represents initial formulation of an "investment plan" to guide implementation of that initiative, particularly focusing on current relevant public and private undertakings. In order to be successful, the initiative must draw upon the wisdom and insights of the entire transportation community, and engage that community in the effort. This document is being distributed as a means of soliciting comment and suggestions from as broad an audience as possible. Please send responses to:

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ACRONYMS

ADT	Average Daily traffic
AEI	Automatic Equipment Identification
AHS	Automated Highway System
AMASCOT	Automated Mileage and State Crossing Operational Test
APL	American President Lines
ATCS	Advanced Train Control Systems
AVI	Automatic Guided Vehicles
AGV	Automatic Guided Vehicle
AVL	Automatic Vehicle Location
BNSF	Burlington Northern Santa Fe
BTEP	Border Technology Exchange Program
CACH	Chicago Area Consolidation Hub
CDLIS	Commercial Driver License Information System
CHCP	Cargo Handling Cooperative Program
CMAQ	Congestion Management Mitigation and Air Quality
CVISN	Commercial Vehicle Information Systems and Networks
cvo	Commercial Vehicle Operations
DEA	Drug Enforcement Agency
DFW	Dallas-Fort Worth Airport
DGPS	Differential Global Positioning System
DIAP	Drug Interdiction A P
DOS	Disk Operating System
DOT	Department of Transportation
ED1	Electronic Data Interchange
ELS	Equipment Location System
FAA	Federal Aviation Administration
FASA	Federal Acquisition Streamlining Act
FHWA	Federal Highway Administration
FLIR	Forward Looking Infrared
FRA	Federal Railroad Administration
GDP	Gross Domestic Product
GPS	Global Positioning Satellites
GRPA	Government Performance and Results Act
HELP	Heavy Vehicle Electronic License Plate
HM	Hazardous Material
IBM	International Business Machines
ISS	Inspection Selection System
ISTEA	Intermodal Surface Transportation Efficiency Act
ITS	Intelligent Transportation System
LORAN	Long Range Aid to Navigation
MACS	Mainline Automated Clearance System
MARAD	Maritime Administration
MCSAP	Motor Carrier Safety Assistance Program
MIV	Mobile Inventory Vehicle
NAFTA	North American Free Trade Agreement
NAHSC	National AI-IS Consortium
NATAP	North American Trade Automation Prototype
NIER	National Institute for Environmental Renewal
NHS	National Highway System
NII	National Information Infrastructure
NOAA	National Oceanic and Atmospheric Administration
NSTC	National Science and Technology Council
0 0 s	Out-of-Service
PC	Personal Computer
PDA	Pease Development Authority
PTC	Positive Train Control
PTS	Positive Train Separation
R&D	Research and Development
RF	Radio Frequency
RFID	Radio Frequency Identification
RSPA	Research and Special Programs Administration
SAFER	Safety and Fitness Electronic Records
SEC	Secure Electronic Commerce
SHIPPER	Ships Performance Review
SMART	Shipment Monitoring and Remote Tracking
SOCP	Ship Operations Cooperative Program
SP	Southern Pacific
SPIN	Ships Performance indicator
STP	Surface Transportation Program
TEU	Twenty Foot Equivalent Unit
TNS	Thermal Navigation System
UHF	Ultra High Frequency
UP	Union Pacific
UPS	United Parcel Service
u s	United States
VAN	Value-Added Network
VHF	Very High Frequency
VMT	Vehicle Miles Traveled
VRS	Vehicle Roadside Communications
VTS	Vessel Traffic Service
WIM	Weigh-in-Motion

1 - INTRODUCTION AND BACKGROUND

The purpose of this report is to provide a framework for integrating the core program activities that constitute the National Science and Technology Council's (NSTC's) public-private initiative to improve freight movement at domestic and international gateways. This report identifies the initiative's component programs, technologies, and the freight industry partners; outlines a set of performance measures and outcomes; documents the initiative's accomplishments to date; and recommends future funding strategies.

Three significant trends in the past decade or so have transformed the way goods move across the globe. The unprecedented growth in the volume of international trade, the extent to which transportation has become embedded with information, and the imperative of maintaining global competitiveness through productivity increases and risk sharing have transformed global freight movement. To a large extent, these trends have shaped the transportation industry's strategies and the U.S. government's freight gateway initiative.

The first trend has to do with the rising volumes of international trade, accompanied by the parallel growth in containerization. The impacts of these concurrent changes have been most visible at the nation's container ports, as landside access bottlenecks, waterside dredging problems, congested terminals, and capacity shortages.

- The volume of goods exported and imported worldwide has grown at unprecedented rates. The value of total U.S. exports and imports in 1996 was $1.4 trillion, having grown by 45 percent from the 1992 levels. Shifts in the location of manufacturing activities *to* overseas sites, and growing out-sourcing practices were the initial driving forces for this sustained growth. About 95 percent of the U.S. world trade moves in ocean-going vessels. Most of this trade is handled by only a few U.S. ports of entry, creating major congestion problems.

- Container loadings have grown from 3.4 million in 1982 to more than 8 million in 1996. Container growth forecasts call for annual growth rates of 6 to 13 percent through the coming decade. At these rates, a doubling of the container loadings in the next several years is a likely scenario. The critical importance of containerization to the flow of world trade is highlighted by noting that what is containerized is typically high value cargo. Whereas containerized cargo accounts for only 12 percent of the tonnage of the exports and imports, containers account for 65 percent of the value of the cargo shipped.

- Megaships and post-Panamax vessels,[1] have increasingly become the preferred vessels for transporting waterborne international cargo. Containerships have grown from the maximum capacity of 3,900 twenty-foot equivalent unit (TEU) containers earlier in the decade to TEU capacities of more than 5,000 in 1996. Because of the economies of scale the megaships offer, containerships as large as 6,000 to 8,000 TEUs are likely to prevail. Major ports take into account the requirements of these vessels, including draft requirements of 42-46 feet, when planning for port access and channel dredging projects.

- Ports have had to invest aggressively in landside and waterside infrastructure improvements in response to the changing vessel size. Between 1993 and 1997, total capital expenditures by U.S. ports amounted to $5.5 billion. Ten ports (Long Beach, Los Angeles, Seattle, Oakland, NY/NJ, Miami, New Orleans, Houston, Georgia, and Tacoma) accounted for 74% of the total outlays. Waterside access is a major challenge, as dredging projects to increase channel depth have created environmental problems relating to the disposal of contaminated dredged materials. Load centering practices of

steamship companies have led to concentration of containership activities at fewer ports. Out of 188 ports in the U.S., containerships call most frequently at 8 load centers located on the Pacific coast of North America and roughly the same number on the Atlantic coast.

- Highway truck congestion has been a problematic outcome of the growing volume of trade. Delays due to congested highways are estimated to cost trading partners over $100 billion per year in foregone productivity. Truck traffic is estimated to account for a minimum of 11 percent of the average daily traffic (ADT) in many urban areas, and for as much as 26 percent of the ADT when factoring in the vehicle equivalence of multiple unit trucks. Increased emissions and safety hazards resulting from disruptions in the flow of passenger traffic add to the costs of truck congestion. Compounding the problem of increased truck traffic has been a disproportionate modal shift in the domestic freight traffic to highway. In the New York-New Jersey port area, for instance, some 98 percent of all the container traffic from the area ports moves by truck. This near total dependency on trucks represents a shift away from the historical water-rail freight mode that prevailed in the area.

- Access problems resulting from the growth of container traffic include bottlenecks on key highway links, as well as the inadequate clearance afforded by many older bridges and tunnels. An estimated one third of all the bridges in the U.S. are structurally deficient, or many need clearance improvements. Disruptions in container traffic caused by the low clearance of freight tunnels is illustrated by noting that the cargo moving east to Manhattan cannot cross the Hudson by rail because the only existing tunnel was built for box cars not doublestack trains. With no alternative railbridges available, doublestack trains have to take a detour of 185 miles to Silkirk, and then move the containers to Manhattan by truck.

The second trend in global freight trade has to do with the extent to which transportation has become embedded with intelligence. Advanced information technologies and communications systems have become closely coupled with transportation and are adding value to the process of moving freight.

- The use of electronic commerce2, including Electronic Data Interchange (EDI), has transformed the exchange of trading information. An estimated 70 to 80 percent of transportation carriers and third party agents use some form of ED1 to conduct business transactions. ED1 has lowered transaction costs by reducing paperwork, error rates, and the cycle time for billing. The costs of implementing ED1 have gone down as well, making it more affordable for smaller companies. The decision to adopt ED1 is no longer about gaining competitive advantage, but rather about staying competitive-as businesses find that EDI has become-a necessity.

- The Internet has become a new player in the field of electronic commerce, though there currently are limitations on how well it can perform the ED1 functions. One use of the Internet has been for load matching. Trucks seeking backhaul can now access a web site that links tens of thousands of business personal computers (PCs) across the continent. A carrier looking for a backhaul can use a PC to input the truck's departure point, departure date, and destination point at a special web site. This information is then added to a central database. Shippers consult a separate web-site to search the database for an available truck to haul their cargo. Since ED1 needs a mailbox computer link (a Value-Added Network or VAN), the Internet has the potential to serve the functions of a VAN, transmitting data in a consistent format. The drawback of the Internet is data security and time sensitivity, making it unsuitable for time-critical transactions or when mission security is critical.

- Market penetration of communications devices has been significant. Data available from market surveys of large fleet carriers -- carriers most likely to adopt automation technologies -- indicate that about 40 percent of the commercial trucking. fleet carries some sort of in-cab computers or monitors; about a fourth of the fleet uses some form of Automatic Vehicle Location (AVL) or GPS-based navigational devices for fleet management; and more than half are equipped with mobile communication devices or electronic logs. Trucking companies are also using various software products for cargo dispatching, routmg functions load optimization, and other termmal or fleet management functions.

- Access to real-time data has become a key equirement for managing the logistics supply chain. Access to satellite data has provided in-transit visibility for the vehicle and cargo, allowing the tracking of the containers for fleet management, customer notification of the cargo status, and dispatching purposes. In federal roadside safety operations, real-time determination of which vehicles are high risk has allowed commercial vehicles to be screened at highway speed and selected for inspection.

- Time definite delivery of cargo, as required by just-in-time production practices, has been facilitated by the widespread application of advanced freight management technologies. These technologies have augmented the quality of freight service by automating inventory management and vehicle dispatching functions. Automation has integrated the supply chain, allowing businesses to meet their just-in-time inventory replenishment needs more efficiently. Computerized production planning networks link the processes of production, storage, and transportation and minimize inventories. Their use for administrative purposes has replaced many redundant or time consuming functions such as reporting, invoicing, credentials purchase, or tax or toll payments.

- Safety benefits from commercial vehicle application of intelligent transportation systems (ITS) technologies have been significant, as these technologies have helped control the human factor involved in many accidents. Positive train separation systems and automation of rail controls for grade crossings have increased operational safety and track capacity. In the trucking field, an estimated 93 percent of accidents are attributed to human error. The use of radar signals in collision avoidance systems has the potential to provide up to four additional seconds of warning of an impending collision. It has been estimated that 90 percent of all collisions could be avoided with an additional second of warning.

- The impact of automation and advanced technologies on freight movement is far reaching. The traditional lines demarcating information and goods have become increasingly blurred. It has been noted that General Motors exported more computers last year than IBM. The imbedded intelligence in modem freight vehicles has to a large extent removed the distinction between the functions performed by a truck and the dispatching office. In-cab computers and satellite devices now allow the-vehicle to function as a "virtual office," maintaining real-time contact with the destination terminal, customer. and the dispatch office. As one commentator has pointed out, twenty years ago, 10 percent of a carrier's time was spent planning the movement of a container, and 90 percent on the movement itself. In the year 2000 these numbers will be reversed.

The third trend has to do with the increased urgency felt among the trading partners to cut costs and improve service quality in order to remain competitive. These imperatives have led to many corporate strategies for increased productivity and risk sharing.

- At the national level, efforts to reduce costs have been successful. Logistics costs in the

U.S. have been declining relative to the Gross Domestic Product (GDP). The total U.S. logistics costs of $730 billion have declined as a percentage of the GDP, from a high of 18 percent in 1981 to 11 percent in 1993. partly as a consequence of transportation deregulation.3 The freight bill portion of the total logistics' costs accounts for about 6 percent of the GDP, and it has also been declining relative to the GDP.

- Raising productivity levels has been the guiding principle for many automation strategies and re-engineering efforts. Port productivity, for instance, is measured by such indicators as the number of gantry crane lifts per hour, or port throughput. Steamship companies use port productivity measures when deciding which port to call at. Productivity improvements are often made in order to increase capacity and cut costs. Since physical capacity expansion is no longer a feasible option for many ports or urban rail terminals, productivity improvements are often achieved through better management of gate processes, automation, or labor agreements that extend terminal service hours. Reducing turnaround time for a drayage truck from an average of 55 minutes to 30 minutes, for instance, translates to greater capacity for the port as well as additional turns for the trucker.

- Joint facilities serving civilian and military users, common user terminals that allow competing railroads to use the tracks, vessel sharing agreements, and equipment pooling alliances have become the preferred methods for avoiding high investment requirements for equipment or for capacity increases at freight facilities.

- Investing in consolidated hub-and-spoke operations and multimodal terminals is among the strategies aimed at creating greater intermodal freight market density. With an estimated 80 percent of the freight in the U.S. shipped to destinations of less than 500 miles, the only way the domestic intermodal industry can increase market share is by creating a critical mass of containerized cargo. A hub-and-spoke system that generates a dense network of origin-destinations for rail linehaul movements of containers is an effective way of increasing this critical mass. Freight consolidation projects such as the UPS Chicago Area Consolidation are examples of projects designed to increase market density.

- Next generation technologies have allowed carriers to maintain their competitive edge. New ocean going vessels such as FastShip Atlantic are capable of cutting down transatlantic transit times by half. Rail technologies such as doublestack trains have achieved significant scale economies in linehaul operations for domestic container moves. Short-haul rail technologies such as Iron Highway have the potential for lowering drayage and terminal operating costs, making intermodal moves profitable in short-haul markets.

The above trends underscore the significance of three cross-cutting issues in freight transportation. The interlinked nature of the physical transportation infrastructure, information infrastructure, and management of freight facilities stresses the need for a technology-based freight movement strategy. Such a strategy would capitalize on the opportunities to employ advanced technologies to address global trade challenges posed by physical infrastructure constraints and the requirements of complex multimodal terminals.

The investment activities documented here are based on these interdependent trends. The report explores the opportunities they offer, and attempts to articulate a research agenda as well as a set of investment targets. It emphasizes the value-added nature of the ITS technologies and the extent to which infrastructure and terminal operations can benefit from them. It shows how a federal freight gateway initiative integrates advanced technologies into infrastructure investment and terminal management plans. Such information can then be used in an investment strategy that

maximizes the benefits from efficient physical infrastructure, terminal operations, and technology application.

The technologies focused on in this report run the gamut from leading edge innovations that help increase the speed, capacity, and cost effectiveness of freight transport, to technologies that enhance system performance by improving safety, emission levels, equipment utilization, or network availability. Many of the technology partnerships that are documented in this report are used widely in the federal transportation programs and the private industry, and include systems that help locate a vehicle by using GPS; electronically identify equipment with radio frequency transponders; or electronically dispatch fleet or customer invoices through ED1 systems or fleet management systems. Also included are technologies such as Positive Train Control (PTC) for electronic braking to enhance safety, high-speed ships for greater linehaul speed, Automated Guided Vehicles for greater port operating efficiency, or Iron Highway for lowering the rail-truck interchange costs at intermodal terminals. The partnership efforts that have applied these technologies and other physical infrastructure improvements to enhance the performance of the U.S. freight gateways will provide the underpinnings of a federal investment plan that will guide the implementation of the enhanced freight gateways initiative.

2 - VISION, GOALS, AND OBJECTIVES

The NSTC's vision of an efficient transportation system is to promote:

> *. ..a sustainable and seamless intermodal transportation system that effectively ties America together and links it to the world... . It will result from a strengthened partnership between government and the private sector focused on effective management and renewal of existing infrastructure, strategic deployment of new technoIogies and infrastructure, and on R&D which supports each of these.4*

The NSTC Committee on Transportation Research and Development (R&D) was created in 1994 to develop the first *Transportation Science and TechnoIogy Strategy* (The *Strategy)* to help Congress and Federal agencies to establish national priorities. The *Strategy* has a four-tiered approach based on planning, partnership initiatives, enabling research, and education. The proposed initiatives fall into three overlapping categories: 1) transportation information infrastructure; 2) next-generation vehicles; and 3) transportation physical infrastructure. *Enhanced Goods and Freight Movement at Domestic and International Gateways* (in this report shortened to *Enhanced Freight Gateways)* is a component of information infrastructure.

The freight-related goals of the *Strategy* encompass the three strategic components of the R&D strategy, plus a fourth component relating to overall system design, planning, and management of freight facilities. The NSTC Transportation R&D Plan has adopted the following goals to be achieved within the next decade:

1. Promote a more efficient physical freight infrastructure by participating in the design and construction of freight facilities to mitigate congestion and provide adequate access;

2. Apply innovations available from the National Information Infrastructure (NII) to develop an ITS that will ensure the safe and efficient intermodal operation of the nation's freight vehicles and use of physical infrastructure;

3. Promote the development of next generation freight vehicles to ensure U.S. leadership in ship and truck technologies; and

4. Promote advanced terminal system designs to improve planning, management and operations of fi-eight gateways, and develop information required for government and industry managers to make effective decisions about commercial vehicle safety and compliance.

The *Strategy* describes the goal of *the Enhanced Freight Gateways* initiative to consist of the following:

> *Enhance US. economic growth by expanding the overall share of global and domestic trade markets through advances in transportation technologies and systems.*

The *Strategy* further points out that the goal would require the application of communications and information systems technologies and infrastructure improvements:

> *On the water side, focus on advanced terminal design and operating systems that complement changing ship designs; and operations*
>
> *On the land side, incorporate advances in high-speed freight rail networks, truck/container transport and handling systems, capsule pipeline systems, truck/airport interface systems, and rail/truck/water interface systems, through application of more efficient communication and information systems.*

The objectives corresponding to each freight-related goal of the NSTC are outlined in Table 2-l.

Table 2-1
Enhanced Freight Gateways Initiative
Initiatives, Goals, And Implied Policy Objectives

INITIATIVE'S GOALS	POLICY OBJECTIVES
1 - Promote advanced port terminal designs and operating systems for improved mobility, access, and air quality	1. Invest in terminal and port access 2. Improve physical infrastructure clearance 3. Facilitate dredging for adequate channel depth 4. Improve terminal capacity and container handling 5. Invest in on-dock rail for improved port access 6. Improve gate processing and access
2 - Promote advanced freight information networks, for greater efficiency and safety	1. Create a linked network of CVO databases 2. Automate roadside safety inspection checks 3. Automate credentials purchase and compliance checks 4. Streamline border crossing clearance processes 5. Promote HM incident management and positive train controls (PTC)
3 - Promote advanced rail, truck, water, and air container interface 2! systems through application of communication and information technologies	1. Promote next generation enhance terminal capacity Promote consolidated rail/air/truck terminal operations 3. Promote marine security and operational efficiencies 4. Promote joint use of military and cargo facilities

3- PERFORMANCE MEASURES AND OUTCOMES

Title V of the Federal Acquisition Streamlining Act (FASA) of 1994 requires federal agencies to institute a performance-based planning, budgeting, and management approach to the acquisition of capital assets. They are required to establish cost, schedule and performance goals. Furthermore, the Government Performance and Results Act (GRPA) of 1993 is designed to ensure that program objectives are more clearly defined and resources are focused on meeting those objectives.5 The guiding principles for the initiative's performance measures reflect the constraints imposed by the government's budget, and include the requirements that:

- Significant cost sharing should be provided by industry in all applied research;
- Priority be given to projects capable of achieving both business success and meeting social goals such as safety and environmental protection; and
- Federal **R&D** budget limits should be adhered to without expectation of new money.

On the operations side, when dealing with the users and operators of the freight transportation system, the basic freight system performance requirements are articulated as the following:

- Reliable service (on-time, no-damage);
- Accurate documentation (immediate, paperless, worldwide);
- Safety (from accidents, cargo contamination);
- Security (protection from physical cargo damage and loss of information security);
- Maximum flexibility (best combinations of modes, ability to respond to load variations);
- Full visibility (of cargo and vehicle);
- Minimum overall costs (to users and carriers); and
- Single accountability and control.

How Performance Measures Relate to Desired Outcomes

When it comes to making transportation investment decisions, priorities should be assigned to each candidate project, given the requirements of the funding entity. One way of determining these priorities is to assign to each goal and objective the potential *impact* or *outcome* of implementing the programs that promote those goals and objectives. These outcomes represent the desired impacts of the investment projects undertaken.

1. **Greater Terminal Capacity, Access, and Mobility** - One way of achieving this outcome **is** to reduce congestion at freight facilities. This will result in lower costs and fewer delays for inter-modal transfers. Projects that relieve capacity constraints, equipment shortages, access bottlenecks, low equipment turns, long gate queues, and inadequate channel depth address some of the problems impacting terminal capacity and access. Some of the performance measures used to ascertain the effectiveness of these projects include container throughput, equipment cycle times, truck/container turns, gate clearance times, and channel depth required by vessels calling at given ports.

2. Enhanced Safety and Regulatory Efficiently - To achieve this outcome, advanced ITS/CVO technologies are being tested to reduce the burden of regulatory compliance while ensuring safe operation of commercial vehicles. The measures of success include reduced rates of terminal accidents and increased security for freight shipments.

3. Greater Economic Competitiveness - To achieve this outcome, ii-eight-related projects can be promoted that reduce the cost of transporting cargo, or in other ways increasing demand for the product and services offered by U.S. businesses. Direct measures include a project's job creation potential, or whether or not it employs state-of-the-art technologies that give a competitive edge to the U.S. freight operators. An indirect impact

on the U.S. competitiveness can be expected from the greater productivity resulting from the enhanced safety and mobility of the U.S. freight movement system.

4. Improved Environmental Quality - To achieve this outcome, infrastructure improvement projects can be initiated that provide the needed access or clearance for a facility. The improvements often reduce emissions as they eliminate circuitous truck traffic and facilitate inter-modal transfers. Also related to this goal are projects that control oil spills and hazardous materials incidents and help with energy conservation goals.

To ascertain the impact of each of the initiative's goals and their implied objectives, a number of corresponding *performance measure can* be devised, as shown in Table 3- 1.

Table 3-l
Measures and Outcomes Corresponding to Initiative's Goals

Goals	Objectives	Measures	Outcomes/ Impacts
Promote advanced port terminal designs and operating systems	1- Invest in access improvements 2 - Improve infrastructure clearance 3- Facilitate dredging 4- Improve capacity 5- Invest in on-dock rail 6- Improve gate processing	• Access time • Truck route circuitry • Waterside vessel needs • Container dwell time • Offloading time • Gate clearance time; truck turns	Freight mobility; terminal/port access; terminal throughput
Promote advanced communications technologies	1- Develop linked CVO databases 2- Automate safety inspections 3- Automate the credentialing process 4- Streamline border crossing 5- Better manage HM incidents, promote positive train controls	• Compliance costs • Inspection time, # violations • Delays/queues - • Clearance time • Response time • Train collisions	Enhanced safety; regulatory efficiency; access to real-time data; network linkage
Promote advanced intermodal rail, truck, air, water interface systems	1 - Promote next generation vehicles 2- Promote consolidated terminals 3- Promote marine security and efficiency 4 - Promote joint use of military-cargo facilities	• # new technologies; throughput • Network density; operating efficiency • # VTS, # spills * Efficient cargo facilities, jobs	Enhanced economic competitiveness; improved environmental quality; reduced risk of spills/security threats

4 - WHAT HAS THE INITIATIVE ACCOMPLISHED: ON-GOING OR COMPLETED PROJECTS PROMOTING FREIGHT GATEWAYS

Corresponding to each of the NSTC goals and objectives, and their expected outcomes and performance measures (as outlined in Sections 2 and 3) are three broad categories of investment projects that have been undertaken in the six years since the ISTEA authorization. The following three sub-sections outline the investment projects that correspond to each set of objectives/outcomes for freight gateways.

Invest in Physical Infrastructure to Improve Freight Mobility, Port Access, and Terminal Throughput

A compendium of the freight-related projects receiving ISTEA funding shows that some $4.6 billion in federal, state and private outlays were spent in freight-related physical infrastructure projects in the U.S. Local sources account for more than one third of the outlays, while Federal sources account for 18% state sources 4%, private sources for another 6%, and one-third came from undetermined sources. Table 4-l summarizes the components of the physical infrastructure projects. Federal funding of these programs were from the following sources:

- Surface Transportation Program (STP);
- STP Enhancement;
- Congestion Management Mitigation and Air Quality Program (CMAQ);
- Bridge Replacement and Rehabilitation Program; and
- "Priority" intermodal projects
- The NHS funds used on highway routes connecting designated major inter-modal terminals within the NHS, as authorized by the NHS Designation Act.

Table 4-l
Physical Infrastructure Improvement Projects
Program Components And Funding Levels

OBJECTIVE / IMPACT	ISTEA PROGRAMS	FUNDING LEVELS **Total: $3.3 billion** **Federal: $840 million**
Bridge and Tunnel Clearance	14 rail bridge and tunnel replacement and clearance improvement projects	Total: $4 18 million Federal: $123 million
Terminal Access	61 projects to improve highway access to intermodal rail terminals, ports, and airports	Total: $659 million Federal: $2 19 million
Emission Reduction and Air Quality Improvement	Auburn/Lewiston and 4 other projects in Maine6 using CMAQ funds to improve air quality in non-attainment areas	Total: $22.8 million Federal: $6.3 million
Highway Congestion Mitigation	Projects designed to reduce highway congestion: NY City Full Freight Access product[7] (Red Hook Barge Project,[8] Howland Hook Container Terminal[9] Staten Island Railroad Revitalization,[10] Halem River Yard[11], and Oak Point Link[12], Ports of LA/Long Beach, Alameda Conidor[13], and Arizona and California Railroad Container Loader, Blyth, CA[14]	Total: $2.1 billion Federal: $457 million
Grade Crossing Safety	One Chicago intermodal terminal project to grade-separate freight and passenger rail crossings: Schiller Park Intermodal Yard[15]	Total $100 million Federal $29 million
Port Access Improvements	3 projects on terminal and on-dock rail construction at Port of Seattle, using STP funds: SW Harbor Terminal 5 Project[16], Harbor Island Terminal 18 Project[17], Immunex Project at Terminals 88-91[18]	Total: $38 million Federal: $4.6 million

The following sections describe the freight gateway improvement projects that have been completed or are currently underway.

Highway Access and Bridge and Tunnel Clearance

Access to freight terminals requires adequate bridge and tunnel clearance as well as highway connections. Many of these projects, by improving access to ports and rail terminals, provide an alternative to all-highway freight movement. The outcomes of these improvements are lower highway congestion, and reduced highway maintenance and commercial traffic costs. Of the $4.6 billion in physical infrastructure improvements spent on 158 projects undertaken through partial ISTEA funding, an estimated $1.3 billion (23%) were for improvements on bridge and tunnel clearance or highway access to a port or rail freight terminal.

Air Quality

To achieve the goal of improving air quality, a number of indirect emission reduction measures are used. These measures estimate changes in environmental pollutants as a consequence of project activities with a goal of reducing highway congestion and truck traffic in areas of air quality non-attainment. Representative freight programs that have attempted to achieve air quality improvement goals are five projects in Maine as illustrated in the adjacent box.

Air Quality Improvement Projects in Maine

The truck-rail transload facility in Auburn/Lewiston, ME was completed in 1994, the first project to take advantage of ISTEA funding for freight terminal purposes. It is a two-track rail and container storage area and involves cooperation of St. Lawrence & Atlantic Railroad. The transload facility re-directs substantial truck traffic to rail by providing 36-hour service between Auburn and Chicago on intermodal trains. Three other intermodal facilities in Maine have been completed or under construction in Eastport (for construction of a floating concrete cargo pier), Presque Isle (a two track transload facility with container storage area) and Waterville(a transfer facility including container storage and staging areas.) As Southeastern Maine is an air quality non-attainment area, these projects are expected to reduce vehicle miles as intermodal rail is substituted for the linehaulservices.

Highway Congestion Mitigation

One of the objectives of the infrastructure improvement goal is mitigating highway congestion. Measures of program success include reduced truck VMT on major freight corridors; grade separated rail and highway traffic; and improved capacity on congested terminal access roads.

New York's Full Freight Access Program is a key

example of such a program. This is a $300 million program consisting of a series of rail clearance and line improvements adopted by the NY State DOT, the Port Authority, and the City of New York as the most effective and least costly way to reduce trucking congestion and enhancing freight mobility, using a combination of Federal CMAQ funds, state, local and private railroad funds to complete the program (see adjacent box for more details.)

Full Freight Access Program

Red Hook Barge Project This project involves construction of access for cross harbor movement of intermodal freight containers by water ferry. The barge service is expected to replace some 54,000 marine-related truck trips per year from the regional highways, as it offers an alternative to drayage moves of containers.

Howland Hook Container Terminal, Staten Island, New York - Rehabilitation of this marine facility has been completed, and include channel and berth dredging, an off-dock rail connection, a new electrical system, drayage, yard paving, and repairs of the wharfarea.

Staten Island Railroad Revitalization - This project included rehabilitation of 10 miles of track on the north shore and 5 miles of track in New Jersey. The railroad will connect Staten Island with Conrail main routes. The City of New York bought abandoned tracks from CSX for $10.3 million and the NYDOT bought the 5-mile track on the New Jersey side.

Harlem River Yard- The construction of this facility, located on the Southern tip of the Bronx involves a 28-acre intermodal facility, which will connect to Oak Point Link and to Metro-North and Amtrak railroads. This project complements the clearance improvements made as part of the future terminals on the Brooklyn waterfront and on Long Island.

Oak Point Link - This new rail freight line along the Harlem River provide access to New York City and Long Island and will improve vertical clearance to trailer on flatcar rail service.

The Alameda Corridor freight project is another prominent example of physical infrastructure improvements undertaken to relieve freight-related highway congestion (see adjacent box for more details.)

Alameda Corridor

This corridor will link the Ports of LA and Long Beach to downtown rail yards and consolidate the operations of the three freight railroads that serve the harbor. Burlington Northern Santa Fe (BNSF), Union Pacific, and Southern Pacific, who currently utilize four separate routes consisting of 90 miles of track, upon completion of project will shift to a single 20-mile, high-capacity, below-grade trainway. The construction will eliminate over 200 grade crossings, widens and improves the adjacent major highway. On-dock railyards will reduce the need for trucks to haul intermodal containers several miles between each port and the railyards. Ten miles of the corridor will be built below grade in an open trench along the Alameda Street, eliminating all at-grade rail crossings. All at-grade rall lines will **be** replaced with a below-grade corridor. The project is designed to mitigate the impact of the containerized internationaltraflic transferring through the San Pedro Ports, reducing delays, emissions and congestion. The project is anticipated to be completed in theyear 2001.

The Arizona & California Railroad Container Loader in Blythe, California is another example of highway improvement projects with congestion mitigation impacts (see adjacent box for more details.)

Arizona and California Railroad Container Loader, Blythe, CA

This facility was completed in 1994 and involved the construction of an intermodal facility for loading containers from trucks onto railcars. The project reduced the number of truck trips to and from Southern California seaports by moving containers carrying hydraulically compressed hay by rail. Truck traffic reduction, air quality improvements, and reduced fuel use were the primary benefits from the container facility. An estimated 2500 trucks were taken off the road between Blythe and the Port of Long Beach and the San Diego area.

Grade-Crossing Safety

Reducing risk of incidents involving rail-grade crossing is another outcome of infrastructure improvements in areas of heavy commercial vehicle traffic. The Schiller Park Inter-modal Yard project is an example of projects designed to improve grade crossing safety (See box for more details.)

Schiller Park Intermodal Yard

This intermodal passenger and freight project involved relocation of the Schiller Park yard to eliminate truck-rail conflicts and improve throughput of both freight and commuter rail services. Container trucks now regularly cross the main line to access container storage. The project will pay to move the Canadian Pacific rail tracks to the other side of the main lines, removing conflicts with the commuter trains. A new main track will be provided for the intermodal yard. Enhanced safety and greater throughput will be some of the benefits to CP and Wisconsin Central. Signal and track improvements are also among the payoffs of the project.

Port Access

Capital expenditures by the U.S. ports between 1993 and 1997 amounted to $5.5 billion. More than half of the expenditures were for improvements on container handling docks, 10 percent for dredging, and the remaining for general infrastructure improvements or bulk cargo facilities. Access to on-dock rail facilities is among key service features sought by container carriers when deciding which ports to call at. Port of Seattle terminal improvement projects are good examples of port efforts to improve access infrastructure, using a mix of public and private funds (see adjacent box for more detail.)

Port of Seattle Terminal Improvement Projects

These are three on-dock terminal improvement projects. The first site is the SW Harbor #5 on-dock terminal involving roadway, railyard, and shoreline mitigation measures. The on-dock facility is designed to move containerized cargo directly onto railcars located in the deep water port terminal, bypassing the need for truck moves to off-dock railyards several miles away. The project also includes construction of a new grade-separated over the rail line to Terminal 5. The second site is the Harbor Island Terminal #18, another on-dock rail facility involving construction of an arterial overpass of the rail lines to separate doublestack rail traffic from the land-side traffic. The third site is the Immunex Project at Terminals 88-91 designed to improve access to the port by constructing grade separated rail, truck, auto, and pedestrian/bicycle access.

Invest in Advanced Communications Technologies

Communications was formerly subordinate to the transportation infrastructure of the time. Written correspondence had to be carried on the transport infrastructure from sender to recipient. It was not until wireless broadcast of voice and visual signals revolutionized the scope of communications, that communications become independent of transportation. Today we're witnessing a reversal. Transportation is becoming increasingly dependent on information and communications.19 The coupling of communications and transportation has allowed efficiencies to be introduced that never existed before. The new systems make the entire transportation chain more "intelligent," so that service providers are able to reduce costs, operate effectively with reduced labor inputs, and move at faster speeds with greater safety.

Advanced communications technologies have greatly improved the efficiency of commercial transactions, improved service and safety, and reduced the costs of regulatory compliance. Enforcement of government safety and credentials regulations, for instance, imposes an economic burden that could be reduced without compromising safety or regulatory compliance. Currently, long-haul trucking operates under a series of federal/state/local regulations relating to cargo weight, fuel taxes, fuel usage, safety, driver performance and working hours, licensing, and registration. These result in numerous stops at roadside inspection sites in the course of the journey, some of which could be reduced.

ITS/CVO technologies offer an effective way to reduce the costs of regulatory compliance while ensuring that the safety and administrative objectives are realized. It is estimated that motor carriers spend one half a billion dollars per year simply to collect and report vehicle mileage and fuel usage data for tax reporting purposes.20 The National Informatin Infrastructure (NII) is an enabling public infrastructure that has the potential to improve service, cost, safety, and efficiency, while lessening adverse environmental impacts of motor vehicle use. The benefits envisioned in the Strategy from investment in advanced communications technologies include integration of NII with the physical freight movement infrastructure, creating:

> *. ..a society infused with information systems that not only connect all modes into one cohesive system, but also link transportation to National Information Infrastructure.*

The programs promoting this vision and funded in the 1992-1997 ISTEA authorization are included in Table 4-2.

Table 4-2
Advanced Communications Technologies
Program Components And Funding Levels

OBJECTIVES/IMPACTS	ISTEA PROGRAMS	FUNDING LEVELS **Total: $143.9 million** **Federal: $111.2 million**
1- Promote linked CVO databases to integrate NII systems	CVISN[21]	Total: $19 million Federal: $19 million
2 - Promote automated safety inspection for greater safety and reduced compliance costs	Pen-based MCSAP Station[22], Automated OOS[23], ISS/SAFER[24], 3 Other Projects[25]	Total: $ 11.4 million Federal: $9.6 million
3 - Promote electronic border crossing for greater global trade benefits and national security	Electronic Clearance for International Borders[26] (Otay Mesa, Detroit/Buffalo, Nogales, Santa Teresa)[27], and BTEP[28]	Total: $20.3 million Federal: $19.9 million
4 - Promote automated purchase of permits and toll payment to reduce regulatory compliance costs	Advantage I-75[29], HELP, Inc.[30] AMASCOT[31], Oregon Greenlight[32], 4 Other projects[33]	Total: $64.4 million Federal: $48.3 million
5 - Promote automated train safety and HM Incident Response to imorove safety	ATCS(Wasb/Oreg[34] and ITS/Grade-crossing[35]), Operation Respond[36], NIER[37], and DIAP[38]	Total: $28.7 million Federal: $14.2 million

Linked Databases

As an integrating mechanism, the Commercial Vehicle Information Systems and Networks (CVISN) project is designed to demonstrate the institutional arrangements necessary to allow real-time access to commercial vehicle operations (CVO) information systems. This will allow truck safety inspections, automated licensing and permitting, and emergency response to take place in real time, and with access to all relevant sources of information. Future benefits from CVISN relate to the potential for the development of a private market for access to information valued by commercial operators. A critical mass of participating operators thus linked through a network of databases, promises important private sectors applications.

Electronic Roadside Safety Inspection

These projects account for $11.4 million in public and private outlays for operational tests and deployment activities, including automated pen-based MCSAP stations, brake inspection technologies, and out-of-service order verification tests, as described in the adjacent boxes.

Automated Pen-based MCSAP Stations

By Congressional mandate, 200 MCSAP sites are to be upgraded to provide real-time roadside access to national safety rating information. Currently more than 500 pen-units and hundreds of copies of the ASPEN/ISS software are in use, providing close to real-time access to tbe latest inspection data. Mobile and stationary inspectors, equipped with a lap-top or pen-computers, have improved inspection speed and national database accuracy. Access to Safetynet data, CDLIS, and ASPEN/ISS for selecting inspection targets is a critical component of the automated **sites.** Pen-based and other portable computer have the capability to load the DOS or Windows version of ASPEN/ISS software and access carrier/vehicle records for automated inspection selection and database upload.

Automated Brake Inspection Technologies

Two of these technologies for detecting brake defects have been successfully tested and are in deployment phase in Maryland and Colorado. The tests demonstrated that the accuracy and efficiency of roadside inspection stations can be increased if automated technologies are deployed to detect brake defects.

Idaho and Minnesota/Wisconsin Out of Service (00S) Verification Tests

The Idaho project tested the automated methods of checking compliance with the state 00S orders, using automatic download to the Idaho Safetynet from pen computers. The test demonstrated the use of AVI tags, VRC systems, and pen-based computers, and allows for expansions that include connection to external databases.

The Minnesota/Wisconsin test created an automated and real-time database linking the 00S orders between the two states. Using imaging technologies, tbe project also tested installation of license-plate scanners at three Wisconsin and one Minnesota sites which form a "detection corridor" along west-bound I-90/94, providing instantaneous access to any 00S order relating to a vehicle.

Electronic Border Clearance

A number of projects have tested the application of ITS/CVO technologies to streamline land border crossings at the northern and southern borders of the U.S. with Canada and Mexico. Several successful border crossing projects designed to enhance the flow of goods at the NAFTA borders are outlined in the following boxes.

US Customs Border Crossing Prototype

A notable initiative for the use of advanced communications technologies to facilitate the flow of commercial vehicles is the U.S. Customs Service's North American Trade Automation Prototype (NATAP). The prototype has developed common data elements and processes incorporating EDI, radio frequency identification (RFID), and Vehicle Roadside communications technologies (VRC) to process commercial cargo shipment data at the Canadian and Mexican land borders. By automating data transmission to obtain cargo clearance, NATAP eliminates redundant cargo clearance data entry across myriad U.S. agencies and their counterparts in Mexico and Canada. A shipper would transmit shipment information via EDI to a Value-Added-Network (VAN) serving the border agencies, allowing Customs officials to use internal criteria to determine whether the shipper is in compliance with cargo admissibility criteria while the vehicle is still in transit. As the shipment approaches the border, the RFID/VRC reader transmits transaction identifier to the Customs VAN. Upon arrival, the vehicle will receive a green light if clearance is granted, or a red light if there are missing data or need for cargo examination. Field demonstrations of NATAP are conducted at Detroit, Buffalo, Otay Mesa, El Paso, and Laredo.
The U.S. Dot has been coordinating its safety inspection programs at the Canadian and Mexican land borders with the NATAP efforts in order to ensure compliance with vehicle, driver, and carrier safety and credentials requirements while allowing streamlined flow of trade traffic.

Michigan - Ontario -New York International Border Crossing

This operational test is underway along the US-Canada border to demonstrate the automated clearance of commercial vehicles and cargo. The initial test sites are Detroit/Windsor River's Ambassador Bridge, Blue Water Bridge, and Port Huron, Michigan. The system designed will be shared with a similar site in Buffalo, New York. The projects will apply advanced vehicle identification technologies to facilitate the flow of cross-border commercial vehicles, and will involve AVI, WIM, in-vehicle displays, and license plate readers.

Santa Teresa Intermodal Facility

This project is an integrated package with three main components: 1)a border crossing process map that shows the flow of Maquilladora freight shipments in the Santa Teresa vicinity (El Paso and Juarez) involving data exchange among customs services, manufacturing shippers, rail carriers, and customs brokers; 2) a Secure Electronic Commerce system involving safeguards through protecting information by digital signature and encrypted data shared over the Internet; and 3) a Shipment monitoring and Remote Tracking (SMART) system that is physically attached to an intermodal container or trailer to track location and status of the cargo. In the SMART system, the location and sensor status data (such as container internal temperature and door opening/closing) are sent **via** satellite to a ground station that displays the shipment information on digital maps. ATIPE software can **retrieve** cargo location and status information and send **it** through the SEC system so any authorized user can retrieve live shipment information on the Internet. This information is displayed on digital maps, along with estimated time of arrival to given points on its route.

Nogales Electronic Commercial Vehicle Clearance

This field operational test in Nogales, Arizona **is** underway for expediting land border movements of the commercial vehicle carrying cargo from Mexico to the U.S. It demonstrates electronic vehicle clearance, using technologies such as WIM, AVI, cargo seals, License Plate Recognition, and digital photography. The project tests the automated customs release processes in coordination with the two counties' immigration and commercial vehicle safety enforcement requirements. In coordination with the split funding arrangements with the Otay Mesa test, the operational test at Nogales includes only trucks entering the US from Mexico.

Otay Mesa International Border Electronic Crossing

This field operational test at Otay Mesa, California is to expedite cross-border commercial traffic by implementing electronic communication between various stakeholders. It will demonstrate the non-stop container transit from port of Los Angeles to Maquila loading docks, which currently takes 2-5 days. Using the U.S. Customs' prototype, the cargo information is pre-processed and transmitted to the U.S. and Mexican Customs electronically. At the port of Los Angeles, the container is electronically sealed, and the trip itinerary is dispatched to Mexico before the container arrival, allowing a more rapid clearance decision to be made by Mexican Customs officials. Due to the split funding of the southern border test with Nogales, Arizona, the Otay Mesa tests are limited only to trucks going from the U.S. to Mexico.

Electronic Clearance for Regulatory Compliance

More than 650 roadside inspection sites across the U.S. perform motor carrier credential and size/weight checks in addition to vehicle safety inspections. Successful efforts have been made to streamline motor carrier registration, credentials purchase, and regulatory compliance checks. Part of the streamlining efforts includes electronic clearance that allows compliant vehicles to bypass roadside inspection sites. Electronic clearance and computerized purchase of credentials reduce the adminstrative costs of enforcement as well as compliance costs to motor carriers. A number of ITS/CVO operational tests have been undertaken to allow electronic clearance and size/weight checks, including the Help Inc. PrePass, Advantage I-75, and Oregon "Greenlight."

Help Inc., Pre-Pass

This is an automated clearance service provided by Help, Inc., currently in deployment phase. In 1996, more than 10,000 trucks were allowed to bypass weigh stations, thus avoiding the routine delays at roadside inspection sites. Pre-Pass allows the subscribers to be electronically weighed and have their credentials verified at mainline speeds, without any need to stop for routine weigh-station inspection.

Advantage I-75

This is a clearance project designed to provide mainline automated clearance at 29 weigh stations along the 2,200-mile segment of the I-75 corridor from Florida to Ontario' s Highway 401. As vehicles equipped with AVI transponders approach a station equipped with Mainline Automated Clearance System (MACS) and WIM scales, they are identified, weighed, and allowed to bypass if there are no indications of weight or credentials violations. The project is testing the impact on fuel and travel time saving as a result of fewer weigh-station stops.

Oregon "Greenlight"

This is a mainline truck pre-clearance system for the Oregon weigh stations and ports of entry. The system uses an in-ground AVI reader to scan the participating trucks' bumper-mounted transponder, and WIM plates embedded in the roadway to weigh the trucks. A computerized detector mounted on a pole alongside the road measures the trucks' height, while a license-plate reader installed in several stations provides additional means of identifying the trucks not equipped with an AVI.

Advanced Rail Safety and Hazardous Materials (HM) Incident Management Systems

Recent rail accidents have led to concerted attempts to improve rail safety through enhanced radio communication and implementation of automated train control systems (ATCS). ATCS would provide capability for positive train control (PTC) through the use of an on-board computer and communications links to a control center. Under ATCS, the brakes would be applied automatically if **necessary** to keep trains apart, enforce a permanent or temporary speed restriction, or stop a train short of a switch not properly lined for that train. FRA is currently funding several projects on rail safety, including the tests of PTC in Washington and Oregon. Two other safety programs involving rail and highway HM operations are Operation Respond and the Pennsylvania HM fleet monitoring project, as described in the adjacent boxes.

Hazardous Material Fleet Monitoring and Data Management System

This project was a pilot for managing hazardous cargo incidents- It investigated the feasibility of fleet and cargo monitoring in the Lackawanna Heritage Valley in the Northeast Pennsylvania, demonstrating the use of emergency response technologies for identifying the contents, location, and status of hazardous shipments. The test also provided carriers and regulators with real-time visibility of the location of individual containers and vehicles. This pilot project was sponsored by FHWA, the National Institute for Environmental Renewal (NIER), and the Pennsylvania DOT, with a key objective of coordinating with existing ITS technologies and Operation Respond.

Operation Respond

This is a public/private effort to improve emergency response by developing, testing, and implementing a software that creates an interface between a carrier's HM databases and the 911 emergency response dispatch centers. The program improves emergency response time by reducing the first responder notification time, allowing positive identification of the container contents, determining the degree of hazard, and advising on the best course of emergency response. The software reformats information obtained from trucking and rail carriers, creates new screens, and makes the emergency response information more accessible to dispatchers. The project was tested in Houston and Laredo, Texas, and in New Orleans/Baton Rouge, LA. The project involves the cooperation of the U.S. Dot's FRA, RSPA and FHWA.

Advanced Train Control Systems (ATCS) and Positive Train Control (PTC)

ATCS has the potential to replace existing signal and train control systems, resulting in greater safety as well as a more efficient use of existing rail lines. ATCS is much broader than train control, as the ATCS communication platform can be used to replace landlines, carry work orders for placing and picking up cars at shipper locations, report information on the condition of an enroute locomotive to a maintenance facility, and perform other non-safety functions. ATCS and its component PTC can enforce speed and movement restrictions, and eliminate train to train collisions. Currently two projects are underway to test the application s of PTC:

- Washington/Oregon Demo - UP and BNSF are involved in a PTC demo projects in Washington and Oregon on approximately 600 miles of railroad to improve rail grade crossing and reduce disruptions of ferry operations. The PTC system employs GPS to determine train location and speed, using these data to provide real-time train arrival information at major crossings. One of the key features of the project is to use radio communications (both UHF and VHF data) to integrate PTC into current traffic control systems for traveler advisory.
- Use of ITS for Grade-Crossing - FRA is working in partnership with FHWA to evaluate the ITS application of the in-vehicle train warning technologies at grade-crossings. Under the appropriations for next generation technologies, PTC and grade crossing technologies are used to emphasize the linking of the ITS and ATCS in high speed rail systems.

Invest in Advanced Intermodal Interface Systems

Currently a number of freight gateway projects in use or in development are designed to promote new rail, marine and intermodal technologies, and facilitate investment in consolidated hubs, marine terminals, and the joint use of military bases as cargo facilities.

Table 4-3
Advanced Intermodal Interface Systems
Goals, Program Components And Funding Levels

OBJECTIVES	ISTEA PROGRAMS & FUNDINGLEVELS **Total: $1.4 billion** **Federal: $223.8 million**
1 - Promote next generation freight technologies	AHS[39]/AGV, Fast Ship, State-of-the-Art Shipbuilding
2 - Promote consolidated inter-modal rail, water, and air terminals	Alliance[40], CACH[41], NC Global Transpark[42], Regional Hubbing[43] , Stark County[44], Port of Oakland Intermodal Joint Terminal[45] and 34 Other Projects[46]
3 - Promote marine efficiency	CHCP[47], SOCP[48], VTS[49]
4 - Promote joint use of military and cargo facilities	Pease International Tradepor[50], and Rickenbacker Airport[51]

Next Generation Freight Vehicles

A number of freight technologies are currently beight tested or deployed that offer significant economies and improved effkiencies. Examples include Iron Highway, FastShip Atlantic, and automated collision controls used with Automated Highway Systems (AHS), as described in the adjacent boxes.

Automated Highway Systems

Automated Highway Systems (AHS) provide safety improvement opportunities for commercial trucking. Studies by National AHS Consortium (NAHSC) have shown the potential safety and productivity benefits to commercial trucks. One application of AHS to commercial vehicles is for "platooning" trucks. A radar guidance system equips the lead truck with a radar reflector at the rear. The second truck's radar unit would hone in on the reflector controlling its own vehicle's steering and speed. . The military is exploring application of some AHS technologies because a large proportion of the military accidents occur in platoons. Developments in the truck manufacturing industry support the extension of the AHS application to trucks. Given the estimated significant safety and mobility benefits, NAHSC has agreed to incorporate heavy vehicle R7D within the scope of the $160 million federal share of the program. For the 1997 proof-of-technical-feasibility demonstration, trucks are added at no additional cost. A possible application of the AHS program is the automatic vehicle guidance (AVG) features that are capable of guiding trucks through commercial vehicle inspection area or in freight terminal to facilitate intermodal transfers.

FastShip Atlantic

A new generation of containerships is FastShip Atlantic, Inc. Scheduled to begin service between Ports of Philadelphia, Pa. and Zeebrugge, Belgium by June 1988. The vessel will be able to cut transit time for transatlantic journey in half Whereas conventional containerships take 7-8 days to cross the North Atlantic, FastShip crosses it in 3.5 days. The vessel can leave Philadelphia fully loaded, cross the ocean, deliver cargo and load new cargo and return to Philadelphia in just 8 days. The vessel has an average service speed of 37.6 to 42 knots, overall length of 774 feet, and draft of 34'3". The ship will carry 1,400 TEUs, with an annual capacity of 100,000 TEUs per ship deployed. Up to 8 vessels are planned to begin operation in 1998. Au integral part of the ship's high speed design is a proprietary loading and unloading system that double-stacks ocean containers on air-cushioned trains that permits precise and fast port operations. The proprietary system Alieon is based on cranes that allow containers to be loaded and offloaded at a rate of 1,000 per hour. This represents an S-fold improvement over the normal crane speed. Introduction of FastShip to Philadelphia has involved an investment of an $80 million terminal by the Delaware River Port Authority, serving as FastShip's exclusive North American hub. One major attraction of tbe new technology is for high value, time sensitive cargo which has traditionally used air as the preferred mode. Because the ship uses gas turbines, it produces less noxious fumes than the common diesel engines, thus favored for its air quality benefits as well as speed.

Iron Highway

Iron Highway prototype consists of a 1,200-foot long continuous platform capable of handling any combination of trailer lengeth, moving as many as 40 trailers at a time. CSX Intermodal, along with New Your Air Brake have completed c commercial pilot t est of the prototype on the CSX rail system between Chicago and Detroit. A joint marketing effort with Canadian Pacific is planned for the Montreal-Toronto corridor. The equipment is designed for shorthaul markets that cannot efficiently be served by doublestack trains.

Consolidated Freight Terminals

Investment in freight terminals accounts for only a small share of freight-related infrastructure projects funded by ISTEA. Lack of readily available public sector funding for freight terminal projects is partly due to the private nature of many freight terminal operations. There is also reluctance on the part of the private owners to seek public funding for such projects, given the actual or perceived strings attached, and the lengthy process of seeking the required funding. A major accomplishment of ISTEA however, has been to facilitate the joint funding of multi-modal freight terminals and cargo handling facilities. Examples of multi-modal freight facilities include Alliance Airport, North Carolina Global Transpark, Stark County intermodal terminal, and the Port of Oakland Joint Intermodal Terminal, as described in the adjacent boxes.

Alliance Terminal

This 20,000-acre facility has been operational since 1989. It began with FAA asked for the donation of 418 acres to build an airport to complement DFW airport. Since operation, the airport has attracted a variety of industrial sites. American Airlines has a maintenance facility which also serves at the new base for DEA's fleet of 44 planes. BNSF built a rail yard next to the airport for rail-truck container interchange. The rail access enticed Ford Motor and Food Lion companies to construct major distribution centers there. Nestle also built a distribution facility, and Federal Express build an air freight center close to the airport Zenith relocated from Chicago, and Nokia, the cellular phone manufacturer has a work force of 2000 people

North Carolina Global Transpark

This project involves an industrial complex designed to link the Research Triangle with available regional freight infrastructure. It is a manufacturing and distribution facility as well as a multimodal freight terminal housing a cargo airport, the Morhead City Port, Norfolk Southern and CSX railroads, and the interstate Highway 70. The existing runway will be lengthened to 10,500 feet. FAA contributed the existing airport facilities as well a grant for the initial Environmental Impact Study. Tenant facilities are under construction.

Stark County Intermodal Terminal

This project was constructed in Stark County, Ohio to facilitate the loading and unloading of truck trailers and containers onto rail flat cars. The terminal serves as an interchange point for Wheeling & Lake Erie Railroad and drayage trucks. The project increases rail freight capacity and reduces truck traffic through Ohio non-attainment areas. User fees of $10 per truck charged for off-loading containers and trailers will be used as a dedicated revenue stream to payback the revolving loans used as part of its financing.

Port of Oakland Joint Intermodal Terminal

This project expands and improves the existing Port of Oakland intermodal operations of SP and UP and BNSF by consolidating their activities into a single, jointly operated terminal. It converts the U.S. Naval Supply Center yard to civilian use, providing additional capacity for commercial operations while allowing for continued military overseas deployment efforts. The joint terminal provides access to freeways, rail service, and adequate loading and parking capacity for expansion of both international and domestic container trade. The ship to rail facility consists of a near-dock seaport intermodal terminal for transfer of containers between rail and ship. Competition between the three railroads provides efficient services for the domestic portion of the container moves. The terminal will incorporate state-of-the-art electronic and satellite technologies.

Two examples of consolidated freight hubs are the United Postal Service Chicago Area Consolidation Hub (CASH) and Air Freight Regional Hubbing Facility in Columbia, SC., as described in the adjacent boxes.

Chicago Area Consolidation Hub (CACH).

CACH functions as a national consolidation point for handling the UPS domestic package volume. The adjacent BNSF facility will be used as the rail connection for intermodal shipment of the UPS trailers. UPS has initiated road and rail improvements at the Willow Springs BNSF railyard and is also building a number of other interchanges. The project is a model of how modem high-tech infrastructure improvements are made possible with joint efforts and solid planning. When operating at full capacity by 1997, the yard will be the world largest package distribution facility with some 4,000 employees, processing some 3 million packages per day

Air Freight Regional Hubbing Facility, Columbia, SC

This completed project involved installation of an air freight regional hubbing facility for UPS at the Columbia Metropolitan Airport. As freight arrives by truck and plane, it is tugged to a sorting facility, sorted, and distributed by air and road across the southeast region and beyond. The project included an aircraft parking apron for 14 DC-8 aircraft, a bridge of trucks and tugs, a vertical depression of SC-302 *to* separate local traffic from trucks, and a sorting facility.

Marine Operations and Safety

A number of public-private projects have applied advanced technologies to streamline the federal maritime regulatory functions, coastal waterways safety and rescue operations, and commercial vessel operations. The Maritime Administration's Cargo Handling Cooperative Program (CHCP) is among the successful ventures involving public and private funding efforts, as described in the adjacent box.

Cargo Handling Cooperative Program (CHCP)

CHCP is a partnership designed to foster research and technology development by U.S. flag carriers. The program is administered by an executive committee made of representatives from the Maritime Administration, US DOT, American President Lines, Ltd., Crowley American Transport, Inc., and Matson Navigation Company. The program calls for improvements in cargo handling technologies relating to a) identification and prototyping of new technologies for container-chassis mating; and b) testing new technologies related to hand-held computers, electronic seals, tire maintenance and repair, overweight containers, and container stowage planning. Funding for CHCP is through Federal Maritime Administration (MARAD) and the private participants. In the five years since inception, $200,000 per year in Federal funds have been available, plus contributions from the three steamship companies APL, Matson, and Crowley American. Ports serving as test sites for these technologies are:

- **Port of Oakland, APL Terminal -** In 1993 the CHCP began a proof-of-concept project to test if differential global positioning systems (DGPS) technology could be used to accurately locate shipping containers under real terminal operating conditions. As Maston Navigation Co. and APL were using Automatic Equipment Identification (AEI) tags on many of their containers and chassis, the project designed an equipment location system (ELS) to integrate the operations of AEI systems used at these carriers gate, on cranes, and in a Mobile Inventory Vehicle (MIV). ELS would automatically identify tagged containers and chassis and related each to its slot location within a terminal. The system was developed for use in the wheeled storage area of a terminal, where companies have the least control over actual equipment placement and would realize the greatest benefit. The centerpiece of ELS was an MIV featuring AEI tag readers, a DGPS receive, an ultrasonic ranging device, a wireless local area network communications system, and an onboard computer. The test involved the MIV driving through the wheeled areas of a terminal, conducting the inventory check, collecting the identification and location data, processing these data, and transmitting them to the base station. MIV **is** able to create an accurate map that indicates the occupancy state and identify of each parking slot. The sonar ranging system provided the mobile processor with an electronic map of the container row. MIV used this information, combined with GPS data to calculate occupancy of the slots. The base station displayed the information in a graphical map-like view of the yard. Tests revealed that ELS can accurately identify and locate containers and chassis within +/- one slot of their true positions at least 99.4 percent of the time. This performance met the criteria for proof of concept.

- **Port of Jacksonville Test Site -** Crowley American Transport, Inc.'s terminal at Port of Jacksonville was the site to test video cameras and automated character recognition technologies, as accurate identification of containers is a major objective of CHCP. Currently, manual method of identification is the most common, as the use of RF tags and readers is not widespread. in January 1996, the port began experimenting with a video container recognition system to identify and locate containers. The high definition cameras read the number located on the side and back of a container and chassis. The images were then collected and passed on to a verification workstation that used character recognition algorithms to identify the numbers. This allowed the movement of the container within the terminal to be easily tracked. The project is currently focusing on refining the capture and recognition methods used for container identification.

Ship Operations Cooperative Program (SOCP) is another example of successful application of advanced technologies to marine terminal operations, as described in the adjacent box.

Ship Operations Cooperative Program (SOCP)

SOCP was formed in 1993 for the purpose of carrying out cooperative research that would not be economically feasible on an individual basis. The full members are MARAD, three ship operating companies (ARC0 Marine Inc., Energy Transportation Group Inc.; and Sea-Land Service, Inc.), National Oceanic and Atmospheric Administration (NOAA), the U.S. Coast Guard, and the Gulf Coast Region Maritime Technology Center The Cooperative also has a number of associate members, including the American Bureau of Shipping, the Military Sealift Command, Boeing North American, Inc., and BP Oil. The funding is provided through member contributions. Some of the activities of SOCP include:

Vision Enhancement System - SOCP is sponsoring a project to test and evaluate a new vision enhancement system called Micro-FLIR (Forward Looking Infrared) Thermal Navigation System ('INS). The product is especially helpful in fog, enhancing navigation on board a ship. Northrop Grumann conducted the initial SOCP sponsored FLIR test on the Sea Land Kodiak sailing between Seattle and Anchorage. A thermal imaging camera was mounted aboard the vessel and its ability to recognized objects ahead during all kinds of weather was recorded and analyzed. Several other tests of FLIR between September 1994 and Feb. 1996 indicated that under a variety of weather conditions FLIR could identify barges and buoys in the harbor area at night, heated tanks on an oil tanker, oil rigs, and ice floats well ahead of the ship at night.

RAM/SHIPNET Database - SOCP has developed a network of databases called RAM/SHIPNET to improve the total life cycle of ships in terms of cost effectiveness, reliability. Also developed are DATE, a shipboard data entry and collection program; SHIPPER (ships performance review) for program analysis; and SPIN (ships performance indicator) for shoreside fleet-wide comparative analysis. The US Coast Guard plans to use the SHIPNET database to revise its regulatory requirements. SHIPNET is also being used by classification societies such as ABS and Lloyd's Register for investigating using equipment failure history data to assist them in improving their classification rules.

Risk Assessment Model - SOCP is applying a risk-based assessment methodology to determine a cost effective alternatives through which owners and operators can comply with regulations without compromising safely or the environment. The process of evaluating the alternative remedies includes sensitivity analyses of safety and environment, recognition of appropriate international standards, and an analysis of the impact on the corporate balance sheet. Examples of regulations assessed include the study of the Official Log Book, that examines the need for maintaining specific entries as required by law, its usage, any safety enhancement features, and costs of upkeep. Effective Navigation Watchkeeping is another example of efforts to integrate personnel and technology to optimize safe navigation, using Electronic Chart Display and Information Systems. The purpose of this system is to achieve effective maneuverability on the bridge using new technologies and using anti-collision devices. Base on these studies, alternative approaches to regulations with high compliance costs are suggested.

Hand Held Computer Applications -This project carried out a limited feasibility study of the potential application of hand-held computes to replace current paper-based shipboard data collection and log keeping processes. The study also investigated legal issues related to the implementation of such a technology. The study concluded that **hand-**held computers, used in conjunction with a shipboard data management architecture could substantially improve data accuracy and timeliness of reports. The study also showed that there are no Federal statutes, rules. or regulations that preclude the use of digital media as a substitute for the paper log.

Vessel Traffic Services (VTS) is another example of the application of advanced technologies to marine transportation, as described in the adjacent box.

Vessel Traffic Services (VTS)

VTS is the principal form of traffic control used in maritime commerce, providing information needed to improve navigational safety and efficiency VTS is an interactive, shore-based waterways management and communications system. It helps determine the presence of vessels in and around ports, and provides information to vessels on such matters as traffic, tides, weather, and port emergencies. It is usually augmented with surveillance equipment (principally radar) for acquiring data on the position of vessels and traffic flow. The U.S. Coast Guard has installed and operated VTS in 8 major ports (in ports of New York, San Francisco, Houston-Galveston, Puget Sound, Valdcz, Alaska, Morgan City Louisiana., Louisville, Kentucky.; and Sault Sainte Marie, Michigan.) The Coast Guard is paying a total of $19 million in operational and maintenance costs in FY '95. Ports of Los Angeles/Long Beach, and Delaware Bay operate VTS-like private systems at costs of $1-4 million and $345,000, respectively. The Oil Pollution Act of 1990, passed in the aftermath of the 1989 Exxon Valdez oil spill, called for a needs-assessment to establish the benefits in collision and spill avoidance of installing VTS at other ports. The Coast-Guard proposal for expanding VTS to 17 new ports, called VTS-2000, is estimated to cost betweenS260 million and $310 million in federal funds to build, and would cost $42 million in federal funds to operate. each year if installed at all 17 ports. These costs were based on upgrading 5 existing CG systems, converting two private systems, and adding 10 ports with no existing VTS systems. The benefits of the new systems ranged frorn $253.7 million (for a new VTS in New Orleans) to net benefits of $92.4 million, and $48.1 million for installing new systems in Port Arthur, Texas and Mobile, Alabama The assessment, however showed negative net benefits for expanding the existing private systems in Philadelphia and Baltimore (that has a radio-based, non-radar system); or installing new systems in ports such as Providence, RI., or Long Island Sound, N.Y. Another report on a study of the VTS-2000 concluded that there is compelling national interest in protecting the environment and in providing safe waterways and ports, and that accuracy and availability of traditional and advanced navigational aides, nautical charts, and real-time hydrographic and meteorological data are critical to ensuring them.

Joint Use of Military and Cargo Facilities

Trends in defense conversion in the past few decades have given rise to conversion of several military bases to civilian freight-related uses. Pease Air Force Base is one example of such a conversion. Rickenbacker airport is an example of a joint-use reliever cargo airport. The two facilities are described in the adjacent boxes.

Pease International Tradeport

In 1992 the Department of Defense transferred more than 1,700 acres of the former Pease Air Force Base to the state of New Hampshire, to be operated as a high technology commercial park by the Pease Development Authority (PDA). Currently the U.S. Department of State has established National passport and Visa Centers after a $5 million refurbishment. New Hampshire Air National Guard's 157th Air Refueling Group, originally co-located with the Air Force, provides airfield services such as tower, weather, and the Aircraft Rescue and Fire Fighting Unit. Emery Worldwide provides direct cargo service daily out of the airport, and Phoenix Air Transport plans to begin cargo service to the Eastern Rim in the near future; and Seacoast Aviation offers services to private and corporate aircraft owners. Infrastructure improvements have been funded through the U.S. Department of Commerce's Economic Development Administration and the FAA. Other private investments include a $30 million, 63,000-square-foot manufacturing part constructed by Celltech Biologicsa of the United Kingdom.

Rickenbacker Airport

Rickenbacker is a joint-use reliever airport specializing in air cargo. Currently 8 airlines conduct scheduled and chartered operations here. The airport provides a low-cost, efficient alternative **to** traditional North American gateway airports. The overall cost of moving air cargo through Rickenbacker is 50% less than New York' s JFK, 45% less than Atlanta' s Hartfield, and 35% less than Chicago' s O' Hare. Part of tbe cost savings are due to less congestion at Rickenbacker. Central location of Columbus contributes to the strategic position of the airport. The central Ohio location provides direct access to 50 percent of the population of the U.S. and Canada and some 60 percent of the consumer markets. The airport serves as the reliever airport with a 2,000 acre Foreign-Trade Zone, and is pivotal point of the Greater Columbus Inland Port. The airport is dedicated to cargo and distribution operations, has two parallel 12,000-foot runways capable of landing any size aircraft 24 hours per day. Air National Guard and other military and general aviation facilities are located at the airport. Since 1992, Rickenbacker has experienced rapid growth, with some 6.8 million square feet of new construction. More than 38 companies, $330 million in private investments, and 5,600 permanent jobs are supported by the airport. Air cargo activity grew by 18 percent in 1995 compared to the previous year, and quadrupled since 1991

5 - PERFORMANCE EVALUATION AND NEAR TERM INVESTMENT STRATEGIES

The next steps in the development of an investment plan are to address the process of evaluating the performance of the implemented strategies, assess the extent to which the goals of *Enhanced Freight Gateways Initiatve* have been achieved, and recommend future funding given the outcomes.

Performance Evaluation

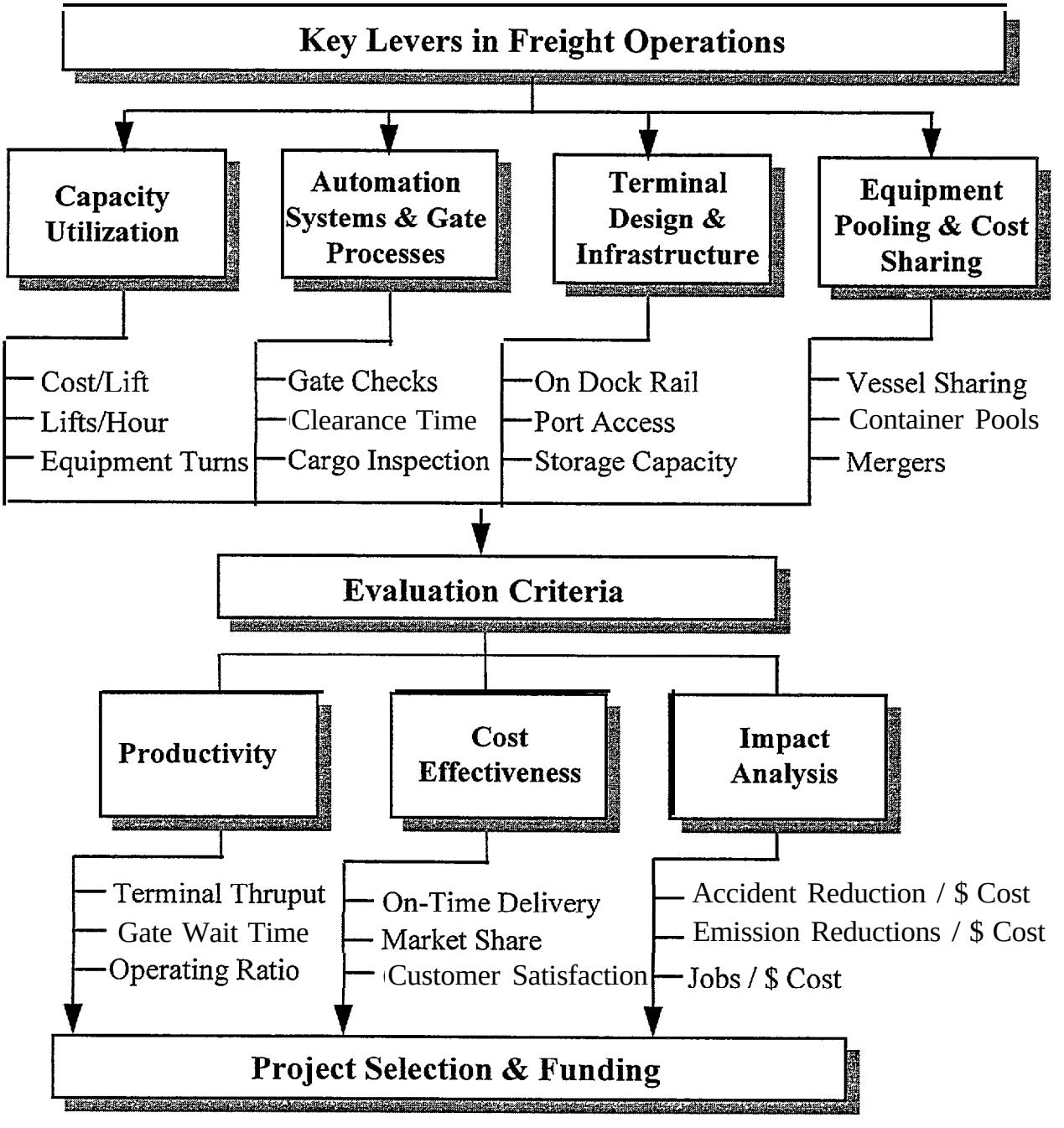
To evaluate the performance of the projects funded through the public-private investment efforts documented in this report, a number of steps are involved, including:

- Collect data on the performance measures designated for the implemented projects (See Section 3);
- Identify the key levers and action items that link project objectives to outcomes;
- Determine the gaps relative to the benchmarks established relative to mobility, air quality, and other NSTC performance goals;
- Determine the evaluation criteria. These criteria will be used in project selection, and include methods such as cost effectiveness, benefit-cost ratios, or impact analysis;
- Evaluate outcomes. This involves asking questions such as: have the projects succeeded in achieving the goals of greater freight mobility and international competitiveness?
- Develop near- and long-term investment strategies in Iight of the evaluation outcomes.

Figure 5-l illustrates the steps involved in performance evaluation, project selection, and funding decisions.

Figure 5-l

Evaluation Criteria Linking Levers to Project Selection



Near Term Funding Strategies

The preceding section described the scope of the freight gateways improvement projects funded subsequent to the ISTEA authorization. This section charts out a funding strategy for the upcoming transportation bill. Note that the projects reviewed here have been jointly built with public-and private funding. Funding information is preliminary and is included only to the extent that the information was readily available. Private freight terminal investments that did not involve public funding are not included here. With only a few noted exceptions, the public funding included federal as well as state and local funding.

A total of $4.8 billion was documented to have been spent on freight gateway projects. The known federal share of the outlays was $1.1 billion (24 percent.) The federal share of the projects is understated here because the compendium that documented many of the projects did not specify the federal share when the exact dollar amount of the contribution was not known (Table 5-l).

Table 5-1
Investment Outlays to Date

GOALS	INTENDED IMPACTS/ OUTCOMES	FUNDING TO DATE Total: $4.8 billion Federal: $1.1 billion
Improve Physical Infrastructure	Mobility, Air Quality, Access and Terminal Throughput	Total $3.3 billion Federal: $840 million
Promote Advanced Communications Technologies	Network Connectivity, Safety, Regulatory Efficiency: and Access to Real-time Data	Total: $143.9 million Federal $11.2 million
Promote Advanced Intermodal Interface Svstems	Economic Competitiveness, Productivity, and Efficient Facility Use	Total: $1.4 billion Federal: $223.8 million

1 - **Physical Infrastructure** - Investments in freight infrastructure projects totaled $3.3 billion. The federal share of these projects was estimated at $840 million, or 26 percent of the total. The projects included bridge and tunnel access rehabilitation, highway access improvements, terminal structure and layout improvements for improved container flow, and port access improvements. Again, the federal share is understated in cases where information on full costs was not available.

Near term funding strategies of these programs are as followed:

- **Continue to Invest to Improve Highway Access and Bridge and Tunnel Clearance** - Unmet needs for access improvements to freight facilities remain. With the NHS funding mandates, freight-related access programs should continue to receive the required outlays.

- **Continue to Invest in Highway Congestion Mitigation Projects** - The congestion reduction impacts of many infrastructure improvements are not always readily identifiable, and often require elaborate

computerized simulations. In many instances, the problem lies not directly at the congested segment of the roadway, but rather with the pre-congestion sources upstream. Access improvements should be combined with strategies for traffic diversion, improved vehicle performance, and mode substitution.

- **Continue to Invest in Projects that Improve Air Quality** - Project selection models should be employed that incorporate external benefits from air quality improvements in the selection algorithm. Air quality improvement often result indirectly from the mix and volumes of traffic, and a combination of factors relating to facility access, congestion levels, and terminal throughput. As basic infrastructure access needs are met, projects with less obvious benefits would need to be prioritized. Increasingly, the investment decision will hinge on a choice among modes. When promoting goals such as safety and emission reduction, the performance record may result in giving preference to rail- or water-based projects.

2 - Advanced Communications Technologies - Investment in freight related information systems totaled $144 million, with $112 million (78 percent) in federal outlays. The projects included the CVISN shared databases, operational tests of hardware and communications systems at freight gateways, automating motor carrier safety and regulatory compliance checks, and electronic clearance across state lines and international land-borders.

- **Continue to Invest in Information Networks and Linked Databases** - The ongoing efforts with CVISN are only at the beginning. Near term improvements in cargo movement are fundamentally dependent on the information infrastructure. Without a complementary information infrastructure, any meaningful system-level improvements in transportation would be impractical. The great payoff in the next two decades will be in the opportunity to leverage the improvements in existing physical freight infrastructure with enhancements through imbedded information technologies.

- **Attempt a Two-Way Learning Mechanism to Make the Findings of the Operational Tests Accessible to A Larger Audience** - Much new knowledge is created as part of the on-going technology application tests. The lessons learned, however, are often one-way, obtained by the researcher from the user data. As trade is essentially a private activity, the flow of information on commercial technology issues has so far been only from the private sector to the public. To achieve the goal of improving global competitiveness, we need to learn from the results, and communicate back to the private sector what w have learned.

- **Investigate the impact of VANS and the Internet** - The impacts of the expanded markets for the services of value-added networks and the Internet are not fully known. We need to explore the broader implications of these systems. So far the federal concern has only been for the data security issues. The larger issue is how such a system would impact fleet management and freight marketing and dispatching operations. The impact of the Internet on networked systems such as the CVISN should also be investigated.

- **Take the Application of Information Technology to Transportation to its Next Frontier** - At the intersection of transportation and information technologies there are opportunities that never before were available. The new technologies allow us to create a world of complementary information and transportation. As one researcher framed it, the changes in this new world go beyond differences in degrees: they are differences *in* kind. The next major frontier is the integrated communications and transportation infrastructure that makes possible benefits that are far greater than estimated before.

3 - Intermodal Interface Facilities - Investment in rail, truck, port and air facilities to improve the intermodal interface amounted to $1.4 billion, with $224 million (16 percent) the federal share. The bulk of public spending for these projects was from local and state federal outlays, with relatively minor federal contributions. These types of projects include primarily private facilities, such as rail terminals, cargo consolidation hubs, and cargo airports. As the impacts of such investments are better understood, and the benefits are more systematically quantified, greater justifications for continued funding will be found.

- **Continue to Fund Joint Facilities and Cost-Sharing Alliances** - Vertical or horizontal integration of the transportation service chain is a key factor in achieving productivity improvements, as demonstrated by the recent wave of mergers. Alliances and joint terminal operations and equipment use can achieve many of the productivity gains without shared ownership. Of key importance here are centralized planning and streamlining of processes. The ultimate benefit from these alliances is that they reduce uncertainty and help carriers and facility operators stay competitive.

- **Fund Termiuai-Level Productivity Improvements** - Consolidation and vertical integration alone will not promote a more efficient freight system. What is needed are value-adding improvements that improve cycle times, productivity, and capacity. Such terminal improvements correct for the existing inefficiencies in the modal infrastructure, and create more productive intermodal facilities.

- **Fund Consolidated Hub Operations and Shared Databases to Achieve Greater Market Density** - Facilities such as the UPS Chicago Area Consolidated Hub are important investments for ensuring greater network density. Developing shared networks of the region's schedules and services are also critical to origin-destination control. Disclosure of information between actors, however, is often problematic, making joint operations difficult. The challenges faced by such cooperative ventures relate to coordination of diverse and community objectives. The lengthy processes involved in seeking joint funding for the Alameda Corridor project is one example of the difficulties involved in funding a multi-beneficiary project. This so called "bootstrapping" challenge applies to funding of joint infrastructure projects, as well as of information systems. The federal role in removing some of these obstacles can be significant.

ENDNOTES

1 Megaships are defined as containerships with TEU capacity of 4,500-5,000. Post Panamax container vessels are so named because these vessels are either too wide or too large to go through the Panama Canal. These vessels can hold more than 5000 TEU. or 20 percent more containers than the vessels normally in traffic until this decade.

2 Electronic commerce (EC) is doing business using EDI, e-mail, world-wide web, on-line systems, and even voice mail. The difference between ED1 and EC is that EC represents the maturation of EDI, by changing the front and back end of international trading. Rather than just a paperless method, EC represents broader capabilities, dealing not just with data but with information and analysis.

3 Of the $441 billion that the nations businesses spent on their freight bill, more than $348 billion (nearly 80%) was for all-highway truck shipments, $34.4 billion for rail shipments. $22.2 billion for water shipments, and $18.9 billion (4.3%) for air cargo. truck

4 As delineated in the NSTC's Interagency Coordinating Committee on Transportation R&D. The committee is composed on representatives from the Department of Commerce, Defense, Energy, and Transportation, the Environmental Protection Agency, and the National Aeronautics and Space Administration.

5 The Information Technology Management Reform Act of 1996 (ITMRA) is designed to ensure that information technology acquisitions support agency missions developed pursuant to GPRA. ITMRA also requires a performance-based planning, budgeting, and management approach to the acquisition of capital assets. GAO recently released a study *(Budget Issues: Badgering for Federal/ Capital* , November 1996) recommending that OMB continue its focus on fixed assets. Since 1994 , OMB has devoted attention to improving the process of planning, budgeting, and acquiring capital assets.

6 Total $19.8 M; Federal $2.3 M (CMAQ, HUD, EDA); State; and Local. Individual Cost for the four projects were:

Auborn/Lewiston: Total 3 m; federal $2.3m (CMAQ);City of Auburn (0.6 m); private rail track work (0.2m); CN provided additional woking capital; St. Laurence & Atlantic Railroad provided working capital to fund the start of the terminal operation and then leased the terminal to the City of Auburn.

Presque Isle - Total cost is $3.8 million: Federal - HUD grant of $2.75 million; State - general fund bond of $1 million; Local - City of Presque Isle funds.

Port of Eastport - Total cost was $13 million, made up of Federal EDA funds and State general bond funding.

Bangor Intermodal Facility-The new lift will be leased at $1,200 per month. The Maine DOT is trying *to* allocate CMAQ funds for its acquisition, however those funds will not be available until October of 1997. Federal funds can not be applied to anything other than equipment on the current privately owned site. Funding of a full facility at a new site is still under investigation.

Waterville intermodal Facility -Total project cost is $3 million. It is anticipated to use $1.2 million in CMAQ funds for Acquisition of lifting equipment ($1 million), improving the local highway left turn lane configuration ($125,000), and grading and paving of an adjacent storage area ($325,000). A request for crediting private investment towards the State share will be approved as provided for in the National Highway System Designation Act. The non-Federal share of this project will be provided by the Guilford Transportation Industries.

7 Total $300 M

8 Total $6.6 M; Federal $5.3 M - CMAQ ($1.3 M), undetermined Federal ($3.3M); State($20 K); Port Authority of NY/NJ ($1-3 M); and Local ($950K) funding were matched in a 50:50 ration to purchase or lease a barge and provide some operating assistance.

9 Total $46 M - Federal, State, and Local Port funds of $46 M were used for dredging($21 M- Port Authority. of NY/NJ) and site rehabilitation($25 M)

10 Total $10 M; Undetermined Federal ($6.1 M) State ($3.8 M) and Local ($870 K). The city of New York bought abandoned tracks from CSX for $10.3 million and the NYDOT bought the 5-mile track on the Jersey side

11 Total $7 M in State and Local funds

12 Total $93.6 M in State and Local funds

13 Total $1.9 B; Federal $447 M - ISTEA Earmarks ($45M), Undetermined FHWA ($400 M), EDA ($2 M), State ($67 M) and Local ($1.4 B). On October 1, 1996, Congress and the President approved a $400 million loan to Alameda Corridor Transportation Authority (ACTA), a joint powers authority created by the ports and participating cities to implement the project. The loan includes a $59 million appropriation as a Treasury reserve against the project's anticipated risk. Other funding sources include $350 million in MTA funds, $45 million ISTEA earmarked funds, $400 million from the two ports, $71 I million in project revenue bonds to be issued by ACTA, and $67 million in State funds, and a $2 million grant from the Economic Development Administration of the Department of Commerce funded start-up costs for ACTA.

14 Total $1.2 M; Federal CMAQ ($250 K), Private and Local Air District funds

15 Total $100 M; Federal ($29 M) - CMAQ/FTA ($29 M), STP, and METRA. The only moneys dedicated to freight have been for the necessary relocation of the CP yard. Intermodal freight operations are benefiting as an incidental result of this commuter rail project.

16 Total $8.5 M; Federal STP ($3.6 M), Port of Seattle and Local ($4.9 M)

17 Total $15 M17; Federal ($0) - Possible STP, State, and local

18 Total $14.5 M; Federal STP ($1 M); Local Port of Seattle ($3.4 M), and Other/Private(Immunex) ($10.04 M)

19 Rainer Alt, Paul W. Forster, and John Leslie King, *The Great Reversal: lnformation and Transportation infrastructure in the Intermodal Vision,* University of California, Irvine, Undated manuscript.

20 Toll collection, similarly, involves administrative costs as well a burden on commercial vehicle operators. A study assessing the benefits of electronic toll collection (ETC) systems reported a decrease in operating expenses of up to 90%; lane capacity increased 250%; fuel consumption decrease or 6-12%, emissions - decrease CO emission 72% per affected mile, decrease HC emissions 83% per effected mile, decrease NO emission 45% per affected mile. For the toll paying public, the benefits of electronic fare payment systems included patron benefits, as indicated by increased usage of up to 90% where the ETC was available; fare collection - increase 3%-30%; and decrease in data collection costs of about $1.5m. *ITI Benefits: Expected and Experience*, FHWA-JPO-96-008, January 1996

21 Total: $19 million; Federal ($19 M)

22 Total: $3.6 M; Federal ITS ($2 M)

23 Total: $1.2 M; Federal ITS ($1 M)

24 Total: $5.8 M in Federal ITS funds

25 Total: $807 K in Federal ITS funds

26 Total: $19 M, Federal ITS ($11.6 M), Federal STP: $900K -For FY 97 $550,000 is requested to support NAFTA issues (in addition to the $19.3 billion Federal-aid highway programs). FY 97 will stay at $400,000. For 4-6 border crossing model deployment projects (2nd gen. technologies) $18M was requested for FY 97

27 **Santa Teresa Intermodal Facility** - Funding was achieved through a $300,000 appropriation in 1992. An additionai $1,650,000 was appropriated in 1994, of which $900,000 consisted of STP money transferred to Highway Planning and Research. FHWA and State of New Mexico jointly provided $300,000 in funding for the first phase of this study by Sandia National Laboratories was $300,000, and $1.2 million for Phase II. GSA, other public funding sources, and private rail partners are also involved. The border crossing **site** has attracted $650,000 for land and $9 million for construction.

Detroit/Buffalo International Border Crossing - The total project cost of $500,000 has a 22% federal share of $110,000 with the remaining shared **by** the Canadian Government and the states of Michigan and New York.

28 Total $800K (FHWA 94-96) - FY96-$250K, 95 - $450K and 94-$100K. FY 96 funding was reduced due to overall budget reductions at FHWA.

29 Total: $17.5 M; Federal ITS ($8.4 M)

30 Total: $7.5 M; Federal ITS ($5.8 M)

31 Total $1.06 M; Federal ITS ($1 M)

32 Total: $25.5 M in Federal ITS funds

33 Total: $12.8 M; Federal ($7.5 M)

34 Total: $8.7 M; Federal $8.7 M

35 Total $12.5 M -Estimated cost of universal PTC range from $843 million for a warning system to $1.1 billion for replacing current signals.

36 Total: $3 M; Federal ITS ($1.5 M)

37 Total: $4 M in Federal ITS funds

38 95-96 Earmark ($500 K)

39 Total $210 M; Federal ($160 M)

40 Private ($881 M) - American Airlines built a $481 maintenance facility; BNSF built a $100 million railyard; Federal Express built a $300 million air freight center

41 Total: $176.3 M (Including $26.3 million for transportation) - State ($13.3 M); Local ($5.5 M); and Private ($157.3 M)

Private Funding:

UPS facility	$150 million - UPS funded
Grade Separation	$15.3 million - UPS and IDOT ($8 million)
Interchange	$10.8 million - IDOT ($2.5 mil.), Hodgkins ($5.5 mil.), and Toll Authority ($2.8 mil.)

42 Total: $111 M - FAA, State ($41 M), Local ($40 M), and Private ($30 M). An FAA grant contributed to the original EIS. The State has spent $16 million on planning and has commissioned $25 million for land acquisition. The $125 million existing airport was provided by local governments who are also providing $40 million in water and sewer improvements.

43 Total $64.3 M; FAA ($24.5 M)-Aircraft parking and other airfield improvements; State ($745 K), Local Sources and Airport Commission ($7 M), and Private ($35 M)-UPS sorting facility

44 Total $35.2 M - Federal CMAQ ($7 M) - Under the Innovative Financing program, the CMAQ funds in conjunction with a Transportation Revolving Loan Fund (TLRF) will be loaned to the project rather than provided as a grant. An off-loading fee of $10 per truckload was established as a dedicated revenue stream which, when the TLRF funds are repaid, the revenues can fund future congestion mitigation and air quality (CMAQ) projects. Private funding ($24 M) is for adjoining warehousing.

45 Public and Private Sectors: $9.4 million from ISTEA "P" program. Total funding required is $300 million; bond financing is being considered

46 Total $511.9 M; Federal $32.1 M (CMAQ, STP, NHS, ISTEA Earmarks, FHWA SPR, Undetermined FHWA, FAA, HUD, Undetermined Federal, State, Local, and Private funds

47 MARAD ($200K/year) and Private (APL, Matson, and Crowley American)

48 Private ($25K/year/member) and USCG/MARAD/NOAA ($75K/year) Private sector cash contributions were $87,000 in 97.

49 The US Coast Guard has installed and is currently operates VTS in 8 ports- paying a total of $19 million in operational and maintenance costs in FY 95. (private VTS operation costs: LA/LB - $1.4 million; Delaware Bay - $345,000)

50 Infrastructure improvements have been funded through the US Department of Commerce's Economic Development Administration and the FAA. Private investments include a $30 million, 63,000-square foot manufacturing part constructed by Cell tech Biologicsa of the United Kingdom.

51 More than 38 companies, $330 million in private investments