Special Report 279

The Marine Transportation System and the Federal Role

Measuring Performance, Targeting Improvement

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

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Committee for a Study of the
Federal Role in the Marine Transportation System

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This report has been reviewed by a group other than the authors according to the procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

This report was sponsored by the U.S. Coast Guard, the National Oceanic and Atmospheric Administration, the U.S. Army Corps of Engineers, the U.S. Department of Agriculture, the U.S. Department of Transportation, and the U.S. Department of Homeland Security.

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Preface

The federal government provides a wide array of infrastructure and services in support of the nation's marine transportation system (MTS). It does so through a number of federal agencies in several cabinet-level departments. In 1998, Congress directed the Secretary of Transportation to convene a broad-based task force to assess the adequacy of the MTS to operate in a safe, efficient, secure, and environmentally sound manner and to assess the federal role in furthering these goals.[1] In reporting back to Congress, the MTS Task Force identified a number of challenges facing the system and urged improved coordination

[1] Section 308, Coast Guard Authorization Act of 1998.

among the federal agencies and other suppliers and users of marine transportation infrastructure and services.[2] The task force's recommendations led to the creation of the MTS National Advisory Council (MTSNAC), consisting largely of maritime industry representatives, and the Interagency Committee for the Marine Transportation System (ICMTS), consisting of representatives from the 18 federal agencies with responsibilities related to the MTS.

The creation of MTSNAC and ICMTS has prompted closer examination of the federal role in the MTS and how the efforts of individual federal agencies relate to one another and to broader national interests that underlie federal involvement in the system. Both bodies seek to ensure that federal decisions are consistent, complementary, and responsive to these national interests. Hence, in September 2002, several of the federal agencies and departments that are members of ICMTS—the U.S. Coast Guard, the National Oceanic and Atmospheric Administration, the U.S. Department of Homeland Security, the Maritime Administration, the Office of the Secretary of the U.S. Department of Transportation, the U.S. Department of Agriculture, and the U.S. Army Corps of Engineers—commissioned the National Research Council (NRC), under the auspices of the Transportation Research Board (TRB) and its Marine Board, to examine the federal role in the MTS and develop an analytic framework for federal policy makers to use in assessing system needs and informing and coordinating decisions to meet them.

To conduct the study, NRC formed a 14-member committee with expertise in economics; marine industry structure and operations; environmental protection; port management and planning; waterways management and operations; and transportation policy, administration, and finance. Committee members served in the public interest without compensation. Mortimer L. Downey, President of PBConsult, Inc., chaired the committee. The Statement of Task, or charge to the committee, is provided in Box P-1.

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[2] *An Assessment of the U.S. Marine Transportation System: A Report to Congress*. U.S. Department of Transportation, Sept. 1999.

Box P-1

Statement of Task

This project will develop an analytical framework for federal agencies to use to identify capital and operating needs and coordinate federal investments and spending on the marine transportation system (MTS) infrastructure. The federal role in the MTS is defined to include activities in support of safe navigation (such as vessel traffic management, charting, marine safety, search and rescue, salvage, weather and oceanographic information), waterway maintenance (dredging of harbors and channels, maintenance and upgrading of locks and dams), environmental protection (e.g., oil and hazardous waste spill prevention and response, vessel discharges, wetlands/habitat protection, and air pollution), security, and customs services. The federal role also includes setting national goals and standards, identifying and implementing funding mechanisms, and evaluating MTS performance.

It is expected that the committee will work through five specific tasks in developing its analytical framework:

1. Review of how federal investments by agencies such as the U.S. Coast Guard, the National Oceanic and Atmospheric Administration, the U.S. Army Corps of Engineers, and the Bureau of Customs and Border Protection are being made currently, including the basis upon which those investments are made, the degree of interagency coordination, and the policy issues associated with those patterns of investment;
2. Review and interpretation of projections for future maritime freight and passenger demand;
3. Assessment of plans for MTS maintenance and expansion by industry, state and local government, and federal agencies (including consideration of plans for environmental protection);
4. Description of the likely impact on the MTS over the next two decades if federal funding remains constant; and
5. Identification of options for federal funding of the MTS. This task will include a comparative analysis of the federal financial role in support of other modes, particularly aviation since this system is also international, and will identify critical factors and trade-offs that must be taken into account in considering alternative federal financing roles. It will also include an assessment of how these options for federal funding contribute to the national goals, standards, and performance measures identified in the MTS Strategic Plan.

How the committee chose to interpret and approach this charge is described at the end of Chapter 1. This report follows several other TRB, Marine Board, and NRC studies of the nation's transportation and freight systems' capacity to support commerce (TRB 2003a; NRC 2001), security requirements (TRB 2002; TRB 2003b), and safety and environmental issues (NRC 1998; NRC 2001; TRB 2001). Each of these topics is complex and requires special expertise and understanding of particular components of the MTS. This committee did not have the time or requisite composition to examine and make specific recommendations on individual federal programs, policy initiatives, or provisions in legislation. Likewise, it did not have the mandate or capability to focus on specific environmental, safety, and security concerns, although such studies have been undertaken by NRC when requested [see, for instance, the Marine Board's assessment of the Oil Pollution Act of 1990 (NRC 1998)]. Therefore, the committee elected to focus its efforts not on detailed compilations of needs for each segment of the MTS, but on ways in which the federal government and marine transportation community as a whole can better identify and prioritize needs and make decisions on the basis of sound information and analysis. In the committee's view, the enhanced capability to make informed and responsive decisions on an ongoing basis will have far greater value than a one-time compilation of priorities.

Believing the report does not go far enough in identifying challenges facing the MTS and requisite changes in federal policies and funding, committee members William O. Gray and James R. McCarville each authored supplemental statements. These individual statements, which are presented in Appendices A and B, are not part of the consensus report, although committee member Geraldine Knatz endorses them.

The committee deliberated over a 9-month period. It met three times and communicated by e-mail and conference calls. During its information-gathering meetings, which were open to the public, the committee was briefed by representatives of many of the federal agencies with responsibilities related to the MTS. Jeffrey High of the U.S. Coast Guard attended all open meetings and served as the federal sponsors' liaison with the committee and staff, clarifying and fielding questions about the study charge

and sponsor expectations. The committee thanks him for his close participation and support throughout the course of the study. In addition, thanks go to the following federal agency representatives who briefed the committee during its first meeting: Barry Holliday, U.S. Army Corps of Engineers; David McFarland, National Oceanic and Atmospheric Administration; Craig Vogt, U.S. Environmental Protection Agency; Daniel Floyd, U.S. Bureau of Customs and Border Protection; Raymond Barberisi, Maritime Administration; Edward Weiner, U.S. Department of Transportation; and Rajiv Khandpur, U.S. Coast Guard.

During the committee's second meeting, two panels of experts from industry briefed the committee on issues of concern from their perspectives. Thanks are due to Christopher Koch, World Shipping Council; Samuel Crane, Maher Terminals Logistics Systems; Peter Finnerty, American Ocean Enterprises; Gary Martin, North American Exporters Grain Association; Robert Flynn, Mallory, Jones, Lynch, Flynn and Associates; Thomas Allegretti, American Waterways Operators; and Les Sutton, Kirby Corporation. The panel discussions provided much insight into the federal role in the MTS and the importance of this system from the standpoint of shippers, carriers, and terminal operators.

During the third meeting, the committee was briefed by Anthony Minyon of Toyota Motor Sales USA and William Lucas of the U.S. Military Traffic Management Command. Their presentations shed further light on the needs and concerns of MTS users. In conjunction with the meeting, the committee visited the Port of Long Beach and San Pedro Harbor. Manny Achemeyer of the Marine Exchange of Southern California and Thomas Jacobsen of Jacobsen Pilot Service offered engaging and informative tours of their facilities and operations. The committee extends its gratitude to them and to the Port of Long Beach and its administrative staff for hosting the meeting and providing logistic support.

Thomas R. Menzies, Jr., managed the study and drafted the report under the guidance of the committee and the supervision of Stephen R. Godwin, Director of Studies and Information Services. Peter Johnson assisted with the drafting and revising of report sections. Eric Beshers authored a commissioned paper that formed the basis for the discussion

of the federal aviation and surface transportation programs in Chapter 4. David St. Amand assisted in the drafting of Chapter 2 and offered information and constructive advice for other sections of the report. Beverly Huey convened the expert panels during the committee's second and third meetings. Tamar Henkin, Transtech Management, Inc., briefed the committee on opportunities for applying innovative financing programs for the provision of marine infrastructure and services.

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the NRC's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making the report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process.

The committee thanks the following individuals for their participation in the review of this report: Paul H. Bingham, Global Insight, Washington, D.C.; Lillian C. Borrone, Avon-by-the-Sea, New Jersey; G. Edward Dickey, Independent Consultant, Baltimore, Maryland; David Fluharty, University of Washington, Seattle; Damian J. Kulash, Washington, D.C.; Eugene K. Pentimonti, Maersk, Inc., Arlington, Virginia; and Craig E. Philip, Ingram Barge Company, Nashville, Tennessee. Although the reviewers provided many constructive comments and suggestions, they were not asked to endorse the committee's findings, conclusions, or recommendations, nor did they see the final draft before its release. The review of this report was overseen by Lester A. Hoel, University of Virginia, Charlottesville. Appointed by NRC, he was responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of the report rests solely with the authoring committee and the institution.

Suzanne Schneider, Associate Executive Director, TRB, managed the report review process. The report was edited and prepared for publication

by Norman Solomon under the supervision of Javy Awan, Director of Publications. Special thanks go to Frances Holland for providing project administrative support.

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Abbreviations

NRC	National Research Council
TRB	Transportation Research Board

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Executive Summary

Much of the freight transported within the United States, and the vast majority of that moved in international commerce, uses the nation's marine transportation system (MTS). The system is varied and immense. It consists of thousands of miles of navigable channels, hundreds of port complexes, and thousands of terminals located along the nation's lake, river, and coastal waterways. It involves tens of thousands of shippers and carriers, who operate a wide range of vessels from this country and abroad, from river barges to the largest oceangoing vessels. Manufactured goods are brought into and shipped out of the country in standardized marine containers transported by the thousands in vessels that regularly cross the oceans. Commodities essential to the economy and

daily lives of Americans, such as minerals, building materials, energy, and farm products, are moved in bulk across the country and to and from other regions of the world on the rivers, lakes, and oceans. The waterways are connected to the nation's other modes of transportation, such as highways, railroads, and pipelines. Together they form a vast freight system that has become integrated with the production process itself. The performance of the MTS affects the location of businesses, their operations and practices, and the demand for the goods and materials they produce—and ultimately the productivity and competitiveness of U.S. producers and the prices paid by U.S. consumers.

Even more than other parts of the nation's transportation system, marine transportation is a joint private- and public-sector enterprise. The private sector owns and operates the vessels and most of the terminals—it is responsible for the commerce that flows through the system. The public sector provides much of the infrastructure at ports and on the waterways—it is responsible for keeping the system functioning in support of commerce, and for doing so in a safe, secure, and environmentally sound manner.

The MTS is still a new and expanding concept. It encompasses not only the vessels, waterways, navigation aids, ports, and other traditional components of the marine sector, but also their connections to other modes of transportation, both public and private. As part of the broader freight transportation system, the marine sector is constantly being shaped and reshaped by economic and technological forces. At the same time, it continues to be heavily influenced by many long-standing political and institutional structures that reflect past economic arrangements and divisions of responsibility. In this regard, the very notion of an MTS is compelling. While an emphasis on "marine transportation" is in many ways restrictive in an increasingly multimodal freight system, explicit thinking about many components working together to form a national system makes good sense. Such a system perspective must be instilled in all decision-making structures, starting with those of the federal government.

GETTING THE FEDERAL ROLE RIGHT

In this study, the MTS is examined in the broader context of its role in the freight system, but with a focus on the federal government's role in supplying, financing, operating, and regulating the infrastructure and services that support the system's efficient use in the public interest. The federal government has a strong interest in fostering an MTS that facilitates commerce and furthers other national interests. The Constitution calls for the federal government to regulate interstate commerce. By its very nature, the MTS is a long-distance mode of transportation that cuts across state and national borders. It has far-reaching impacts and implications that compel a prominent and effective federal presence. The system's integration with other modes of transportation means that the federal role must be viewed within an even broader context that recognizes the high degree of modal interconnectivity characterizing the national freight system.

The federal government today has a large and influential role in the MTS. It helps pay for the construction and maintenance of navigable channels. It helps manage the traffic that operates on the waterways and provides the aids to navigation, charts, and information on water and weather conditions used by mariners. It regulates the safety of vessels and their environmental compatibility, and it responds to marine accidents that threaten public safety and the environment. It helps finance the highways that connect marine ports and terminals to the larger transportation system. And now more than ever, it is seeking ways to ensure the security of the marine sector and the transportation system overall.

While these federal responsibilities are substantial collectively, they are widely dispersed and not well coordinated. They are fulfilled by many federal programs administered by multiple federal agencies and governed by numerous statutory requirements, some reflecting past federal interests and institutional arrangements. In general, the institutional roles and divisions of responsibility in the federal government do not correspond well with how the MTS is organized and functions today.

Several federal agencies and departments are collectively responsible for many of the functions listed above, as well as many others. Sponsors of this study include the U.S. Coast Guard, the National Oceanic and Atmospheric Administration, the U.S. Department of Homeland Security, the Maritime Administration, the U.S. Department of Transportation, the U.S. Department of Agriculture, and the U.S. Army Corps of Engineers. Together, they asked for an analytic framework that can be used in identifying their capital and operating needs, coordinating their program activities and infrastructure investments, and guiding other agency decisions so that they are consistent and complementary in furthering national interests. These federal agencies and their policy makers receive much advice on desirable levels of federal funding and on specific changes that are needed in federal programs and policies. However, they lack good information and analyses to support and coordinate these decisions. They—and Congress—need to know how well the MTS is functioning to meet the demands of commerce, safety, environmental protection, and national security. They also need means for identifying shared goals, assessing progress toward achieving them, and planning concerted actions to further this progress.

The federal government has assumed important roles in the MTS, as mentioned above. In this report, the committee does not examine or question the bases for these roles, except to note that most are long-standing and rooted in the Constitution. Policy makers may choose to give more or less attention to any of these roles. The thrust of the committee's recommendations is to ensure that federal decision makers have the information at hand to make determinations and decisions that further their goals.

INFORMATION AND ANALYSIS FOR DECISIONS

The committee finds that strengthening of the information and analytic bases for federal decisions relating to the MTS is urgently needed. Federal program expenditures on individual components of the MTS are large, and each expenditure must be justified in its own right. Even more important, the furtherance of safety, environmental protection, com-

merce, and security requires that federal policy makers coordinate decisions across programs with these broader interests in mind. To do so, they must have an understanding of how well the overall system is performing in each of these areas. Moreover, they must have knowledge of how the MTS is used and how it functions within the broader transportation system and economy.

Such information and understanding are important for a number of reasons. Having so many responsibilities spread among so many programs, federal policy makers must know how these programs are working collectively to further national interests and where they may be working at cross-purposes. They must be able to identify problems and needs as they arise and take timely actions to address them. Lack of such understanding could lead to neglect of problems and missed opportunities for solving them, including transportation inefficiencies that persist and cascade through the national economy, environmental problems that may become crises, and failure to embed safety and security into the functioning of the system.

Demands on the MTS are growing and continuously changing. Traffic demand, propelled by continued growth in international trade, is increasing. In addition, environmental, safety, and security demands are changing. A growing and increasingly integrated system will require more and better information to support decisions. Yet information on system performance is mostly program- and project-specific in its focus and use. For example, much information is collected on the incidence and length of delays at individual locks on the inland waterways. These data, while helpful, are not now being used in more comprehensive ways to assess congestion and delays on the system as a whole and their impacts on national freight transportation patterns and costs. Such data should be used to assess the current performance of the nation's navigation infrastructure in facilitating commerce and to evaluate investments and policies to improve performance. Likewise, information is collected on vessel groundings and collisions and on oil spilled in U.S. waters; this information is helpful in assessing the safety of vessel operations and design. That information could be routinely used to guide federal investments in hydrographic

data and channel dredging to improve the safety of the marine operating environment, but this is not done.

Expecting individual agencies to collect and analyze system-level performance information is unrealistic. Of necessity, each agency's information needs will be driven by its specific program objectives, budgets, and statutory obligations. Nevertheless, one federal entity—the U.S. Department of Transportation (DOT)—has a clear responsibility to ensure that this national and system-level performance information is made available and is used for federal transportation policy making. DOT has the capability to develop this information by drawing on data collected by other federal agencies and nonfederal entities. It also has the responsibility to view the operations and performance of the MTS within the broader context of the nation's transportation system and its relation to national interests. No other federal agency involved in the MTS has this overarching perspective and charge. DOT can communicate this information to Congress and the Office of Management and Budget, where the connections among federal agency budgets and policies must take place. Therefore, the committee urges the following:

The Secretary of Transportation should seek a mandate from Congress for DOT to take the federal lead in measuring, monitoring, and assessing options to strengthen the MTS's contribution to the furthering of key national interests, including commerce, environmental protection, safety, and security. While legislative authorization is imperative to sustain such an effort, DOT should assume this leadership role immediately—thereby demonstrating the value to Congress.

Acting in this capacity, DOT should consult with the other federal agencies and users of the system in establishing performance goals for the MTS that relate to national interests, and it should seek a formal endorsement of these goals from Congress. Ultimately, a better-informed Congress will need to ensure that these goals are pursued through the commitment of resources and appropriate changes in the responsibilities, organization,

and expectations of the federal programs and agencies. The information that DOT supplies will be especially important in ensuring that federal policies and programs pertaining to the MTS are made in the context of its role in the national freight system.

By itself, good information on system performance is not enough to bring about more rational and coordinated federal decision making, but it is a start—and one that has precedent in other federal transportation programs. Congress has come to demand regular reporting of the performance and needs of the nation's aviation and surface transportation systems. A long-standing analytic effort, and one that is a good model for the MTS, is DOT's biennial *Report to Congress on the Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* (C&P report). This report, developed by DOT with the help of the Federal Highway and Transit Administrations, is mandated by Congress and provides policy makers with regular national-level information on system performance—not only measurements of current conditions and performance, but also assessments of future demands and expectations, as well as options for meeting them.

Hence, as a central part of fulfilling the role recommended above, the committee recommends the following:

DOT should immediately begin to develop, and seek a mandate from Congress to produce on a regular basis, reports on the use, condition, performance, and demands of the MTS modeled after the biennial C&P reports developed for the federal highway and transit programs. Not only should these reports portray current conditions and performance, they should also look to the future by assessing the funding levels and investments required to improve system conditions and performance over time.

A wide range of metrics, data, and analyses will be required to measure and monitor aspects of the MTS. The focus should be on metrics that translate into performance (e.g., trends in safety and transportation costs) as opposed to simple measures of program output (e.g., miles of channel

dredged, number of vessels inspected). None can be expected to be comprehensive, and all will be open to interpretation. Information will need to be obtained from many different sources, including federal agencies, state and local authorities, and the private sector. The very act of gathering, synthesizing, and analyzing such information and relating it to performance should prompt more critical thinking about the scope and effect of federal involvement in the MTS. It should provide many insights into system performance trends that are not now apparent from the scattering of information across parts of the system. The idea is to provide credible, objective, and accessible information on a regular basis that will be useful in prioritizing investments and making policy decisions relating to national interests.

OTHER CONCERNS AND RECOMMENDED ACTIONS

With goals for and good information on MTS conditions and performance, federal policy makers will be in a much better position to ensure that federal programs are well devised and resources well placed. Moreover, the experience from other transportation modes suggests that the analyses and regular performance reporting recommended above will draw the attention of both the public and Congress to the needs of the MTS. The notice drawn to the needs of highway and transit is an important intangible of the C&P reports for these modes and should not be overlooked.

Such system-level information should not supplant detailed assessments of specific federal projects and investments, such as the benefit–cost evaluations performed by the Corps of Engineers for its navigation infrastructure. Instead, this information will provide decision makers with a more detailed picture of how federal infrastructure functions collectively. This will be important in assessing federal funding policy and methods of managing the infrastructure components as a connected enterprise. Efforts to understand system functions and needs have proved helpful in convincing users of the aviation and highway systems that their financial contributions to the federal infrastructure programs are being well spent.

The information derived from regular system condition and performance analysis and reporting will, in the committee's view, help guide these congressional spending decisions, including the design and targeting of federal efforts to meet identified problems and needs. In the interim, however, consideration must be given to early actions for meeting MTS needs. The beginnings of an analytic framework for helping to identify MTS needs and priorities, as well as opportunities for meeting them, are presented in Chapter 6. The perspectives taken into consideration are those of the federal agencies, MTS users, and system components. In the committee's view, such a multidimensional framework will help to sort and coordinate federal priorities and to ensure that they are consistent with one another and compatible with furthering national interests.

Other insights from the federal aviation and surface transportation programs suggest that simply developing and reporting system condition and performance is not enough. The creation of national, broad-based trust funds for the federal aviation and highway programs, coupled with multiyear congressional authorizations and contractual obligations for the use of these funds, has helped foster a federal commitment to fully reinvest user-generated revenues back into the system to improve conditions and performance. Similar devices and commitments by Congress and the executive branch to prevent the diversion of user-financed trust funds established for waterway infrastructure do not exist. Without this commitment, users are reluctant to support additional user financing, and they have come to question the federal commitment to improving the system.

On the basis of its review of other federal transportation programs, the committee is convinced that user financing of the MTS must be accompanied by a federal commitment to reinvest all of the generated funds back into the system. The extent to which federal funding for marine transportation programs should be derived from user fees is something for Congress to decide. Greater acceptance of this financing approach by users, however, requires a demonstrated commitment to reinvest the revenues that are being collected. The committee therefore recommends the following:

The administration, supported and informed by DOT and the U.S. Army Corps of Engineers, should seek from Congress the commitment to fully and promptly reinvest all user-generated revenues back into the MTS. The commitment should be accompanied by the kinds of statutory and political devices used in the federal aviation and surface transportation programs to make it binding.

During the course of this study, the committee interviewed users of the MTS and reviewed reports identifying critical system shortcomings and needs. The committee observed that a number of problems and concerns were raised repeatedly. When they are examined on the basis of the analytic framework offered in Chapter 6, many of these problems and concerns appear to fall outside or transcend the jurisdictions of individual federal agencies. Often they have been allowed to persist because they require the attention of more than one federal agency, are emerging and not well defined or understood, or arise in part from efforts to address other important needs and problems. All are candidates for the kinds of performance measuring and monitoring urged in this report. Some, in the committee's opinion, deserve early attention because they have the potential to be exacerbated by escalating transportation demand. They include the following:

- **The capability of highways and other intermodal facilities at major ports to handle increasing container traffic.** The challenges involved in integrating the nation's freight transportation systems, and the jurisdictional issues that arise, are perhaps most apparent at the interconnections of the nation's public seaports, public highway systems, and private railroads. At these points, federal, state, local, and private-sector interests and responsibilities intersect, but they are especially difficult to coordinate because of differing planning horizons, resource constraints, and investment priorities.
- **The ability of the federal government to respond effectively to changing vessel traffic, sizes, and uses in the provision of navi-**

gation infrastructure. As it seeks to provide harbor channels, locks, and other navigation infrastructure, the federal government faces multiple and sometimes conflicting demands. Most notably, demands for the increased use and capacity of the nation's waterway infrastructure often conflict with demands for environmental protection.

- **Absence of systematic and comprehensive efforts to strengthen marine safety, security, and environmental protection.** The fragmented roles of the federal agencies in promoting marine safety, security, and environmental protection have led to many prevention, mitigation, and response activities, each tending to focus on specific subsets of problems. The result is a mix of efforts, such as economic protections afforded domestic shipbuilders and carriers in the name of promoting national security and the regulation of vessel designs and operations to promote safety and protect the marine environment. Other options to help achieve these goals may be considered, such as improving infrastructure and navigation information, but seldom in a systematic way. An examination of safety, security, and environmental needs will be important in ensuring that the nation's commerce is unhindered and that the pressures from increased commerce do not compromise such needs.

In each of these three areas, more information and analyses are required. In some cases, a restructuring and reshaping of the federal government's roles and divisions of responsibility may be necessary. There is a need to start addressing these issues and concerns more directly. Experiences from other federal transportation programs suggest opportunities for doing so. In the committee's view, such opportunities should be vigorously pursued to help bring about integration of the nation's freight transportation systems. The following three recommendations are offered in this spirit:

The Secretary of Transportation should seek from Congress a more balanced set of tools to make national transportation investment and policy decisions that recognize the increasing

integration of the transportation modes and the effects that federal decisions concerning one mode have on other modes. As a first step, DOT should examine and advise Congress on ways to expand the scope and flexibility of existing federal transportation investment and finance programs so that they can be used more effectively for the development of multimodal and intermodal transportation facilities. It is not enough to encourage federal policy makers to take a multimodal perspective on transportation investment and policy making; they must also have sufficient tools at their disposal to act from this perspective.

The Secretary of Transportation should seek from Congress the means to undertake, in collaboration with industry and other federal agencies, an applied research and technology program aimed at furthering the capacity, safety, environmental protection, and security of the nation's ports, intermodal connections, and other marine facilities and services. This effort should include collaboration with the U.S. Army Corps of Engineers to explore opportunities for applying technology, including intelligent transportation systems, to the inland waterway system and with the Department of Homeland Security and its agencies to pursue technologies to strengthen system security. Experience from other federal transportation programs suggests the value of federal support of research in improving the national transportation system; thus, a comparable supporting role in the furthering of the national MTS deserves consideration.

As part of its efforts to measure and monitor MTS performance, DOT should aim to develop a more thorough understanding of the operations, capacity, and use of the system, and of the freight system in general. Such an understanding will help identify ways to better integrate security, environmental protection, and safety features and capabilities into the system as it facilitates the nation's commerce. Examining the implications of federal investments and activities across modes will also be important in

ensuring that these investments are compatible with one another and with these national interests. Such outcomes can no longer be treated as mutually exclusive or conflicting goals of national policy, but rather as interdependent and essential to one another.

CONCLUDING OBSERVATION

The integration of the nation's transportation modes, particularly for the movement of freight, is a long-term phenomenon that may ultimately compel changes in federal responsibilities and institutions. Short of such change, much can be done to ensure that the federal government remains responsive to the needs of commerce and the public. The actions recommended in this report represent first steps in ensuring that the MTS, and intermodalism in general, has a meaningful influence on federal policies and decision-making processes.

1

Background and Introduction

Waterborne carriage is by far the oldest of the major modes of long-haul transportation. People have long been fascinated by marine activity, particularly by the variety of ships and other vessels that ply the world's rivers, lakes, and oceans. Although vessels are the most obvious and engaging element of the maritime domain, modern marine transportation is a large and diverse enterprise sustained by waterway infrastructure, waterfront facilities, support services, and interconnections with other modes of transportation. Most of the marine transportation business operates outside the public spotlight, and thus its far-reaching influence on the national and world economy is seldom appreciated or well understood.

It has become trite to say that the world is becoming "smaller" and more integrated economically, but trade figures confirm that economic globalization has been on the rise since World War II. Advances in telecommunications and aviation contribute to this trend by helping to make individuals, industries, and governments around the world better connected. Indeed, people no longer depend on slower ships for long-distance travel; jet airliners account for nearly all overseas travel. Business contacts and transactions are greatly facilitated through overnight package delivery services, telecommunications, and now Internet exchanges. Nevertheless, most of the goods traded internationally still must be physically moved. As trade routes have expanded, so have the distances over which these goods must be moved in a timely fashion.

The large majority of goods traded internationally continue to be transported by water. Most of the distances traversed are on the water—but water transportation is continuously changing and becoming more efficient. And distinguishing where the land and waterborne portions of the journey begin and end is becoming more difficult and less meaningful as these segments become integrated physically and operationally.

This study examines marine transportation in the broader context of its role in the freight system, which itself has become a key and increasingly integrated part of the overall production system. Marine vessels also serve passenger travel, and their use for local commuting and cruise vacations has been growing. However, their greatest utility is in freight transportation. In this capacity the marine sector has been subject to tremendous pressures to change and adapt and has demonstrated an ability to do so. Major changes in the design and capacity of merchant vessels over the course of decades are obvious to even the most casual observer. Less apparent are the changes that have taken place in how these vessels are used, the infrastructure and services that support and accompany their use, and the demands placed on this use by industry, government, and the public. The marine and broader transportation sectors have kept pace with these demands, and one can make a strong case that without their innovations and efficiencies, the fast pace of economic globalization would not have been possible in the first place.

In this chapter the major components of the marine transportation sector today, its uses, and some of the major factors influencing its development in recent decades are described. This sector is referred to as the "marine transportation system" (MTS) in this report. As freight transportation and its marine, land, and aviation components become more integrated, the term "MTS" is becoming limited and outmoded. Nevertheless, the marine sector has many distinct elements. The term "MTS" has the advantage of encompassing many of the landside elements, including connections to other modes that are not traditionally viewed as part of the maritime domain. The term is used in the report in this broader way, but with recognition that the MTS should be viewed even more broadly as an interconnected element of the larger national and international freight system.

The overview of the MTS and its components in this chapter is intended to provide details and data helpful for the discussion in the remainder of the report. It also provides context for understanding the federal role in the MTS, which is the focus of this study. The overview is not intended to be comprehensive. The origins of the study, its aims, and the organization of this report are outlined at the end of the chapter.

COMPONENTS OF THE MTS

The components of the MTS can be described in a number of ways. One is to group them by the characteristics of the providers of the individual system components. For instance, some key components, such as navigation channels, are supplied by government, while others, such as vessel operations, are supplied by the private sector. They can also be grouped by physical or functional characteristics; for instance, as fixed infrastructure (e.g., locks, channels, terminals), support services (search and rescue, piloting, charting), and operating elements (vessel and vehicle operations).

Because the MTS consists of many separate but interdependent parts, no groupings of its individual components can be completely satisfactory. The traditional division is by "waterside" and "landside" components: the former consist of the navigation aids, channels, and associated infrastructure and services, and the latter consist of port complexes, ter-

minal facilities, and connections to surface transportation modes. In some ways, such groupings are appropriate, since they coincide with major divisions of responsibility among the federal government, state and local authorities, and the private sector.

The federal government has long taken the lead in providing waterside infrastructure and services by constructing, maintaining, and operating the nation's navigation channels on both inland and coastal waters. It has left to state and local governments, as well as the private sector, responsibility for supplying and operating landside facilities. However, the waterside and landside domains are not neatly bounded. The landside components connect to, and their performance often depends on, highways, railroads, and other modes of transportation. The waterside components connect to international waters, and thus federal responsibilities intersect with those of foreign countries. In fact, most vessels engaged in foreign trade with the United States are foreign registered and are operated by foreign companies and crews. Moreover, the vessels operating in U.S. waters are almost all privately owned and operated, sometimes by entities having large landside operations, including terminals and connecting modes of transportation.

The MTS background that follows is a basic overview of the system. First, the oceanborne sector is described. It consists of seaports, harbors, coastal waterways, and oceangoing vessels that accommodate mostly, though not exclusively, cargo moving very long distances overseas (internationally and between the U.S. mainland and Alaska, Hawaii, and U.S. territories). This discussion is followed by overviews of the inland river, intracoastal waterway, and Great Lakes systems. These systems accommodate mostly domestic cargo moving over long distances, including the inbound and outbound legs of international shipments. In both cases, the basic infrastructure and operating elements are sketched, including the types and characteristics of the vessels used and their main cargoes.

Ocean Transportation

Hundreds of natural and man-made harbors are situated along the U.S. coastline. Many of these harbors contain federally maintained channels

used regularly by vessels engaged in freight and passenger transportation. Marine terminals that consist of piers and berths where vessels are docked for loading and unloading are located on the waterfront. Marine terminals are both publicly and privately owned. Most are privately operated and designed to handle particular kinds of commodities. The terminal may be a stand-alone facility on the shoreline or part of an agglomeration of terminals and other marine service facilities (e.g., tugboat operators, fuel depots, ship repair facilities) that together make up a larger port complex. Such complexes are often owned and operated by state or local authorities, with either the terminals themselves or the land they occupy being leased to private companies. Individual terminals, whether part of a larger port complex or standing alone, are usually connected to rail sidings, roads that accommodate trucks, and pipelines. A major railhead or highway arterial may be located at the port complex or in the vicinity, and the port may serve traffic from inland and coastal waterways as well as the open oceans. The terminal itself may be the origin or destination point for the cargoes moved on the waterways, as is the case for coal shipped to the dock of a waterfront power plant or chemicals shipped from a waterfront chemical plant.

This brief description of the various waterside and landside components of the oceanborne transport sector reveals how difficult it can be to characterize such a large and diverse enterprise briefly. Individual harbors, ports, and terminals differ in their physical attributes, organization, and patterns of use. Their use can be bolstered or constrained by proximity to major shipping channels, harbor channel configurations, landside capacity, local markets, and connections to the interior (Mayer 1988, 78–80). Some handle only bulk commodities, some mostly containerized cargoes, and others a wide mix of freight. Some are connected directly to mainline railroads or situated along major truck corridors; others are well connected to inland waterways or pipeline networks. Some handle mostly local traffic, while others are major cargo transfer points. The background that follows illustrates this diversity.

Navigation Infrastructure and Services

U.S. coastal harbors consist of thousands of miles of main channels, connecting channels, and berths. Many navigational channels are made of relatively short, straight sections between 1 and 3 miles long, connected by turns and bends. Channel dimensions and dredging requirements vary from place to place. Widths can vary from 200 to more than 700 feet, and even more in turning basins. Channels deeper than 12 feet are defined by the federal government as "deep draft"; however, many oceangoing vessels need several times this depth to operate safely when loaded in confined waters.

About 40 of the nation's 70 deep-draft seaports have channel depths of 40 feet or more and are thus accessible to a variety of oceangoing vessels (USACE 2003, Table A-1). For the most part, the main navigation channels are maintained by the U.S. Army Corps of Engineers, which refers to about 300 harbor channels as "projects." Some federally maintained channels, such as those serving the ports of Anchorage, Alaska, and Puget Sound, Washington, are located along naturally wide and deep harbors; hence, they do not require a great deal of dredging to maintain their dimensions. Other channels, such as those along portions of the Gulf Coast and in seaports at the outlets of large rivers, require frequent maintenance dredging to remove sediments.

The shipping channels are marked by navigation aids that range from lighted buoys and beacons to radio navigation systems. The Coast Guard is responsible for placing, maintaining, and operating these aids, while the National Oceanic and Atmospheric Administration (NOAA) surveys and produces nautical charts of the waterways. The Coast Guard maintains nearly 50,000 aids to navigation, while NOAA is responsible for mapping and charting more than 3 million square miles of ocean floor, of which about 500,000 square miles have significant navigation activity (USCG 2000, 59; NOAA 2000, 5). NOAA also monitors currents, tides, winds, and other water and weather conditions, and supplies these data to mariners.

Responsibility for waterway management, including coordinating and controlling vessel operations and scheduling on the waterways, is dis-

tributed among various entities: the Coast Guard, local pilot associations, private marine exchanges, port authorities, and individual vessel operators. In many places, harbor and port traffic is controlled through passive means, through the following of universal operating rules and with guidance provided by navigation aids. The Coast Guard establishes and enforces the traffic rules, but it seldom guides individual vessel movements in the same hands-on manner that occurs for aircraft operating in controlled airspace. In some busy ports and harbors, the Coast Guard operates vessel traffic service centers. The primary role of these centers is to monitor traffic flows and advise mariners on safe vessel movements (NRC 1996). In some ports and harbors, marine exchanges and pilot associations operate similar systems under Coast Guard authorization. The use of pilots in coastal and confined waters is compulsory for most commercial vessels, including foreign-flag vessels. Pilots are licensed by both state and federal authorities depending on the locality, the trade, and the vessels involved (NRC 1994).

The maintenance dredging of the berths where vessels load and unload is generally the responsibility of port and terminal operators. The responsibilities for landside and waterside facilities intersect at this point.

Seaports and Marine Terminals

There are about 70 deep-draft port areas along U.S. coasts, including about 40 that handle 10 million or more tons of cargo per year (USACE 2003, Table A-1; USACE 2002a). Within these ports there are about 2,000 major terminals, mostly privately owned and operated (BTS 1999, 8). Sea terminals and their associated berths are often specialized to serve specific types of freight and passenger movements. Terminals handling bulk cargoes such as petroleum, coal, ore, and grain are frequently sited outside the boundaries of organized public port authorities. These facilities are often the origin and destination points for bulk commodities, and thus they differ from terminals often found in public ports, where shipments are transferred from one mode to another. Terminals handling containerized cargo tend to be located within larger public port complexes with significant warehousing, storage, and intermodal transportation connectivity.

Most large port complexes have a mix of terminals that handle general cargoes as well as various bulk commodities. Today, most general cargo, including manufactured goods, is moved in reusable steel containers through specialized terminals equipped with massive gantry cranes that lift the containers between the ship and the shore. Because the standardized container lends itself to such mechanized handling, container terminals require considerable capital investment by either the public port authority or the private terminal operator. They require land for storing containers that arrive or depart by truck either while they await local pickup and delivery or transfer as part of a longer-haul movement. This storage site may be adjacent to the marine terminal or at a remote location, sometimes near highway, rail, and river corridors outside the port complex. In general, the amount of container storage space required and its proximity to the marine terminal will depend on the nature of the container operations at the terminal. Containers that are passing through the terminal for longer-distance movements inland may be stacked on railroad cars or trucks almost immediately after unloading from the ship, whereas containers awaiting local pickup and delivery may require longer periods of port or off-site storage. Containerization and the attendant automation have not only led to greater efficiencies in cargo transfer but also reduced cargo theft at ports and in transit.

Bulk terminals differ in their design and operating needs depending on the commodities they handle. Oil refineries, chemical plants, and utilities located on the shoreline are primary destinations for liquid bulk traffic. Refineries and chemical plants are also the origin points for petroleum products and chemicals moved by tank vessels. Likewise, waterfront grain elevators double as storage centers and as bulk terminals for the loading of oceangoing vessels.

Because most bulk commodities have a relatively low value per ton, transportation makes up a larger share of their total cost than it does for high-value containerized cargo. Hence, to speed loading and unloading and to reduce the dwell time of the ocean vessels and the trains, trucks, and barges that serve them, modern dry bulk terminals have invested in large-capacity cranes, continuous-feed conveyor belts, gravity-fed load-

ers, and other high-volume cargo-handling equipment. In some cases, large bulk vessels, especially tankers, cannot access terminals because of channel constraints; hence, they may be partially unloaded (lightered) by smaller vessels in deeper waters. A large portion of U.S. crude oil imports is lightered by shuttle tankers operating from offshore locations to refinery terminals. Loading and unloading of petroleum can also occur at offshore terminals connected to landside terminals by underwater pipelines (NRC 1998).

Vessel port calls are fairly concentrated, especially for the containerships. Container terminals at 15 ports account for 85 percent of all containership calls in the United States, and the port complexes in 6 areas—Long Beach–Los Angeles, New York–Newark–Elizabeth, San Francisco–Oakland, Hampton Roads, Charleston, and Seattle–Tacoma—account for about 65 percent of these calls (BTS 1999, 25). Tanker calls are likewise concentrated regionally. They are most frequent in areas with significant petrochemical industries, such as the Gulf Coast, Delaware Bay, New York Harbor, San Francisco Bay, and San Pedro Harbor (NRC 1998). The ports in southern Louisiana are the centers of dry bulk grain traffic, most of which moves down the Mississippi River for export on larger oceangoing ships.

Intermodal Connections

Goods transported overseas seldom make the entire journey from origin to final destination by one mode. Seaports and marine terminals are, to a large extent, nodes on the rail, highway, pipeline, and inland waterway systems. Whether they are used for transporting bulk materials or containerized cargoes, ports and marine terminals must have good access to other modes of transportation if they are to function. Containers are designed to be modular for easy interchange among modes, which allows containerized cargoes to be moved by the combination of ship, rail, and truck that best meets the needs of shippers and receivers.

As noted above, marine terminals that handle bulk cargoes are typically located in places with good access to other bulk-oriented modes of transport, such as unit trains, pipelines, and barges. Bulk cargoes can be

transferred from one mode to another through the use of conveyor belts, pipelines, and other large-volume loading and unloading equipment; drayage by truck or side rail is seldom required. Moreover, the terminal itself may be the commodity's origin or destination point, as is the case for refineries, utilities, and chemical plants. In contrast, the origins and destinations of container cargoes are seldom located at or near marine terminals. Drayage by truck over short distances between marine vessels and railroads is often required even at ports with extensive rail connections. To reduce the need for truck drayage, some ports have invested in on-dock rail lines to provide a direct feed between the long-haul rail and marine terminals. Ports also invest in road connections to the public highways, and most terminal operators have invested in technologies to improve the efficiency of cargo movements within the terminal complex.

Of course, well-functioning intermodal connections at ports and marine terminals are of little value if the networks they connect to suffer from recurrent bottlenecks and limited throughput capacity. High-capacity containerships and the scale economies of container terminals have led to a concentration of containerized cargo in a small number of large ports, which results in large flows of traffic through the connecting highway and rail systems. Surface transportation corridors that are prone to congestion can have economic effects that cascade widely.

Ocean Vessels

Major classes of oceangoing vessels are tankers, containerships, dry bulk and general cargo freighters, and specialized ships such as the roll-on/roll-off (ro-ro) carriers used to transport motor vehicles. The largest-capacity vessels are petroleum tankers and containerships, which along with dry bulk vessels make up most of the tonnage capacity of vessels serving U.S. international trade. In addition, a large variety of smaller, specialized vessels provide unique services to many ports and terminals. U.S. ocean ports and terminals handle more than 75,000 vessel calls per year (BTS 1999, 25). About two-thirds of these calls are made by tankers, containerships, and dry bulk carriers. The remainder are made by other kinds of cargo and passenger vessels.

Tankers Approximately 3,500 tankers operate worldwide carrying crude oil, petroleum products, chemicals, liquefied petroleum gas and liquefied natural gas, and other kinds of liquid commodities, including vegetable oils (TRB 2001; USACE 2003, 86). Tankers vary widely in size and capacity because of the range of commodities they carry, their varied uses, the economics of the markets they serve, and the depth and width constraints of the shipping channels they transit (e.g., at ports and through canals). Capacity is often measured in deadweight tonnage (dwt), which excludes the weight of the vessel itself. The smaller tankers, with capacities of 50,000 dwt or less, are generally used for shorter-haul crude oil movements, offshore lightering, and the carriage of petroleum products that usually require smaller deliveries.

The world's largest tankers are designed and used mainly to carry crude oil. The large crude oil tankers in the world fleet are generally about 300,000 dwt, but some are much larger, and a few exceed 500,000 dwt. These larger tankers are used mainly in the long-distance crude trade (e.g., from the Middle East or Africa to the United States). Since these tankers are too large to enter U.S. ports, they usually unload their cargo offshore in shuttle tankers or at offshore terminals that have pipeline connections to shore facilities (NRC 1998). A fully laden 125,000-dwt tanker requires about 50 feet of channel depth; in comparison, a fully laden 300,000-dwt tanker may require channel depths exceeding 70 feet, which is far greater than is available in most U.S. ports and harbors.

Containerships Operating on regular routes and schedules, containerships are the most common cargo vessel calling on major U.S. seaports. The world fleet totals about 2,900, and fleet size has been continually rising over time as containerization has become the norm for moving general cargo in international trade (USACE 2003, 90). The capacity of containerships is usually measured in 20-foot equivalent units (TEUs), which, at one time, was the prevailing length of containers. Today, 40-foot (truck-size) containers are used as well, each equaling 2 TEUs. The TEU capacities of containerships vary. The smallest ships carry 500 to 2,000. The larger vessels can carry more than 4,000, and a few newer ones have

carrying capacities in excess of 8,000. Currently, about 300 containerships are capable of carrying more than 4,000 TEUs, and they account for one-quarter of the total container-carrying capacity in the world fleet (USACE 2003, 90). Most containerships that visit U.S. ports have design drafts in the range of 32 to 42 feet, but the largest ships (with capacities of more than 4,000 TEUs) can require channel depths of 45 feet or more (USACE 2003, 93, Table A-1). Because service timeliness is critical, these ships are built to be fast and capable of being loaded and unloaded quickly.

Dry Bulk Vessels In the U.S. foreign and domestic trades, dry bulk vessels carry commodities such as grain, coal, ores, fertilizers, and a variety of other materials such as wood chips, logs, and cement. These vessels usually operate on long-term time charters rather than on scheduled lines. Their use and operations are dictated largely by seasonal and regional variations in the demand for and supply of commodities. Most of the world's grains are transported in international trade by these vessels. There are about 5,700 dry bulk vessels in the world fleet (USACE 2003, 88), with most having capacities of 50,000 dwt or less (although much larger vessels are used in certain long-haul, high-volume trade routes).

General Cargo Ships General cargo ships, which were once the standard way of moving merchandise overseas, have largely been supplanted by containerships and specialty vessels and have been declining in number for several decades. Although general cargo ships are no longer dominant, some offer versatility in moving boxed, baled, or palletized freight. Many are equipped with cranes and other self-loading equipment, which allows their use in places without dockside equipment. There are about 3,800 general cargo ships in the world fleet, and more than 90 percent have capacities of less than 30,000 dwt (USACE 2003, 84).

Specialty Vessels Specialized vessels accommodate the transportation needs of some cargos more efficiently. Ro-ro carriers, for example, have become common for transporting automobiles, earth-moving equip-

ment, and other large machinery. Increased demand for imports of liquefied natural gas has led to specialized, insulated carriers for this product, which is unloaded at terminals for storage and regasification.

Passenger Carriers Most of the passenger vessels operating in U.S. ocean waters are ferries.[1] About 225 ferry operators operated nearly 700 registered ferries in 2000.[2] Many carry automobiles and trucks as well as passengers. A handful of states, including Washington, California, New York, North Carolina, New Jersey, and Massachusetts, account for most of the ferries used along the seacoasts. Ferries are used for public transportation in some seaboard cities and to connect the mainland with coastal islands, often on a seasonal basis. The introduction of fast ferries capable of 25 knots or more in recent years has increased ferry demand in some places and created traffic management challenges in some busy harbors and ports. Although they are important parts of the public transportation systems in Seattle, San Francisco, and New York, passenger ferries account for a small percentage of the nation's total passenger trips.

Oceangoing ships no longer have significant roles in long-distance passenger transportation, which is now the domain of jet airliners. However, about 125 cruise ships serving the vacation industry operate on a regular basis from U.S. ports (BTS 1999, 22; USACE 1999). Most cruise ships are floating resorts on which passengers make multiday round-trips. As these ships have become increasingly popular for vacationers, their size and numbers have grown along with their amenities. During the 1990s, the number of passengers on cruise lines more than doubled. Today about 5 million people take cruises each year from the United States; most depart from southern Florida and head for the Caribbean Islands (Alaska is also a popular cruise market, but it is served mainly by the Port of Vancouver in Canada) (USACE 1999). Some cruise lines do cross the open seas (especially along the North Atlantic), but they account for a very small percentage of international passenger trips.

[1] Specialized excursion vessels that are certificated as passenger vessels by the Coast Guard, such as those engaged in dinner excursions, are not included in this discussion.

[2] National Ferry Database, Bureau of Transportation Statistics (www.transtats.bts.gov).

Inland River, Coastal, and Great Lakes Systems

While the deep oceans are the primary means of moving freight internationally, the U.S. river, coastal, and Great Lakes waterways are important means of moving ocean-borne freight internally and for providing outbound feeder traffic for overseas shipping. Of course, these waterways intersect with the ocean shipping channels in such places as the outlet of the Mississippi River and elsewhere along the Gulf Coast, the openings of the Columbia and Willamette Rivers in Oregon and Washington State, and the Great Lakes–St. Lawrence Seaway System. At these points the nation's waterways connect to form part of the long-distance and international transportation system. These waterway systems have many differences in navigation infrastructure, landside components, and vessel characteristics and operations. The inland river systems differ from the intracoastal systems, which in turn differ from the Great Lakes system. Each requires a separate overview.

Inland River Systems

By far the largest and busiest inland waterway system in the United States is the Mississippi River system, which includes the large Ohio and Missouri tributary systems. This system extends for more than 6,000 miles and encompasses navigable waterways on more than a dozen tributary systems passing through 17 states leading to the Gulf of Mexico. It accounts for 86 percent of the route length of the inland river systems and more than 95 percent of total system tonnage (USACE 1997, ES-6). The only other significant river systems (in terms of tonnage moved) are the Columbia–Snake Rivers system, which extends for about 600 miles through the states of Idaho, Oregon, and Washington to the Pacific Ocean, and the Black Warrior–Tombigbee Rivers system, which runs for more than 400 miles through Alabama to the Gulf of Mexico. While various other U.S. rivers are used to move freight for short lengths, such as the Hudson, Sacramento, and James Rivers, their reach and transportation functions are much more localized and limited.

These major river systems have some common features and some important differences. They are all shallow-draft systems with controlling channel depths that seldom exceed 12 feet. In many places, navigable depths would not be maintained and the rivers would not be able to accommodate significant commercial traffic without the active intervention of the Corps of Engineers in building and operating locks and dams, controlling water flows, dredging channels, and using other channel training structures such as revetments.

The Corps of Engineers operates about 170 locks on the inland rivers, most of which are located on the Mississippi River system (USACE 2002a; BTS 1999, 30). Many of the locks and dams were constructed in the early part of the 20th century, and some date back to before the Civil War. The physical characteristics and use patterns of the locks differ along the various river systems and their segments. Locks along the Columbia River lift river traffic by as much as 110 feet, while each of the locks on the Upper Mississippi River lifts traffic by an average of about 15 feet. Lock sizes also vary greatly. The majority of locks on the Mississippi, Illinois, and Ohio Rivers are either 600 feet or 1,200 feet long and 110 feet wide, although some older locks, and those on tributaries, are considerably smaller. Most locks on the Columbia and Snake Rivers have the same dimensions, 675 feet long and 86 feet wide.

Most of the commercial traffic moving on the nation's navigable rivers uses pusher-style towboats with barges that carry dry and liquid bulk commodities. The vessel fleet, which is all U.S.-owned and -operated by law, consists of nearly 30,000 barges, including about 3,000 tank barges and 25,000 dry bulk barges (USACE 2003, 3). The dry barges are usually flat bottomed and rectangular in shape with cargo space below the deck. The barges carrying liquids such as petroleum products, chemicals, or foods may have tanks integrated into the hull or carried independently. Each barge can typically carry between 1,000 and 1,800 tons of cargo (USACE 2002b, 6). Most are moved by towboats pushing 12 to 15 barges and extending for about 1,200 feet; hence, when they pass through 600-foot locks, these tows must be divided for separate lifts.

Barges are loaded and unloaded at terminals situated along the riverbanks. There are more than 1,800 shallow-draft terminal facilities in the United States (DOT 1999, 10). In contrast to the oceanborne sector, there is no need for river terminals to be sited in shelter; hence, terminals are located at numerous points along riverbanks both within and outside of larger port complexes. Terminal location is determined by a number of factors, including access to railheads, highways, and pipelines and proximity to commodity suppliers and users. About 60 percent of river terminals handle dry bulk cargoes (DOT 1999, 10). Grain elevators and coal depots are major terminals. About one-quarter of the river terminals, including many that are petroleum facilities, handle liquid commodities. In fact, a large portion of the nation's materials for energy production (e.g., coal, petroleum) is transported on the inland waterways. The remaining terminals handle a mix of cargoes, such as steel, chemicals, and building materials. As noted earlier for the movement of bulk cargoes on the oceans, these terminal facilities are often utilities, storage centers, and manufacturing plants that are located on the waterfront for ease in receiving and shipping these bulk materials. Hence, they are themselves cargo origin and destination points rather than transfer facilities.

Rivers vary in the extent to which they are used and open for navigation. Ice and river water flows dictate the length of the navigation season in some places, as does the seasonal demand for agricultural products and other commodities.

Coastal and Intracoastal Waterways

The oceans are used for more than shipping goods and materials overseas; they have a role in the domestic movement of commodities. As noted, large oceangoing vessels operate long-haul domestic routes between Alaska and Hawaii and ports on the West Coast and ports along the Gulf of Mexico through the Panama Canal. However, the main coastwise shipping activity in the United States occurs along the Gulf Coast and, to a lesser extent, along the Atlantic Coast. The Gulf Intracoastal Waterway (GIWW), which is maintained by the Corps of Engineers for 1,300 miles from Texas to Florida, is used for moving grain, coal, refinery products,

and chemicals domestically and for supplying feeder traffic to seaports. Much of the traffic moving through the GIWW consists of shallow-draft dry bulk and tank barges. Some larger self-propelled tankers and freighters are used on longer-haul and deeper coastwise routes, such as between Baton Rouge and Tampa. Deep-draft operations are facilitated by a series of locks and canals along the GIWW in southern Louisiana, which provide deep-draft (45-foot) channels for more than 200 miles from the Lower Mississippi River to the Gulf waters (USACE 2003).

The other major (in terms of route length) intracoastal waterway maintained by the Corps of Engineers is the Atlantic Intracoastal Waterway (AIWW), which is a series of channels more than 700 miles long that extends from Virginia to Florida. The AIWW consists of coastal waterway segments and connecting canals that have a navigable depth of 7 to 12 feet. It is used primarily by recreational boaters and to a limited extent by commercial vessels, accounting for about 1 percent of domestic tonnage (USACE 1997, ES-7). Barges carrying petroleum products, fertilizer, stone, and sand are the primary commercial users.

Farther north on the Atlantic Coast, petroleum products are moved between the mid-Atlantic states and New England. Waterways such as the Chesapeake and Delaware Canal and the Cape Cod Canal facilitate these movements, which supply the Northeast with heating oil, gasoline, and heavy fuel for industry.

Historically, the coastal waters of the United States have not been used to any significant extent for moving containers domestically, on either barges or containerships. Most of the coastwise traffic consists of bulk movements. While the recent introduction and growth of container-on-barge service on some Gulf and mid-Atlantic coastal routes have spurred interest in such activity, the total quantity of this traffic remains small.

Great Lakes System

The Great Lakes have features in common with both the inland and coastal waterways. They are sometimes called the nation's "north" or "fourth" coast. Made up of seven waterways linked at a dozen lock sites, the Great Lakes channels have controlling depths ranging from 23 to 28 feet and can

accommodate certain oceangoing vessels, which gain access through the St. Lawrence Seaway.

About 350 terminals are situated along the U.S. shoreline of the Great Lakes (DOT 1999, 8). A half dozen lake ports rank among the top 50 U.S. ports in terms of tonnage, including Duluth–Superior, Chicago, Detroit, and Cleveland (USACE 2002a). The terminals in these ports, as well as most others on the Great Lakes, for the most part handle dry bulk cargoes, led by iron ore, grain, coal, sand, stone, and lumber. Both barges and self-propelled vessels are used to carry these commodities. Specially designed "lakers," some as long as 1,000 feet, can carry 70,000 tons of cargo. Oceangoing vessels also operate on the lakes; most are bulk carriers, and they seldom exceed 35,000-dwt capacity.

Navigation on much of the Great Lakes System is seasonal, lasting about 8 months, although the use of icebreakers can extend operations by several weeks.

DEVELOPMENTS AFFECTING MARINE TRANSPORTATION

The maritime sector has had to adapt to many changes over the years. Before the age of railroads, major U.S. ports were connected to the nation's interior by inland rivers and canals, which led to the dominance of certain ports such as New York. The subsequent development of a national railroad network fostered growth in ports having good rail access (NRC 1976, 13–32). Urban growth and increased competition for shoreline land led to further changes in port location and development patterns. For example, the center of New York harbor's port complex became New Jersey rather than the land-constrained shores of Manhattan and Brooklyn, and much of San Francisco's port traffic moved across the bay to Oakland (Mayer 1988, 88).

Any discussion of recent developments in the MTS must mention the far-reaching effects of shipping merchandise in unitized, intermodal containers. This revolutionary service was invented in the United States during the 1950s, gathered worldwide momentum during the 1960s, and became the standard means of shipping after deregulation of the domes-

tic railroad and trucking industries during the 1970s and early 1980s. It has culminated in a massive transformation in the nature, productivity, and location of international marine transportation during the past two decades (TRB 1992, 17–21). In particular, the proliferation of this technology, coupled with the growing demand for and removal of impediments to foreign trade, has led to tremendous growth in containership traffic at West Coast ports that are well connected to railroads and Interstate highways, over which containers shipped from Asia can be economically transported to large local markets as well as far across the continental United States (Chilcote 1988).

Not every major influence on the MTS over the past several decades can be described. However, it is important to recognize that the system is highly dynamic and responsive. The following developments illustrate the sector's capacity for change.

Growth in Trade of Manufactured Goods

Just after World War II, U.S. waterborne commerce was dominated by domestic movements of goods and materials, but this situation has changed dramatically over the past four decades as international trade has burgeoned. In 2001, U.S. international merchandise trade (both imports and exports) was more than 20 times higher in value than it was in 1970, having grown twice as fast as U.S. economic output over this period (BTS 2003, 13).

The growth in international trade has had major implications for marine transportation—not only for traffic volume, but also for the nature and location of this traffic. The United States trades with more than 200 countries around the world; however, about three-quarters of this trade (in value) is with five countries: Canada, Mexico, Japan, China, and Germany (BTS 2003, 9). While North American trade moves mainly by truck and rail, most of the goods traded with the latter three countries are transported by water. Waterborne transportation accounts for half of the value of goods traded with Germany, two-thirds of the value of trade with Japan, and 80 percent of the value of trade with China (BTS 2003, 8).

Trade with China has had a particularly strong influence on the MTS. In 1980, China ranked as the 24th-largest trading partner with the United States in terms of trade value; by 2001, it was 4th (BTS 2003, 21–22). In 1970, Japan was the only Asian country among the country's top 10 trading partners; by 2001, three other Asian countries—China, South Korea, and Taiwan—had joined it. Much of the Asian trade involves manufactured goods, and containerization has grown commensurately. This growth has been especially strong at those U.S. ports on the Pacific Coast that have good rail and highway connections to the nation's interior. The ports of Long Beach and Los Angeles have been transformed by the growth in transpacific trade in manufactured goods and particularly by the emergence of China and Korea as major trading partners.

The ratio of the value of U.S. merchandise trade to gross domestic product was 22 percent in 2001 compared with 13 percent in 1990 (BTS 2003, 1). The expectations for future trade growth are discussed in the next chapter. To a large extent, this growth is expected to continue, which will prompt further changes in the marine transportation sector.

Intermodalism, Transportation Deregulation, and Hubbing

Economic deregulation swept through the U.S. domestic transportation sectors during the 1970s and 1980s, and subsequently in many other countries. It unleashed tremendous changes in business methods and relationships, management practices, organizational structures, services, and the deployment of technologies. With greater flexibility to restructure their networks, add and shift capacity, compete for customers, and set rates, railroads and trucking companies began acting more like logistics companies. They integrated their operations to achieve economies of scale and scope and to provide shippers with transportation services from origin to final destination (Gallamore 1999; Chilcote 1988). Hence, at virtually the same time that international trade and demand for container movements were escalating, the transportation industry as a whole was increasingly able and compelled by competition to offer new kinds of services and to introduce technologies that improved service quality and reduced cost.

Deregulation was by no means the only driving force behind containerization and its development. For example, the reductions in manufactured goods trade barriers under the General Agreements on Tariffs and Trade had a substantial effect in spurring and sustaining growth in international trade. Deregulation coincided with these other changes, and together they influenced the development of containerized shipping. A major outcome of deregulation in the trucking and rail industries was a shift by carriers to hub-and-spoke systems. The intent was to concentrate traffic flows to increase points of service; frequency of service; and the utilization of labor, equipment, and infrastructure. Hubs, or load centers, were established as transfer points where traffic arriving from many different origins and headed toward many different destinations (some transcontinental) could be consolidated to increase vehicle capacity utilization (load factor).

Gateway seaports became natural hubs for this activity, especially for intermodal container traffic. The scheduling and pricing flexibility permitted by deregulation allowed trucking companies and railroads to greatly expand the size of their networks connected to container ports, partly though network integration, marketing alliances, and long-term service contracts (TRB 1992, 21–23; TRB 1993, 33–34; Gallamore 1999, 515). With advances in computer technologies, carrier schedules and services could be better integrated to ensure smoother connections, reduce paperwork through single bills of lading and through rates, and track individual shipments and cargo flows across the interconnected systems. In turn, these developments led to higher load factors on the vessels serving the containerized trade, which prompted further increases in containership size and service frequency.

Hub-and-spoke operations have proved beneficial to shippers. They have subsequently adjusted their own operations to take advantage of enhanced transportation capabilities—for instance, by using just-in-time inventorying and decentralizing manufacturing, warehousing, and distribution activities (TRB 1998, 12–15). Changes in the structure of the marine transportation industry have also resulted. Indeed, the concentration of container traffic in a few seaports is a manifesta-

tion of the changes in business practices set in motion by deregulation some 25 years ago.

Security Imperative

Liberalization and growth in global trade and the emergence of a worldwide supply chain have raised many new transportation security concerns. International terrorism, in particular, has created many challenges for the federal government, the MTS, and the freight system generally. The marine transportation sector has long been concerned about cargo theft and the smuggling of contraband and illegal migrants. However, the threat of terrorism has emerged as the sector's most significant security concern since the attacks of September 11, 2001. The threat is multifaceted; transportation systems and their components may be used to bring terrorists and their weapons into the country and they may be the target of terrorists. The terrorist may seek to disrupt the efficient functioning of the transportation system, which can have social and economic repercussions that spread widely, especially because of the increasingly global and time-sensitive nature of the supply chain (Flynn 2000; TRB 2002).

The terrorist threat has heightened interest in the development and deployment of new technologies for tracking shipments, locking and sealing containers, and examining the contents of containers in nonintrusive ways. It has led to greater recognition of the importance of integrating security into the cargo-handling system and throughout the entire supply chain, rather than only at points of entry. It has also spurred greater interest in protecting the communications and information systems that underlie the logistics system (TRB 2003). The understanding has grown that security cannot be achieved by simply adding more guards, fences, and inspectors. Concerted efforts by the public and private sectors (in this country and abroad) are required to build security into the basic structure and operations of the freight system. A particular concern is to ensure that security gaps are not created where the individual modes of transportation interconnect and where public- and private-sector jurisdictions and responsibilities begin and end.

During the past 2 years, government and industry have taken steps to integrate security into the freight system at all its stages. Examples of such efforts are provided in Chapter 3 and include the Customs Trade Partnership Against Terrorism, which is a joint initiative between the U.S. Bureau of Customs and Border Protection and business. Participants agree to establish security programs and meet specific guidelines for securing their facilities and operations. In addition to providing a more secure environment, the program promises shippers and receivers faster processing through customs. Meanwhile, the federal Marine Transportation Security Act of 2002 mandates that port authorities, waterfront facilities, and vessels have comprehensive security plans and incident response plans developed in conjunction with the Coast Guard. This legislation seeks to ensure that security is given explicit consideration by carriers, shippers, terminal operators, and port authorities during operations and infrastructure planning.

The security imperative promises to have far-reaching effects on the MTS. The full implications are not yet known, although they appear to be in the direction of prompting more institutional cooperation and modal integration. To keep the MTS functioning smoothly in support of commerce, more attention will need to be given to developing security capabilities such as shipment tracking systems that also provide efficiency benefits, and vice versa. Security considerations, like safety considerations, must be integrated into all aspects of marine operations and infrastructure development, and doing so will have similar beneficial effects.

Focus on the Environment

Over the last half century, American society has become increasingly aware of and concerned about the environmental and health effects of many economic activities. Numerous environmental protection laws affecting how individuals and industries view and treat the environment have been enacted at the federal, state, and local levels. The MTS has been affected by these changes as much as any other sector. Broad-based federal legislation and regulations to protect air and water quality, ecosystem functions, wildlife and their habitats, and the health and well-being of humans have

prompted many changes in marine transportation demand, operations, and infrastructure. A number of statutory and regulatory requirements have focused specifically on marine transportation. Examples are federal requirements for the safe disposal of the material dredged from navigation ways, regulations on air emissions from ship engines, and the treatment of ballast water to prevent the spread of harmful and invasive species.

Some of the effects of changing environmental demands and concerns on the MTS are obvious. For instance, concern over the effects of locks, dams, dredging, and other channel training structures on river ecosystems, as well as the effects of barge operations themselves, has affected federal investment and management decisions on the inland waterways. The potential for ecosystem and floodplain disturbances caused by extending the locks on the Upper Mississippi River and Illinois Waterway (to reduce barge traffic delays), for instance, has caused the federal government to spend more than 10 years studying the consequences of such development and seeking alternatives that will minimize adverse environmental effects (NRC 2001). The expense of disposing of dredged materials containing contaminants and the protections afforded marine life from dredging activity have increased the time required for and raised the cost of dredging, presumably limiting the scale and number of dredging projects. Legislation to reduce the incidence and severity of marine oil spills has prompted changes in the tanker business; for instance, by requiring the conversion of the fleet to double-hull vessels (NRC 1996; NRC 1998; TRB 2001).

These are only a few examples of how environmental concerns have become important factors in the direction and development of the MTS, both in this country and abroad. The effects of these and many other environmental policies and protections have been large and were mostly unanticipated 30 to 40 years ago. They demonstrate the difficulty of predicting the future of this dynamic and highly interconnected system.

PREPARING FOR FUTURE DEVELOPMENTS

The marine transportation system has undergone dramatic change in recent decades. The rate and magnitude of change have at times taxed the

ability of the public sector to provide the basic infrastructure and services essential to the system's functioning. Public ports, in particular, have been transformed in both their degree and range of use. For some ports, the changes have led to sharp increases in traffic and user demands for new facilities, space, and intermodal connections. For others, trends have gone in the opposite direction, as users have shifted to new locations. Nearly all ports have found it difficult to predict demands as little as 5 to 10 years into the future, which complicates the planning of costly and long-lived port infrastructure.

The federal government, like the management of public ports, must make investment and program decisions that will have long-lasting effects on the MTS while having only limited understanding of future demands on the system. Federal agencies have important roles in nearly all aspects of the MTS. These roles are essential in facilitating commerce, ensuring marine safety and environmental protection, and meeting the imperative of national security. With so many functions, some dating back to the nation's founding, the federal government is presented with a considerable challenge in coordinating them all and making them complementary and consistent with national priorities.

MTS Task Force

By the 1990s, the marked changes in the marine transportation sector, some of which were highlighted above, magnified shortcomings in coordination and consistency of federal marine transportation programs and activities. In 1998, Congress called on the Secretary of Transportation to convene a task force to "assess the adequacy of the nation's marine transportation system to operate in a safe, efficient, secure, and environmentally sound manner."[3] The task force was charged with examining the

[3] Public Law 105-383, Nov. 13, 1998, 112 Stat. 3411. An impetus for the congressional request was a 1996 study by the International Association of Independent Tanker Owners (INTERTANKO) on port and terminal safety (INTERTANKO 1996; INTERTANKO 2002). That study urged more systematic thinking on how to improve the productivity, safety, and environmental compatibility of tanker and other maritime operations through greater coordination of public- and private-sector responsibilities.

capability of the MTS to accommodate projected increases in foreign and domestic marine traffic over the next two decades.

To aid in this assessment, the task force held seven regional listening sessions intended to reach out to government and industry users, owners, and operators of the system. These sessions were followed by a national conference. The product of these efforts was a 1999 report to Congress that describes the MTS's components, functions, and uses; the role of the public and private sectors in supplying marine transportation infrastructure and support services; and various challenges that lie ahead for the system—from competing land uses near waterways to changing patterns of trade and heightened concern over maritime security (DOT 1999).

The task force concluded that the system's "ability to handle the emerging needs of tomorrow will be severely challenged." It recommended that similar outreach to MTS users be undertaken on a regular basis so that the various federal and other government agencies involved in the MTS can better recognize emerging needs and address them sooner. To aid in doing so, the task force urged Congress to create a national council composed of nonfederal members to advise on MTS matters, and it urged the creation of regional harbor committees to identify and address local concerns. It also urged the establishment of an interagency committee to be charged with improving the coordination and consistency of federal agency programs, regulations, and policies pertaining to the MTS.

In response to the task force's recommendations, 18 federal agencies with responsibility for marine activities established the Interagency Committee for the Marine Transportation System (ICMTS) through a Memorandum of Understanding effective April 2000. Meanwhile, the U.S. Department of Transportation created the MTS National Advisory Council (MTSNAC), with members drawn from transportation firms, state and local agencies, industry associations, port authorities, labor unions, academia, shippers, and environmental organizations, to regularly advise the federal ICMTS on maritime transportation issues.

Call for This Study

In May 2001, MTSNAC urged ICMTS to conduct a needs-based assessment of the federal and nonfederal components of the MTS.[4] In particular, it requested an evaluation of (*a*) prerequisites for MTS to meet projected traffic demands, (*b*) potential impacts on other modes of transportation if disruptions or failures should occur in the marine system, and (*c*) future funding required to meet the system's needs. Subsequently, the General Accounting Office (GAO), which was asked by Congress to examine more closely the federal role in funding the MTS, noted the absence of definable and measurable national goals for the MTS (GAO 2002). It urged clarification of these goals, procedures for evaluating federal program performance with regard to the goals, and an examination of alternative funding approaches commensurate with the goals (GAO 2002, 5–6).

In response to the recommendations of MTSNAC and GAO, ICMTS members agreed to sponsor this study of the federal role in the MTS. The aims of the study, the approach taken, and the organization of this report are described in the following sections.

STUDY CHARGE AND APPROACH

Charge

The federal agency sponsors of this study and their charge to the study committee (Statement of Task) are presented in the Preface. The central charge is to develop an analytic framework for federal agencies to use in identifying their capital and operating needs and coordinating their infrastructure investments and program expenditures related to the nation's MTS. The Statement of Task does not define further what is meant by an analytic framework. However, it does imply that the study should view the many related activities of federal agencies in support of safe naviga-

[4] Minutes for May 3–4, 2001, Meeting of MTSNAC, Kings Point, New York. MTSNAC Resolution 3 (www.mtsnac.org/docs/meet-min/MayAug01.doc).

tion, waterway maintenance, environmental protection, and security in an integrated manner.

The sponsors asked the committee to perform the following subtasks in developing the analytic framework:

- Review how federal agency investments in the MTS are now made, including the degree of interagency coordination of these investment decisions and the policy issues associated with patterns of investment;
- Review and interpret projections for future maritime freight and passenger demand;
- Assess plans for MTS maintenance and expansion by industry, state and local governments, and federal agencies;
- Describe the likely impact on the MTS over the next two decades if federal funding remains constant; and
- Identify options for federal funding of the MTS and analyze the federal financial role in support of other modes and the critical factors and trade-offs that must be taken into account in considering alternative federal financing roles.

Approach

The sponsors asked the committee to complete the study in less than 1 year. After reviewing the Statement of Task, the committee determined that detailed reviews of individual federal programs, policy initiatives, and legislation related to the MTS would not be possible; such a diversity of reviews would require much more time and a range and depth of expertise not available to the committee. It therefore elected to focus its efforts on developing the requested analytic framework for federal decision making. Recognizing that federal policies are made in a pluralistic and political environment, the committee chose not to provide a highly mechanistic framework for planning and making decisions. Instead, it sought to develop a means by which policy makers can begin to think more comprehensively about the scope of federal involvement in the MTS

and the aims of this involvement. The result is a framework for marshaling information and analyses in support of decision making and for better understanding the effects of decisions.

As further requested, the committee worked through the various subtasks listed above. Some of the subtasks proved more amenable to evaluation and more helpful for developing the analytic framework than others. All required interpretation by the committee concerning their meaning and their relative importance in developing a framework for decision making. The committee gave the most attention to the following:

1. Reviewing the federal programs related to the MTS, the national interests that these programs are intended to serve, and the degree of coordination that takes place to meet and balance these interests;

2. Reviewing forecasts of commercial demands on the MTS in the coming decades, as well as the prospects of changes in other demands on the system and the emergence of new demands (e.g., demands related to the environment, safety, and security); and

3. Comparing the federal government's roles and responsibilities for marine transportation with its roles and responsibilities for other modes of transportation, including the scope and locus of federal involvement, funding approaches, and means by which program priorities are determined.

Two of the subtasks proved problematic as requested. First, an assessment of plans for MTS maintenance and expansion by private industry, state and local government, and federal agencies could not be conducted, at least not in a thorough and detailed way. The MTS is so large and diffuse that any meaningful evaluation of such plans would have consumed much of the time available for the study; simply gathering and interpreting these plans, from so many public- and private-sector sources, would have taken considerable time and effort. Nevertheless, the committee interviewed a number of shippers, carriers, terminal operators, and other users of the system. It also examined available government and industry

reports depicting aspects of the performance, condition, and needs of the system. Many of these reports were derived from surveys of small and nonrandom samples of ports, vessel operators, shippers, and others involved in the MTS. Although they provided an incomplete picture of system performance, the reports gave the committee additional insights into the current needs and condition of the MTS, as well as emerging areas of concern.

Second, the committee did not seek to describe the likely impact on the MTS over the next two decades if federal funding remains constant. The federal role in the MTS is important and not likely to diminish in importance any time soon; hence, funding levels will need to be commensurate with this importance, in the committee's view. In light of anticipated continued growth in international trade, constant levels of federal funding, in real or nominal terms, would appear to be an adverse and unlikely scenario. Rather than speculate on future levels of funding, the committee examined the more relevant question, in its opinion, of how the federal government decides to allocate resources among priority areas. The growing demands on the MTS, along with competing demands on federal resources, suggest that well-informed and well-supported allocation of federal resources will gain in importance.

To develop an analytic framework for decision making, the committee reviewed the major federal programs related to the MTS and the national interests that underlie them. Four national—and federal—interests stand out: (*a*) ensuring marine safety, (*b*) protecting the marine environment, (*c*) facilitating commerce, and (*d*) providing for national security. The committee examined how decisions are made with respect to these interests across the many federal agencies having a role in the MTS. It found notable deficiencies in and opportunities to improve the information used to measure, monitor, and assess the performance of the MTS across all four of these dimensions.

The emphasis of the report is on the federal role in supplying, overseeing, operating, and helping to finance the infrastructure and support services essential to the MTS. Other kinds of federal interventions, in areas such as taxation, labor law, and agricultural policy, have profound effects on the marine transportation sector, as they do on many other

industries and segments of the economy. In fact, these broader federal policies and laws may have a much larger influence on the MTS in the aggregate than do the narrower federal activities examined in this study. The committee acknowledges their importance but does not try to examine them here.

REPORT ORGANIZATION

In Chapter 2, major public- and private-sector forecasts of marine transportation demand for the next two decades are examined, and possible implications of changes in demand for the capacity and functioning of the MTS are assessed.

The major roles and responsibilities of the federal government in providing key infrastructure and services that support the MTS are reviewed in Chapter 3. Consideration is given to the federal role in ensuring marine safety, environmental protection, the facilitation of commerce, and national security, as well as to how the federal agencies coordinate their policies and programs within and across each of these major areas of responsibility. The federal roles in aviation and highway transportation are discussed in Chapter 4, and they are compared with the federal role in marine transportation. Elements and features of the federal highway and aviation programs that appear beneficial and may be transferable to a federal marine transportation program are identified.

In Chapter 5, the data and reports available for use in assessing and monitoring the performance of the MTS with respect to safety, environment, commerce, and security are reviewed. Consideration is given to how this information is being used to guide federal decisions and where improvements in information are needed.

Chapter 6 offers an analytic framework for decision makers to view the components of the MTS, their uses, and the federal role in a more systematic and complete manner. It concludes with recommendations for the federal government to gather and analyze information on MTS performance in support of more informed and responsive federal decision making.

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Abbreviations

BTS	Bureau of Transportation Statistics
DOT	U.S. Department of Transportation
GAO	U.S. General Accounting Office
INTERTANKO	International Association of Independent Tanker Owners
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
TRB	Transportation Research Board
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard

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2

Marine Transportation Demand

In its 1999 report, the federal Marine Transportation System (MTS) Task Force expressed concern that fast-growing demand in marine freight and passenger travel will challenge the capacity and functioning of this transportation system. It noted that "the total volume of domestic and international marine trade is expected to more than double over the next 20 years" (DOT 1999, viii). This estimate, equivalent to growth on the order of 3 to 4 percent per year, was derived largely from extrapolations of recent trends and near-term forecasts of the tonnage of waterborne cargo moved into and out of the country in international trade (DOT 1999, 25–28). However, significant variations were expected in the rate of growth among different freight segments. The fastest growth,

3.5 percent per year on a tonnage basis, was predicted for goods moved in international trade (DOT 1999, 26). In comparison, bulk cargoes moved domestically on the inland waterways were projected to grow at 1.3 percent per year (DOT 1999, 27).

In this chapter, these and other demand projections are reviewed in more detail to gain a better understanding of where the most dynamic growth in marine transportation demand is expected. In particular, consideration is given to forecasts of demand for the following freight sectors:

- Containerized cargoes shipped overseas, consisting primarily of manufactured and processed goods, as well as other kinds of general cargo moved in intermodal containers;
- Liquid bulk cargoes shipped overseas, consisting primarily of petroleum and chemicals moved by tankers;
- Dry bulk cargoes shipped overseas, consisting largely of agricultural products, coal, and iron ore; and
- Cargoes shipped domestically on the inland rivers and Great Lakes, consisting largely of dry bulk and liquid bulk commodities, much of it moved by barge.

The discussion begins with an overview of current traffic volumes in each of these freight sectors. The major sources of long-range forecasts of traffic demand in each of these sectors are then examined. The chapter concludes with an assessment of possible implications of this forecast demand on the capacity and functioning of the MTS.

CURRENT DEMAND

The most commonly used measure of marine freight is tonnage. More than 2,300 million tons of cargo moved through the MTS, domestic and international, during 2000 (the latest year for which complete data are available). The breakdown by freight sector is shown in Table 2-1.

Table 2-1 **U.S. Waterborne Cargo, 2000**

	Cargo (millions of tons)
International ocean, total	1,290.2
Containership	156.5
Tanker	590.7
Dry bulk vessel	391.5
Other vessel	151.5
Domestic ocean and coastal, total	242.1
Self-propelled (mostly tanker)	135.6
Barge	106.5
Inland rivers and lakes, total	841.9
River barge	727.9
Great Lakes vessels	114.0
Total	2,374.2

Note: Original data converted from metric tons to short tons.
Source: BTS 2002.

On the basis of tonnage moved, barge traffic on the inland rivers represents the largest sector of the MTS; it accounts for about 30 percent of total tonnage transported. Most of the freight moved on the inland rivers consists of heavy bulk commodities, which leads to the high tonnage totals for this segment of the MTS. More than half the tonnage moved on the rivers, for instance, is from shipments of coal and petroleum. Bulk commodities are also predominant on the Great Lakes and in domestic ocean and coastwise shipping. The former consists of shipments of iron ore and coke, while the latter includes the traffic moved domestically along the Gulf Coast and between Alaska, Hawaii, and the U.S. mainland—much of it petroleum.

Another way to measure traffic is by cargo value. Table 2-2 shows both the value and tonnage of cargo moved over the oceans in U.S. international trade. As might be expected, vessels carrying containers, which are used to transport high-value manufactured and processed items, account for a much higher proportion of traffic on the basis of value (about 67 percent) than on the basis of tonnage (less than 15 percent).

FORECAST METHODS AND RESULTS

Presenting an accurate picture of demand for marine freight transportation is complicated by differences in the kinds of freight moved, some of

Table 2-2 **U.S. Waterborne Cargo in International Trade, 2002**

Freight Sector	Amount of Cargo (millions of tons)	Value of Cargo ($ millions)	Percent of Total	
			Amount	Value
Containership	161.8	490,461	14.2	67.3
Liquid bulk (tanker)	602.0	109,303	52.9	15.0
Dry bulk vessel	373.5	128,616	32.9	17.7
Total	1,137.3	728,380	100.0	100.0

Source: U.S. Maritime Administration, Waterborne Databank (www.marad.dot.gov/marad_statistics).

which are more easily and aptly measured by weight and others by value. Even more difficult is forecasting how demand for marine freight will change over time, particularly over the course of a decade or more. In the following discussion, some of the approaches used in forecasting demand and the major sources of these forecasts are reviewed. The forecast results are then reviewed, and their assumptions and uncertainties are considered.

Common Forecasting Approaches

The accuracy of longer-term projections of marine transportation demand hinges not only on an understanding of the basic drivers of demand, such as growth in the national economy and in international commerce, but also on many other factors that can be even more difficult to predict, such as changes in legislation and transportation technology. Such factors will, in time, have measurable effects on both the level and nature of transportation demand. Forecasters of marine transportation demand in the early 1950s, for instance, could not foresee the advent a decade later of containerization, which would quickly transform the way general cargo is transported and help spur even greater international trade.

Despite such uncertainty, long-range demand forecasting is not a futile exercise. As long as transportation services require large-scale capital investments by the public and private sectors, demand forecasting will be required to support decision making. Forecasts are required for planning port facilities, making vessel and terminal investments, and regional and national economic planning. The key to using this information is understanding the sensitivities of forecasts to demand drivers and understanding how the forecasts themselves can go awry. In these

respects, long-range demand forecasting has advanced a great deal since the 1950s as computational capacity, modeling techniques, and information sources have improved.

Basic kinds of forecasting methods are described in Box 2-1. Each has strengths and weaknesses. Some of the simpler methods that are based on few variables have the advantage of flexibility; decision makers find them easy to use for "what-if" scenario analyses. They may not be especially accurate, but they are capable of providing "ballpark" estimates for the initial stages of decision making. At the other end of the spectrum are complex forecasting models designed to provide detailed projections across many economic sectors and regions with a high degree of internal consistency (e.g., imports equal exports for all commodities on a global basis). They may be used to inform national policy making. Such complex multivariate modeling systems require large amounts of data and computer processing and a substantial amount of time from the modeler.

Major Sources of Demand Forecasts

Because the quantity of marine traffic is heavily influenced by international commerce, forecasts of international trade are especially important inputs in most marine freight forecasts. Similarly, projections of domestic and international energy demand, as well as the demand for agricultural commodities, are important.

The major commercial and government suppliers of long-term trade and commodity forecasts tend to use the most sophisticated forecasting methods described in Box 2-1, which incorporate time series, constrained demand, and multivariate modeling approaches. These suppliers include

- Global Insight, Inc.,[1] which forecasts trade in all major physical commodities (i.e., nonphysical commodities, such as electricity and services, are not included), across nearly all countries, and in detail by commodity, trade route, and vessel type (e.g., container, tanker, dry bulk);

[1] Global Insight, Inc., is the combination of the formerly separate entities of DRI/McGraw Hill and Wharton Econometric Forecasting Associates (WEFA).

Box 2-1

Common Methods of Demand Forecasting

- Constant growth rate forecasts: Sometimes referred to as "hockey stick" projections, these forecasts are driven by a posited growth rate that is expected to continue over the forecast horizon. Such unconstrained forecasts can lead to illogical projections over long periods of time (e.g., a projection based on a constant unconstrained reproduction rate could lead to a forecast of rabbits taking over the world).
- Constrained forecasts (based on the assumption of limited supply or demand): To overcome the limitations of constant growth rate forecasts, limits are imposed on growth rates to ensure reasonable results.
- Industrial analysis forecasts: The forecast is based on manufacturing capabilities, with industrial development and investment as the primary predictors of growth.
- Market research–based forecasts: Surveys of individual opinions, purchasing plans, and consumer expectations are used to develop growth rates and other information, on which the forecast is then based.
- Time series forecasts: Historical data are analyzed, typically on the basis of regression analyses, to predict future demand or supply. Critics of projections based on historical data liken them to driving a car by looking in the rearview mirror.
- Scenario forecasts: Scenario-based forecasts are based on a set of assumptions about future conditions. War gaming, such as that used by the Department of Defense, is an example of scenario-based forecasting.
- Simulation-driven (Monte Carlo) forecasts: Ranges of expected outcomes, rather than single data points, are used for inputs and combined into an expected outcome distribution. Simulation-driven forecasts can provide insight into the range of potential outcomes and their likelihood.
- Multivariate modeling forecasts: These forecasts develop an internally consistent model of future trade through the use of a large number of independent variables and multiple constraints. High-speed computers have facilitated the generation of these complex models, which are used for national and world trade models.

- The Energy Information Administration (EIA) of the U.S. Department of Energy, which publishes the *Annual Energy Outlook* containing long-term forecasts of U.S. energy balances, including projected imports and exports of specific energy commodities (e.g., crude oil, coal, petroleum products, natural gas); and
- The Institute of Water Resources (IWR) of the U.S. Army Corps of Engineers (USACE), which projects demand for transportation on the nation's waterways, including the inland waterways. Because bulk cargoes are the chief source of demand for inland waterways, IWR employs specialty consulting firms to develop long-range forecasts of agricultural products, minerals, energy, and other commodities moved in large quantities on inland waterways.

Forecast Results

Several forecasts from the preceding sources are examined in this section. They offer insight into the factors that can influence demand, and they illustrate the kinds of information that decision makers in the public and private sectors have at their disposal to plan for the future. Results from the latest (at the time of this study) 20-year forecasts from Global Insight, EIA, and USACE are presented at different levels of aggregation and across different demand sectors, starting with forecasts of all U.S. international trade and then focusing on specific categories of freight, including containerized cargo, energy, and agricultural commodities.

International Trade (Total) Forecasts

Global Insight's forecasts are developed from dynamic trade models of supply and demand that cover more than 75 physical commodity types in each trading region of the world (currently encompassing 54 major countries and 16 regions). Factored into the models are current and projected exchange rates, price deflators, demographic trends, expected production capacities, and other relevant variables such as transportation costs. Forecasts for U.S. international trade in all commodity sectors are

Table 2-3 **Forecasts of U.S. International Trade, All Cargo, 2000–2020, Global Insight, Inc. (February 2003)**

	Total U.S. Trade (millions of tons)		Compound Annual Growth Rate (%)	Percent Change
	2000	2020		
Exports	386	538	1.7	39.5
Imports	872	1,304	2.0	49.5
Total	1,258	1,842	1.9	46.5

Note: Original data converted from metric tons to short tons.
Source: Personal communication with analysts from Global Insight, Inc., by Navigistics Consulting on behalf of the committee.

shown in Table 2-3. The forecasts, which are based on tonnage, anticipate an average annual growth rate of 1.9 percent per year from 2000 to 2020. Total trade volume is thus projected to increase by nearly 50 percent over the forecast period.

Container Trade

Global Insight also forecasts growth in trade sectors. The firm's most recent forecasts for U.S. containerized exports and imports are presented in Table 2-4. Cargo exported in containers, measured in 20-foot equivalent units (TEUs), is expected to grow an average of 3.4 percent per year, while containerized imports are expected to grow an average of 5 percent per year. Containerized traffic overall is expected to grow 4.4 percent per

Table 2-4 **Forecast U.S. Trade in Containerized Cargo, 2000–2020, Global Insight, Inc. (February 2003)**

	Container Trade (thousands of TEUs)		Compound Annual Growth Rate (%)	Percent Change
	2000	2020		
Exports	8,133	15,946	3.4	96.1
Imports	12,217	32,455	5.0	165.7
Total	20,350	48,401	4.4	137.8

Note: Figures exclude domestic containerized trade among the contiguous 48 states, Hawaii, Alaska, and Puerto Rico.
Source: Personal communication with analysts from Global Insight, Inc., by Navigistics Consulting on behalf of the committee.

year. At this pace, traffic would double in about 15 years and increase by more than 135 percent over two decades.

Energy (Liquid and Dry Bulk) Trade

EIA's latest *Annual Energy Outlook* (2003) contains petroleum import and export forecasts for the next two decades. The 2020 forecasts are shown in Table 2-5. The largest gains are expected for petroleum product imports, which are projected to grow 4 to 5 percent per year. Crude oil imports, which account for most of the petroleum trade, are expected to grow less than 2 percent per year on average, resulting in a 40 percent increase in import levels from 2000 to 2020. The quantity of petroleum exports is relatively small and is not expected to change much during the period.

EIA 20-year forecasts of imported and exported natural gas (which is moved mostly in liquefied natural gas tankers) and coal are shown in Table 2-6. Natural gas imports are forecast to grow at a rate of about

Table 2-5 **Forecast U.S. Petroleum Trade, 2000–2020, EIA (January 2003)**

	Petroleum Trade (millions of tons)		Compound Annual Growth Rate (%)	Percent Change
	2000	2020		
Crude imports	496.2	695.7	1.7	40.2
Product imports	119.3	301.7	4.7	152.8
Product exports	54.2	58.9	0.4	8.6
Total	669.7	1,056.3	2.3	57.7

Note: Pipeline volumes from Canada are included in the figures.
Source: EIA 2003.

Table 2-6 **Forecasts of U.S. Coal and Natural Gas Trade, 2000–2020, EIA (January 2003)**

	Energy Trade[a]		Compound Annual Growth Rate (%)	Percent Change
	2000	2020		
Coal exports	38.5	18.7	–3.6	–51.5
Natural gas imports	97.4	182.0	3.2	86.9
Natural gas exports	6.2	10.4	2.6	67.7

[a] Millions of tons of coal; millions of tons of natural gas in oil equivalent units.
Source: EIA 2003.

3.2 percent per year during the period, which would lead to a near doubling. In comparison, the quantity of coal exported is expected to decline in absolute terms as more of the country's domestic production is used internally (coal imports are insignificant and are expected to remain so).

Inland Waterway Forecasts

USACE projections of freight traffic on the inland waterway system (to 2020) are summarized in Table 2-7. These projections, made in 1995 and 1998, are cited in the 1999 MTS Task Force report (DOT 1999). They anticipate 1.3 percent annual growth in the total volume of cargo transported on the inland waterways. The tonnage of all types of cargoes is expected to grow at a rate of 1 to 2 percent per year. Total annual tonnage moved on the inland waterways is expected to increase by 26 percent during the 20-year period.

More recent forecasts were released by USACE in July 2002. These forecasts, shown in Table 2-8, are for shipments only on the Upper Mississippi River. The magnitude of predicted change (23 percent) in traffic volumes is consistent with the 1995 and 1998 USACE forecasts for the inland waterway system as a whole.

Table 2-7 **Forecasts of Commodity Traffic on the Inland Waterway System, 1995/1998–2020**

	Traffic (millions of tons)		
Commodity Group	**1995–1998 Weighted Average**	**2020**	**Compound Annual Growth Rate (%)**
Farm products	87.9	124.2	1.6
Metals	30.9	44.7	1.7
Coal	175.2	222.2	1.1
Crude petroleum	43.4	53.8	1.0
Nonmetallic minerals	99.9	139.9	1.5
Forest products	17.9	21.9	0.9
Industrial chemicals	41.7	65.0	2.0
Agricultural chemicals	12.2	14.9	0.9
Petroleum products	111.5	138.2	1.0
Other	11.2	11.1	–0.1
Total	631.8	835.9	1.3

Source: USACE 1995 and 1998 projections cited in DOT 1999, 27.

Table 2-8 **Forecasts of Commodity Traffic on the Upper Mississippi River, 2000–2025, USACE Central Scenario (July 2002)**

Commodity	Compound Annual Growth Rate (%)	Percent Change
Farm products	1.5	34.5
Coal and coke	0.2	4.9
Petroleum products	0.5	10.6
Agricultural chemicals	–0.3	–6.5
Construction materials	0.4	9.0
Industrial chemicals	2.0	48.8
Iron and steel	0.5	10.9
Miscellaneous	1.5	34.0
Total	1.0	23.2

Source: USACE 2002, Tables 12 and 17.

Summary of Forecast Results

Table 2-9 summarizes the results of these major forecasts of marine transportation demand to 2020. What is most apparent from this comparison is the expectation for continued high rates of growth in container traffic. Much more modest growth is anticipated for the dry and liquid bulk commodities shipped overseas and on the inland waterways.

FORECASTING ASSUMPTIONS AND CONFIDENCE

A common assumption of models forecasting high growth in container traffic is that international commerce will flourish, populations will

Table 2-9 **Summary of Major Forecasts of Waterborne Cargo, 2000–2020**

		Traffic		Compound Annual Growth	Percent	
Sector	Units	2000	2020	Rate (%)	Change	Source
Total ocean (international)	Million tons	1,143.4	1,674.5	1.9	46	Global Insight
Container	TEUs (thousands)	20,350	48,401	4.4	138	Global Insight
Petroleum	Million tons	669.7	1,056.3	2.3	58	EIA
Dry bulk	Million tons	355.9	444.0	1.1	25	Global Insight
Total inland river	Million tons	661.7	836.0	1.3	26	USACE

increase, and incomes will rise worldwide, all of which will cause trade in manufactured goods to grow. Most forecasts assume that the U.S. economy will expand at an average annual rate of 3 percent during the period, causing gross domestic product to nearly double. In its middle-series estimates, the U.S. Bureau of the Census projects the national population to increase by 50 million between 2000 and 2020.[2] By themselves, the assumed increases in national income and population explain a great deal of the expected growth in international trade and thus the anticipated strong growth in container trade. Of course, other assumptions are embedded in the forecast models. Some are especially difficult to model, including the following:

- The occurrence of "shocks," such as enduring droughts, political upheaval, and war. Although such shocks do occur, their timing, magnitude, and effects are largely unpredictable; hence, long-range forecasts do not take them into account. Rapid and large-scale changes in the political and economic systems of China, for instance, could yield such "shocking" effects on international commerce, and thus on the demand for marine transportation.
- The introduction of new technologies that have transforming effects on the pattern and level of marine transportation demand. Complex demand models do assume that evolutionary changes in technologies will make transportation services less expensive over time. The models, however, do not have good ways of accounting for the occurrence and impact of dramatic technological changes. The widespread introduction of intermodal containers in the 1960s (sometimes referred to as the "container revolution") is a good example of how technological change can transform marine transportation demand.
- Major changes in consumer preferences. The fundamentals of consumer behavior are well understood; for instance, consumers tend to purchase more of a good as its price falls. Nevertheless, preferences for

[2] www.census.gov/population/projections/nation/summary/np-t1.pdf.

particular goods can change, causing some to become more or less in demand over time. The most complex demand models tend to work on a life-cycle basis that incorporates consumer sentiment indices to account for changing consumer preferences. However, consumer preferences can change in unanticipated ways. As an example, during the 1970s, Americans began purchasing foreign-made automobiles and electronics at much higher rates than previously. Many factors accounted for this change, including greater acceptability of foreign-made goods as perceptions of poor product quality diminished.

- Major changes in trade policies. Substantial changes in tariffs or trade embargoes with major trading countries are examples of government policies that could have direct impacts on the demand for marine transportation services. Such changes, and the precipitating factors, can be unpredictable.

In addition to these uncertainties, demand modelers must make assumptions about a range of other factors, such as rates of borrowing and savings and demographic trends. Given the size and complexity of world trade, the influence of any one of these "macro" factors can have far-reaching effects on forecast accuracy. Moreover, the compounding effects of even small variations in rates of growth can have large effects on the aggregate growth levels predicted over time. For example, an actual growth rate in container trade that is just one-quarter of a percentage point lower or higher than the forecast rate can lead to predictions of traffic growth that are off by tens of millions of TEUs in a matter of 20 years.

Finally, the human element of forecasting must be taken into account, because published forecasts are often influenced by perceptions of what seems reasonable. Sometimes forecast results, no matter how well modeled, do not appear realistic to decision makers, causing forecasters to make adjustments. Often, the adjustments are intended to reduce the forecast rate of growth; however, they can also be made to increase it. As an example of the former, in 1987 the Ports of Long Beach and Los Angeles

Table 2-10 **Example of Past Long-Term Cargo Forecast Compared with Actual Volumes, All Cargo and Containerized Cargo Only**

	Amount of Cargo[a]		Compound Annual	Percent
	1985	2000	Growth Rate (%)	Change
All Cargo				
WEFA 1987 forecast	675	1,178	3.8	74.4
Actual	675	1,393	4.9	106.4
Containerized Cargo Only				
WEFA 1987 forecast	5,893	12,125	4.9	105.8
Actual	5,893	20,350	8.6	245.3

Note: Figures exclude seaborne domestic traffic (e.g., shipments between U.S. mainland and Alaska, Hawaii, and U.S. territories).
[a] For all cargo, amounts are in millions of tons; for containerized cargo only, amounts are in thousands of TEUs.
Source: WEFA (San Pedro Bay Cargo Forecasting Project 2020, December 1987).

(as part of the San Pedro Bay 2020 Plan for capital development) cosponsored projections of total U.S. oceanborne trade for 1985 to 2000, as well as forecasts of containerized trade. These forecasts, performed by WEFA for the period 1985 to 2000, are shown in Table 2-10. They are compared with actual traffic volumes during the period. The 1987 forecasts substantially underestimated traffic growth, especially for container movements. More than 15 years later, it is difficult to know all the factors contributing to this inaccuracy. However, participants in this forecasting effort recall initial growth projections that were considerably higher (and of a magnitude comparable with actual levels). These high-growth forecasts were not used out of concern that they would be viewed as too high to be credible.[3] Because they necessarily involve many assumptions and uncertainties, all forecast models present a series of scenarios from which policy makers must choose in making long-range plans and decisions.

Most forecasts are accompanied by sensitivity analyses to provide a range of possible outcomes. Moreover, the development and refinement

[3] Personal recollection of study committee member involved in the forecasting project.

of forecasting models compel evaluation of the many factors that can influence marine transportation demand, including differing constraints on the supply of marine transportation services and capacity. Although the understanding gained from modeling can never be comprehensive, it can help inform both public and private decision making.

SUMMARY ASSESSMENT

The 1999 MTS Task Force report raises concern that a doubling of demand for marine freight during the next two decades will severely tax the capacity of the MTS. Long-range forecasts, however, suggest the importance of focusing on different components of demand. Rising incomes and escalating trade in manufactured goods are factors driving demand for the movement of marine containers. Of all the segments of the MTS, the container segment has the greatest potential for growth. Forecasts indicate that international container traffic could continue to grow at a rate of 4 to 5 percent annually, which would cause a doubling during the next two decades. It could grow at an even faster rate. The capacity of the MTS to handle such growth is therefore likely to become a greater concern for both industry and government.

Growth in international container traffic at the rate forecast could necessitate new physical infrastructure, which will take many years to complete, as well as improvements in the management and efficiency of these assets. Traffic in bulk shipments moved on the inland rivers and lakes is expected to grow at a more modest pace of 1 to 2 percent per year. However, much of the infrastructure on these systems is old and, in some cases, outmoded. Even relatively modest growth in traffic levels on these systems—producing 20 to 40 percent increases in volumes in 20 years—will further tax many parts of this federal infrastructure system.

Many factors have the potential to influence marine transportation demand, including some that cannot be predicted or planned for. History suggests the importance of adaptability and flexibility in meeting marine transportation demand.

REFERENCES

Abbreviations

BTS	Bureau of Transportation Statistics
DOT	U.S. Department of Transportation
EIA	Energy Information Administration
USACE	U.S. Army Corps of Engineers

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3

Federal Roles in Marine Transportation

The major roles and responsibilities of the federal government related to the nation's marine transportation system (MTS) are reviewed in this chapter. The federal government's influence on the MTS is multifaceted and far-reaching. Federal policies and programs concerning international trade, agricultural production, and many other areas affect the demand for and supply of marine transportation services, the structure of the maritime industry, and the efficiency with which it operates. The federal government has a direct role in the provision of much of the infrastructure and support services needed for the MTS to accommodate the nation's commerce. It also has a lead role in ensuring that the system functions safely,

in a manner that minimizes environmental impacts, and in support of the nation's military and security needs.

These varied federal responsibilities and functions are carried out by several agencies. Each is described in this chapter in relation to the national interests listed above. Consideration is given to how these federal agencies coordinate their MTS-related policies and programs in pursuit of these interests.

ENSURING MARINE SAFETY

The U.S. Coast Guard is the principal federal agency responsible for the safety of marine operations. It shares some safety-related functions with other agencies, including the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Army Corps of Engineers, but the Coast Guard has overarching responsibility for ensuring that the navigation environment and operations are safe for vessel operators, crew, and passengers. It pursues this safety mandate through numerous programs and activities, as described in the following subsections.

Aids to Navigation

As part of its traffic management responsibilities, the Coast Guard places and maintains the aids to navigation that mark the nation's channels. This service can be traced back to creation of the U.S. Treasury's Lighthouse Service by Congress in 1789, which preempted state authority over navigable waters. In addition to providing lighthouses, the Lighthouse Service was charged with installing, operating, and maintaining beacons, buoys, and public piers. In 1939 the Coast Guard assumed these responsibilities (USCG 2000).

The Coast Guard's Aids to Navigation Program's main purpose is to prevent groundings and collisions with other vessels and structures (USCG 2003). After World War II, the agency aggressively pursued many new navigation technologies to achieve these goals more efficiently and effectively. For instance, most lighthouses were automated, and short-

range navigation aids and radio services were introduced. Today, the Coast Guard maintains nearly 50,000 fixed and floating aids (e.g., buoys, day marks, fog signals, beacons, radio towers) for short-range navigation (USCG 2000). It also maintains aids used for longer-range navigation, including LORAN and DGPS (Differential Global Positioning System).

Search and Rescue Services

In 2002, the Coast Guard responded to nearly 40,000 calls for assistance from mariners in distress. Most of these calls were for incidents involving pleasure craft and commercial fishing vessels (USCG 2003, 16). Nevertheless, when larger merchant and passenger transport vessels are in distress, the response can be costly and complex, and the Coast Guard must prepare for such events. A major component of the Coast Guard's rescue program is its role in the Automated Mutual Assistance Vessel Rescue System (AMVER). Vessels participating in this mutual aid network transmit information via satellite about their location, intended course, communication links, and rescue capabilities to a database at the U.S. Coast Guard Operations Systems Center. This information allows rescue coordination centers worldwide to locate vessels near a ship in distress, in order to divert them to render aid. More than 12,000 ships from over 140 nations, representing about 40 percent of the world's merchant fleet, participate in AMVER.[1]

Many of the Coast Guard's provisions and procedures for search and rescue conform with long-standing international agreements, such as the International Convention for the Safety of Life at Sea and the International Convention on Search and Rescue. These conventions were developed with Coast Guard participation through the International Maritime Organization (IMO), which is a specialized United Nations agency.

Commercial Vessel and Crew Standards

A forerunner agency to the Coast Guard was the Department of Treasury's Steamboat Inspection Service. Established in 1851 in response to

[1] seas.amverseas.noaa.gov.

repeated, and sometimes spectacular, steamboat accidents, the service was given the responsibility to develop and enforce federal rules governing the safe construction, operation, and equipage of merchant vessels (Johnson 1987). It was also responsible for investigating marine accidents, and its authority was eventually broadened to include oversight of crew and passenger safety, including crew licensing. A sister agency in the Department of Treasury, the Bureau of Navigation, had responsibility for administering navigation laws. These two federal agencies were later merged to form the Bureau of Marine Inspection and Navigation. The Coast Guard assumed all of the safety regulation and inspection responsibilities of the Bureau of Marine Inspection and Navigation on a temporary basis during World War II and permanently after the war.

Today, the Coast Guard promulgates and enforces a variety of regulations governing vessel construction and equipment, seaworthiness, pilotage, fire protection, life-saving appliances, and crew member qualifications. Standards apply to small passenger vessels used for charter and for-hire passenger services, as well as larger merchant ships. The Coast Guard enforces the standards through various means, including technical plan review and periodic vessel inspections. Because most oceangoing commercial vessels that call at U.S. ports are registered in other countries, the Coast Guard must work in concert with IMO and other international bodies to ensure the safety of these vessels. The agency exercises port-state control of foreign-flag vessels operating in U.S. waters, which sometimes involves inspections to ensure that all U.S. and internationally agreed-upon standards for vessel safety, security, and environmental protection are met.

The U.S. Maritime Administration (MARAD) contributes to the training of qualified mariners through its support of the U.S. Merchant Marine Academy and by administering federal aid to six state maritime academies. The academies seek to raise the skills and competency of merchant mariners as well as to provide a sufficient merchant marine capability to serve U.S. commercial interests and the U.S. armed forces in the event of a military deployment.

Navigation Advisories and Nautical Information

Although the Coast Guard has overarching federal responsibility for marine safety, several safety-related responsibilities and supporting functions are carried out by other federal agencies. NOAA, in particular, has several such functions. For instance, it is responsible for providing marine weather forecasts and advisories through its Marine Services Program. Much of the information provided through this program and relayed to mariners by the Coast Guard is derived from NOAA's National Data Buoy Center maintained by the agency's National Weather Service (NWS). Mariners can access the information in the form of marine advisories and forecasts through Coast Guard and NWS radio broadcasts, telephone services, and Internet postings. On inland waterways, NWS tracks river levels and icing conditions. It operates river forecast centers, which provide flood warnings for hundreds of river locations.

NOAA is also responsible for surveying and charting U.S. coastal waters and the Great Lakes (the Corps of Engineers surveys and charts the inland rivers). In fact, the U.S. Coast and Geodetic Survey was one of several federal agencies brought together to form NOAA more than 30 years ago. These services are now provided by NOAA's National Ocean Service (NOS). NOS is responsible for providing mariners with nautical charts, shoreline maps, and real-time water level and current data. NOS's Office of Coast Survey supplies mariners with nautical charts and hydrographic information. The charts, which are provided in both paper and digitized formats, contain information about the nature and form of the coast, the rise and fall of tides, the depth of water, the general configuration of the sea bottom, and the locations of hazards and navigation aids. NOS monitors sea level variations and currents through measurement stations linked by its National Water Level Observation Program. It also manages the National Spatial Reference System, which ensures the integrity and accuracy of geospatial coordinates—critical to navigators in all modes.

Safety Monitoring and Assessment

In support of its safety mission and programs, the Coast Guard collects and analyzes information on marine incidents. The kinds of safety data collected

by the Coast Guard, which are discussed in more detail in Chapter 5, include marine casualty reports and oil spill and pollution data. The Coast Guard uses this information in support of its regulatory development and enforcement programs and for setting performance goals and reporting to Congress on program accomplishments.

Another federal agency with responsibility for monitoring marine safety performance and needs is the National Transportation Safety Board (NTSB). While NTSB investigates only a handful of marine transportation incidents each year, its investigations focus on major events that resulted in or could have resulted in major loss of life or environmental damage, or that involved other modes of transportation. Examples of events that NTSB investigates are ferry and cruise ship fires, tanker groundings, and barge collisions with rail and highway bridges. NTSB often makes recommendations for corrective actions that are directed to the Coast Guard for further evaluation and implementation.

ENSURING MARINE ENVIRONMENTAL PROTECTION

Marine safety and environmental protection are, in many respects, inseparable goals. Actions that prevent or mitigate the severity of vessel collisions, groundings, and other kinds of distress can protect human life as well as the environment. For instance, well-designed tankers that operate safely are less likely to have accidents that harm crew or to become involved in oil and chemical spills that damage the environment. In this regard, the Coast Guard's extensive regulatory, programmatic, and operating responsibilities to provide for safe marine transportation also have environmental benefits.

The Coast Guard has many responsibilities and functions that are aimed specifically at marine environmental protection, and it has the lead federal role in ensuring that navigation activity is environmentally compatible. It promulgates and enforces federal and international rules intended to prevent marine pollution. It operates the National Response Center, which receives reports of pollution incidents and directs the Coast Guard's on-scene coordinators in response operations. The agency's National Strike Force, which specializes in pollution response, is part of

a multiagency federal response capability known as the National Response System. The Coast Guard receives a significant amount of support from other federal agencies in carrying out its environmental responsibilities.

Marine Pollution Prevention and Response

Oil and chemical spills into inland and coastal waters and at sea are major environmental threats associated with marine transportation. Ever since the Oil Pollution Act of 1924, the Coast Guard has had a prominent role in regulating and responding to the release of oil in U.S. waters. In the aftermath of several large-scale spills from the 1960s through the 1980s, Congress expanded and strengthened the Coast Guard's role in preventing and mitigating marine pollution. The Coast Guard has authority to establish regulations governing the design, maintenance, and operation of vessels not only to ensure passenger and crew safety but also to protect the marine environment. In addition, it is responsible for establishing spill cleanup and liability regulations, investigating spill origins, and ensuring that the responsible parties pay for cleanup and restoration.

The Coast Guard's environmental responsibilities have grown over time, commensurate with growing public interest in environmental quality. In landmark legislation following the 1989 *Exxon Valdez* oil spill, Congress passed the Oil Pollution Act of 1990 (OPA 1990), which set new requirements for vessel construction, crew licensing and manning, and contingency planning. The act enhanced the federal response capability and enforcement authority and included stiffer penalties for parties responsible for spills. Congress gave the Coast Guard responsibility for administering the Oil Spill Liability Trust Fund (generated from taxes on crude oil) and for establishing the National Pollution Funds Center to administer funds for damage assessments and restoration from oil spills. OPA 1990 gave the Coast Guard a number of new responsibilities for safety and environmental protection. The Coast Guard must take a more concerted and systematic approach to meet these responsibilities through regulation, planning, and industry incentives affecting vessel design and operations, manning, and incident response and mitigation.

NOAA provides the Coast Guard with technical information and scientific expertise for oil and chemical spill response and restoration. Its information on tides, currents, weather, and waves is important for guiding spill containment actions. NOAA scientists, who are experts in oceanography, biology, chemistry, and geology, can predict where a spill will go and its possible effects, which is essential for planning mitigations. Moreover, NOAA's surveying and charting programs, as well as its weather advisories, are intended to help prevent environmental accidents in the first place.

Stewardship and Monitoring of the Marine Environment

NOAA has an important role in protecting the coast and ocean environment by collecting scientific information, protecting national marine sanctuaries, and administering the National Marine Fisheries Service. This stewardship role is relevant to the MTS in a number of ways. One of NOAA's functions is to provide environmental guidance to ports. The nation's coasts are managed by the individual states with financing assistance from the federal government administered through NOAA's Coastal Zone Management Program, a federal–state partnership that encourages the preservation and restoration of the nation's coastal communities and resources. Through this program, NOAA provides states, local governments, and port authorities with technical guidance and information on coastal management.

Finally, NOAA is responsible for protecting marine fisheries, habitats, and endangered species through a number of programs and services, including the National Marine Fisheries Service. By law, the agency must be consulted when actions—especially federal actions—can disrupt coastal wetlands and benthic habitats. Examples of such actions are dredging, filling, disposing of dredged material, and placing structures in marshes. The possible impacts on marine life and habitats from such planned actions must be assessed by NOAA and its National Marine Fisheries Service in advance. Under provisions of the Sustainable Fisheries Act, federal agencies are required to consult with the National Marine Fisheries Service when they take actions, such as dredging, that may affect

protected fish habitat. To further protect fisheries, endangered species, and marine habitats, NOAA works with the Coast Guard in developing and enforcing ballast water management programs that are intended to prevent the harmful spread of invasive species.

Other Environmental Protection Responsibilities

Like all federal agencies, the Corps of Engineers must examine the environmental impacts of its projects and actions, including dredging activities and water development projects. The corps has extensive environmental science and engineering expertise for performing such evaluations. Moreover, it is called upon by other government agencies to review proposed projects that can have environmental impacts on wetlands. The corps' role in wetlands permitting is one of its most significant civilian responsibilities and requires extensive interaction with the ports, terminal operators, and other parts of the MTS.

The U.S. Environmental Protection Agency (EPA) is the national agency responsible for administering and enforcing most of the country's major environmental statutes. Navigable waters are covered explicitly by the Clean Water Act, which regulates the discharge of pollutants into waters and provides for the protection of watersheds and wetlands for safe drinking water, seafood, and recreational activity. EPA shares or has sole implementing authority for many other acts that affect marine transportation, such as the Clean Water Act and the Endangered Species Act. Even its implementation of the Clean Air Act can have important implications for marine transportation, because the operation of vessels and motor vehicles in urban port complexes is subject to EPA pollution monitoring and air quality attainment standards.

EPA is also responsible for administering the National Environmental Policy Act (NEPA), which is intended to ensure that all federal agencies give proper consideration to the environment before undertaking major projects. It coordinates the NEPA environmental impact assessments that other federal agencies such as the Corps of Engineers and the Coast Guard must complete for major projects they undertake, approve, or help fund.

FACILITATING COMMERCE

The federal government has long had a central role, rooted in the Constitutional provisions giving Congress authority to regulate interstate commerce, in developing and maintaining the nation's navigable waterways. In fulfilling this role, the federal government has taken the lead in building, maintaining, and operating the nation's navigation channels and supplying various other related infrastructure and services, as described below.

Navigable Channels

The U.S. Army Corps of Engineers is the chief federal agency responsible for ensuring that inland, coastal, and harbor channels support the nation's navigation needs. It has held this responsibility for more than 175 years. The corps was the country's only formally trained body of engineers for much of the 19th century, and Congress and the president turned to it frequently to provide engineering expertise for both military and civil works. As early as 1824, when Congress passed the General Survey Act, the president charged the corps with surveying all of the nation's transportation routes and recommending options for improving them for national defense and commerce (Ferejohn 1974). Two years later, Congress passed the first Rivers and Harbors Act and appropriated funds to the corps for making specific navigation improvements to the Ohio, Mississippi, and Missouri Rivers. This marked the beginning of the corps' navigation and water development programs. As discussed in more detail later in this chapter, it also marked the beginning of Congress appropriating funds for specific navigation projects and the corps' dual role in assessing needed projects and undertaking them—a pattern of responsibility that remains to this day.

The Civil Works Director of the corps is responsible for planning, building, maintaining, and operating 137 locks sites on the inland rivers, 70 on the Atlantic, Gulf, and Pacific Coasts, and 26 on the Great Lakes. These federally owned sites contain 270 lock chambers, many of which are accompanied by dams that are used to control the river flows and depths and for other purposes such as supplying hydroelectric power, drinking

water, and waters for recreational boating and fishing (USACE 1997, 53). About half of these locks and dams are 50 or more years old; hence, maintenance is a major responsibility of the corps.

Altogether, the corps is responsible for the navigation infrastructure on about 12,000 miles of active commercial waterways, most with a constant minimum water depth of 9 feet or more. The infrastructure is operated from eight divisions (also called Regional Business Centers) and more than three dozen district offices, each of which has responsibility for operating and maintaining the channels, locks, and dams within its boundaries.

In addition to operating the lock and dam infrastructure, the corps is responsible for dredging the river, lake, and intracoastal ways. Dredging activity is particularly important along the Lower Mississippi River and the Gulf Coast. Most of this dredging is referred to as "maintenance" activity because it is intended to maintain existing channel dimensions. The corps is responsible for keeping the inland waterways free of hazards and pollution, mapping the waterways, and supplying and maintaining channel navigation markers and aids. Its roles in planning, building, regulating, maintaining, and operating the inland waterways give the corps one of the most comprehensive sets of responsibilities for civil infrastructure management in the federal government—perhaps surpassed only by the Federal Aviation Administration's (FAA's) responsibility for the nation's airspace.

In addition to having such a prominent role on the inland and intracoastal waterways, the corps is responsible for the navigation channels and major infrastructure (e.g., breakwaters, jetties) in the nation's ocean and lake harbors. Almost all of these channels exceed 12 feet in depth and are defined as deep-draft waterways. For the most part, the deep-draft channels do not require the corps to take an active operational role, as is required for the functioning of lock chambers and other control structures on the inland and intracoastal waterways. Instead, the corps' main responsibility is to ensure that the navigable channels have sufficient depth and width to accommodate vessel traffic. Channel dimensions differ from place to place and require varying amounts of construction and maintenance activity.

One aspect of channel maintenance that is outside the purview of the Corps of Engineers is the provision of ice-breaking services. Congress has charged the Coast Guard with providing ice breaking to keep the nation's channels and harbors open to navigation "per reasonable demands of commerce." Most ice control activity takes place on the Great Lakes, the St. Lawrence Seaway, and certain northeastern U.S. rivers and harbors to permit a predictable navigation season, especially for fuel shipments. The Coast Guard also approves the location of and plans for bridges and causeways over navigable waters, ensuring that drawbridge operations provide reasonable accommodation for both marine and highway users.

Vessel Traffic Management and Information

The Coast Guard is responsible for regulating vessel traffic on U.S. waters, on both the coastal and the inland systems. It does so through two distinct levels of management. The most common is passive management, in which the Coast Guard establishes the navigation aids and "rules of the road." The second, more active level of management requires vessels of a certain size and function to report their locations to the vessel traffic service (VTS) center and to monitor certain radio frequencies while operating in designated areas. The VTS centers provide marine advisories and traffic information; they also advise on routing and vessel separation distances.

The Ports and Waterways Safety Act of 1972 and the Port and Tanker Safety Act of 1978 authorize the Coast Guard to establish vessel traffic management schemes for U.S. harbors, rivers, and other navigable waters with traffic congestion and hazardous conditions. While the intent of these acts is to improve navigation safety by preventing groundings and collisions, they have also produced more orderly flows of traffic and other commercial benefits.

As described earlier, NOAA's NOS is responsible for charting the shipping channels and disseminating this information to mariners. The information contributes to the efficient and orderly flow of traffic as well as to

marine safety. NOAA packages this and related information in various products, including its popular *Coast Pilot* series, which consists of books for different ports and coastal areas that contain information on channel depths, tides, currents, water levels, anchorages, bridge clearances, and applicable vessel traffic management regulations.

A more ambitious NOAA initiative is the installation of Physical Oceanographic Real-Time Systems (PORTS) in several major U.S. harbors. PORTS provides ship operators and pilots, on a real-time basis via telephone and the Internet, with water level, current, and other oceanographic and meteorological information. Port authorities and other local interests pay for the PORTS installations as well as their operating costs, while NOAA provides the raw data and sets standards for interoperability. NOAA is promoting PORTS as a means to improve marine safety by reducing collisions and groundings. NOAA also views the system as a way to increase port operational efficiency and capacity by providing mariners access to more accurate and timely information on water depths and tides to time their port entries and exits.

Landside Facilities and Intermodal Access

The provision of marine terminals and other landside facilities is primarily the responsibility of the private sector and state and local governments, often operating through public port authorities. Since the early 1980s, MARAD has been responsible for reporting to Congress on the status of public ports. The agency tracks port expenditures and capital investment plans. It also sponsors periodic studies on port landside infrastructure and intermodal access needs.

In viewing the MTS within the context of the overall freight logistics system, the entire role of the federal government in building and integrating the system should be considered. The provision of highway connections to ports is one important component. The federal highway program, administered by the Federal Highway Administration (FHWA), provides financial aid and technical assistance to the state and local governments that bear responsibility for building and operating the highways joined to the nation's ports and marine terminals. The federal highway program

has special eligibility provisions for the use of federal aid in constructing intermodal facilities, although no federal aid is specifically categorized for improving highway connections to ports. The federal highway program and its relation to marine transportation are described in more detail in the next chapter.

PROMOTING NATIONAL SECURITY

A long-standing security concern of marine transportation shippers and carriers is preventing cargo theft and vandalism. Another is the use of the MTS for illegal immigration and the entry of illegal drugs and other contraband. Recently, security concerns have expanded to include the use of the system by individuals to illegally enter the country, bring in weapons, and carry out acts of terrorism. The need for the United States to defend itself against these and other threats from abroad has led to more attention being given to the role of the MTS in meeting the nation's military requirements. Several federal agencies, both civilian and military, have responsibilities related to these national security needs.

Port, Waterway, and Intermodal Security

As the only U.S. military service with law enforcement authority, the Coast Guard has long assumed a key role in the security of marine transportation, and particularly in protecting against threats that have a bearing on national security. Its enforcement responsibilities encompass all federal laws, treaties, and regulations applicable to the maritime domain. They range from patrolling U.S. waters for vessels carrying drugs and undocumented migrants to preventing incursions by foreign fishing vessels. Immediately following the terrorist attacks of September 11, 2001, the Coast Guard placed security zones around key ports and their infrastructure. The agency has since maintained an extraordinarily high level of security vigilance, which has required a massive shift of resources. In March 2003, the Coast Guard was transferred to the newly created Department of Homeland Security (DHS). In DHS, the Coast Guard was expected to establish stronger organizational and operational ties with

the Bureau of Customs and Border Protection, which is responsible for intercepting contraband shipments into U.S. ports.

In passing the Maritime Transportation Security Act of 2002 (MTSA), Congress called on the Coast Guard to develop a National Maritime Transportation Security Plan aimed at ensuring that all ports, facilities, and vessels have comprehensive security plans and incident response capabilities. The act directs the Coast Guard to work with the Transportation Security Administration (TSA)—also housed in DHS—to limit access to security-sensitive areas through background checks and the issuance of transportation security identification cards for employees working in security-sensitive areas. It also establishes a grant program to be administered jointly by TSA's Office of Maritime and Land Security with assistance from the Coast Guard and MARAD. The grants are allocated to port authorities, terminal operators, and state and local agencies to plan and provide security infrastructure and services and to offer security training at the maritime academies. In implementing the act, the Coast Guard is required to assess threats and vulnerabilities at more than 50 critical ports and to review the security plans and self-assessments of security required of individual ports and vessel and terminal operators. In July 2003, the U.S. Coast Guard promulgated a series of interim regulations to implement the provisions of the MTSA. It estimates that compliance with the provisions will cost those subject to the regulations approximately $7,350 million over the next decade (*Federal Register* 2003, 39,272). The regulations cover screening for passengers and baggage, the creation of restricted areas and access controls, personnel identification procedures, and security patrols. Collectively, the provisions of the MTSA present many major challenges to the MTS community and to the Coast Guard and other federal agencies charged with implementing them.

The Coast Guard joins other agencies in DHS with responsibility for aspects of maritime security, including TSA and the Bureau of Customs and Border Protection (created from the Customs Service and the Border Patrol). These agencies have collaborated in a number of activities, including the Container Security Initiative and the Customs Trade Partnership Against Terrorism (C-TPAT). The C-TPAT program is aimed at reducing the risk of containers being targeted by terrorists. It seeks

to "push the nation's borders out" by integrating security actions throughout the freight logistics system; for instance, by linking the Coast Guard's security efforts at sea with those of the Bureau of Customs and Border Protection at U.S. and foreign ports and those of TSA in the other parts of the transportation system.[2]

Military Support

Another important security role of the MTS is in enabling the rapid deployment of military personnel, equipment, and supplies. Several civilian and military agencies have responsibilities related to military transportation and deployment capacity, including MARAD, the U.S. Navy's Military Sealift Command, and the U.S. Transportation Command.

One of MARAD's defense-related responsibilities is to ensure sufficient merchant marine capacity to meet the needs of the U.S. armed forces. Along with the U.S. Navy, MARAD maintains the National Defense Reserve Fleet, which consists of several hundred military and merchant vessels that have varying states of readiness capability for deployment in support of military forces. A small portion of this fleet, the Ready Reserve Fleet, is maintained by MARAD at high readiness to support rapid deployment of the military's strategic sealift. MARAD also provides war risk insurance for vessel operators and manages the Voluntary Intermodal Sealift Agreement (VISA). VISA provides for the emergency activation of port equipment and facilities to support the loading and unloading of vessels for military purposes.

MARAD is charged by Congress with supporting the training of merchant mariners—again, to ensure sufficient trained crew in the event of a military deployment. This federal function can be traced back to 1916, when the U.S. Shipping Board was established by Congress to develop the merchant fleet in anticipation of U.S. involvement in World War I. MARAD, which was part of the Department of Commerce until 1981, took over merchant marine training responsibilities in the 1950s. As mentioned, MARAD operates the U.S. Merchant Marine Academy and administers federal aid to six state maritime academies.

[2] www.cpb.gov/xp/cgov/import/commercial_enforcement/ctpat/.

MARAD supports the U.S. merchant marine through a number of other programs authorized by Congress. The Merchant Marine Act of 1920, better known as the Jones Act, requires the use of U.S.-built and -operated vessels for domestic water freight and passenger service in the name of ensuring a shipping and shipbuilding infrastructure for national defense and economic self-reliance. Congress has since passed other provisions in support of these goals, including loan guarantee and tax incentive programs for U.S. shipbuilders and shipyards, which MARAD administers.[3] Although the Jones Act and these MARAD programs are designed to raise U.S. shipbuilding and merchant fleet capacity, they have been accompanied by a declining flag fleet, especially for overseas shipping. Today, the U.S. fleet serves mostly domestic (coastal and inland) trade, which is precluded by law from being served by foreign carriers. There are no longer any U.S. flag carriers operating containerships on transatlantic and transpacific liner routes, even though containership service was inaugurated in the United States more than 40 years ago (TRB 1992, 17–21).

Also with regard to military use of the MTS, the Department of Defense's Transportation Command and its component Army Military Traffic Management Command, Navy Military Sealift Command, and Air Force Military Airlift Command have plans and programs in place to ensure adequate marine transportation capacity for military needs, both on the land- and the watersides. They include the previously discussed National Defense Reserve Fleet (administered by MARAD and funded by the Navy) and the Ports for National Defense Program, whose primary goal is to ensure the adequacy and responsiveness of defense-important U.S. port infrastructure.

COORDINATION OF FEDERAL MARINE TRANSPORTATION PROGRAMS

Multiple federal agencies have significant roles to play in each area of responsibility described above: fostering commerce, ensuring safety, pro-

[3] The Capital Construction Fund and Construction Reserve Fund, which provide loan guarantees for U.S. shipbuilders and buyers, are administered by MARAD's Ship Financing Office.

tecting the environment, and promoting national security. Moreover, in the performance of its functions, one agency often depends on others, as illustrated by the Coast Guard's reliance on NOAA for weather and hydrographic information to support its traffic management and safety activities. This interdependence requires coordination among the agencies, although mostly at the project and procedural levels rather than in the executive and legislative domains, where funding and policy-level coordination can take place.

Coordination Within Areas of Federal Responsibility

As might be expected, most interagency coordination, to the extent that it takes place, occurs where agencies have closely linked responsibilities. Agencies responsible for particular aspects of marine safety, for instance, seek to coordinate their activities. However, they are less likely to coordinate closely with agencies having different, though still relevant, responsibilities, such as navigation capacity.

Perhaps more than in any other area of federal responsibility, means have emerged for agencies to coordinate marine security. By bringing the Coast Guard, TSA, the Bureau of Customs and Border Protection, and several other agencies with security-related missions into DHS, Congress expressly sought to integrate the programs of federal agencies with transportation and homeland security missions. Only a few months have passed since the creation of DHS, and it is too early to know the results of this effort. Nevertheless, these agencies are collaborating, as demonstrated by the aforementioned C-TPAT, which is managed by an Interagency Container Working Group of DHS.

In the case of marine environmental protection, Congress has created a number of organizational means and statutory requirements for the federal agencies to work together. An example of the former is the National Response Team (NRT). Cochaired by the Coast Guard and EPA, NRT provides multiagency coordination to set national policies and priorities on marine pollution prevention, preparedness, and response. Among the most far-reaching of the statutory requirements for interagency coordination are those set forth in NEPA, which mandates

that federal agencies consult with one another on actions having environmental significance. In general, EPA ensures that NEPA requirements are fulfilled by each responsible federal agency. It works with the Corps of Engineers, NOAA, and other federal agencies with relevant information, expertise, and authority in implementing the act for the marine environment.

Despite these coordinating efforts, environmental responsibilities remain highly dispersed. Numerous federal agencies have environmental protection responsibilities that impinge on the MTS, in part because environmental concerns often transcend traditional economic and organizational divisions. The protection of wetlands and their ecosystems, for instance, can affect the port and marine transportation community, but wetlands protection is a broader federal goal that requires the involvement of interests and federal entities outside the marine and transportation domains. The same is true of federal efforts to protect metropolitan air quality, which must encompass urban port complexes but are much broader in scope.

With regard to marine safety, the Coast Guard has much of the federal responsibility within its purview. Yet to fulfill many safety functions, the Coast Guard depends on data, technical expertise, and resources from other federal agencies, especially NOAA. The necessary coordination occurs (as evidenced by the aforementioned PORTS initiative), but it is complicated by the fact that the agencies are housed in separate departments.

The most dispersed federal efforts are in the provision of navigation infrastructure and services to facilitate commerce. Both the Corps of Engineers and the Coast Guard have major operational and infrastructure roles in this regard. However, several other federal agencies, including MARAD, NOAA, and FHWA, have important roles. These agencies are housed in multiple departments under the jurisdiction of numerous committees of Congress. They have different organizational cultures, decision-making processes, legislative obligations, and resource limits.

Coordination Across Areas of Federal Responsibility

Whereas the coordination of federal activities within specific areas of responsibility takes place to varying degrees, the challenge of coordi-

nating decisions and activities across areas of responsibility is far greater. The federal government certainly has an interest in ensuring that its many decisions and actions related to the MTS are working together in the public good. However, such system-level perspectives have proved extremely challenging to adopt. Within the U.S. Department of Transportation (DOT), MARAD sometimes serves as a clearinghouse for federal agencies to coordinate their marine-related activities. Moreover, DOT's Office of Intermodalism (housed within the Office of the Assistant Secretary for Transportation Policy) is expressly charged with coordinating projects, programs, and policies involving more than one mode of transportation. Both organizations offer a potential link between the federal maritime and other surface transportation programs; however, both are relatively small and committed to fulfilling other responsibilities.

The Coast Guard is in a position to coordinate the federal government's marine safety, capacity, security, and environmental protection functions. Having major programs in each of these areas, it has a strong interest in such coordination. At the same time, it has many other responsibilities to balance (such as combating illicit drug traffic, ensuring compliance with recreational boating regulations, and regulating commercial fisheries), as well as limited jurisdiction. The Coast Guard's influence on the MTS is far more limited than, say, FAA's influence on the aviation sector.

The federal Interagency Committee for the Marine Transportation System (ICMTS), which meets two or three times per year, draws members from at least 18 federal agencies with responsibilities related to the MTS. It provides a regular venue for officials from various federal agencies to exchange information and resolve problems that cut across their respective programs, for instance, through the formation of security, safety, and environmental subcommittees. However, ICMTS is not a congressionally authorized body, nor does it have a White House–level mandate to engage in more substantive program budgetary and policy planning.

The difficulties inherent in coordinating agency decisions and activities are not unique to the MTS. Congress and the executive branch have established special coordinating mechanisms for some high-profile federal responsibilities spread among agencies. One example is the Office

of National Drug Control Policy, which was established to set overall policies, priorities, and goals for the country's multiagency drug control efforts. Likewise, Congress created the White House Office of Science and Technology Policy to ensure the implementation of sound science and technology policies and research budgets across federal agencies. For the most part, however, the White House Office of Management and Budget (OMB) is charged with coordinating and rationalizing budgets and policies across executive branch agencies. As a practical matter, it faces a considerable challenge in linking the actions and resources of so many federal agencies with overlapping and related responsibilities for the MTS.

In the end, federal priorities and policies must be rationalized through the political process. Informing Congress about the implications of its decisions—for instance, how federal investments in waterway infrastructure will affect marine safety and environmental protection—is a starting point in promoting a more rational and integrated federal marine transportation program. Other federal transportation programs routinely report information to Congress on system performance and conditions.

FUNDING FEDERAL MARINE TRANSPORTATION PROGRAMS

Because so many federal agencies have responsibilities related to marine transportation, a complete picture of how federal programming and budgetary priorities are established is not possible. Individual agencies and departments, in concert with OMB, prepare the annual budget requests for most programs. Through its assigned committees, Congress reviews and modifies these budgets and appropriates funds accordingly. Most programs do not draw from a dedicated source of funds, but must compete for money from the general fund. To a large extent, this process is followed for the funding of the major marine-related programs of the Coast Guard, NOAA, MARAD, and most other federal agencies.

The funding of the navigation projects and programs of the Corps of Engineers follows a different, and in many respects unique, process that requires additional explanation. In some ways, the process resembles that

of the other major federal transportation programs in the aviation and surface modes. In other ways, it is fundamentally different. The process is described below, and it is contrasted with these other modes in the next chapter.

Advent of User Financing and Trust Funds for Navigation Projects

The Corps of Engineers has had a prominent role in the country's navigation and water development projects for more than 175 years. During the 1970s and 1980s, this role came under increased political scrutiny for a variety of reasons, including concerns that projects were becoming too expensive and were intruding on state and local decision making (Hershman and Kory 1988). For nearly a decade, the Carter and Reagan administrations declined to propose any new navigation construction starts in the corps' budget. That moratorium eventually gave rise to a series of changes in the way federal navigation projects are conceived and funded.

The first major change in this process came in 1978 when Congress passed the Inland Waterways Revenue Act, which assessed a 10-cents-per-gallon tax on motor fuel used by barge operators. The revenues from this tax were to be credited to an Inland Waterways Trust Fund (IWTF), and half of all federal expenditures on the construction and major rehabilitation of locks, dams, and other inland waterway infrastructure were supposed to be drawn against this account. Funds for project operations and maintenance (O&M) were to be derived, as in the past, from general revenues.

The establishment of user fees for inland waterway projects followed the creation of similar fees and trust funds for the federal highway and aviation programs during the 1950s and early 1970s, respectively. In both prior instances, however, the laws establishing the trust funds also created formulae for spending the funds, as described in Chapter 4. In contrast, the legislation creating the IWTF did not contain similar spending commitments; hence, it offered less assurance that revenues generated from users would be reinvested in the inland waterways system.

In its 1982 budget message, the Reagan administration, drawing on the experience in the highway and aviation modes, advocated extending

the concept of "user pays" throughout the maritime sector. It proposed a nationally uniform set of user charges that would cover all federal outlays for waterway construction, operations, and maintenance. The proposal did not gain congressional support, partly because of worries that a uniform fee would divert revenues derived from the users of large, commercially important ports to support federal investments in the infrastructure of competing ports and harbors. Nonetheless, to end the decade-long impasse on new navigation projects, all the interested parties began to accept the idea of more federal user charges and other forms of cost-sharing. This process culminated in passage of the omnibus Water Resources Development Act of 1986 (WRDA-86).

WRDA-86 authorized scores of new navigation projects, but in doing so it changed the rules by which projects would receive federal funding. Specifically, it called for nonfederal interests (state, local, and private entities) to bear more of the financial burden of project construction, operations, and maintenance. It did so through several major provisions for user financing and cost-sharing.

First, the act raised the fuel tax paid by barge operators from 10 cents to 20 cents per gallon by 1996. However, Congress consented to the wishes of users by establishing an Inland Waterways Users Board consisting of shippers and carriers to advise the Corps of Engineers on inland waterway construction, replacement, and rehabilitation projects. The act also established a 0.125 percent tax on the value of cargo shipped into and out of U.S. ports, with revenues credited to a newly created Harbor Maintenance Trust Fund (HMTF). All federal harbor O&M expenditures were to be debited against this account. Like the IWTF, the HMTF was not accompanied by legislation ensuring that revenues paid into the trust fund would be reinvested in U.S. harbors. And unlike the IWTF, the HMTF was not accompanied by a user board to advise on funding priorities.

The second major change brought about by WRDA-86 was the imposition of cost-sharing requirements for federal dredging projects to deepen and widen harbor channels. The act required nonfederal (state, local, and private) interests to contribute money and other resources (e.g., land) to help cover project expenses; a schedule of cost-share requirements

based on dredged channel depth was outlined in the act. It authorized the use of federal funds to pay for 80 percent of the cost of dredging channels to a depth of 20 feet or less, 65 percent of the added cost of dredging depths between 21 and 45 feet, and 40 percent of the added cost of dredging to depths of more than 45 feet. Federal money would continue to pay for dredging to maintain channel dimensions in most instances. The act allowed nonfederal sponsors to collect port and harbor dues as a way to recover local cost-shares. These allowances were accompanied by restrictions on how such user fees could be levied. In particular, shallow-draft vessels could not be assessed fees intended to recoup costs associated with deep dredging.

Even after the introduction of user fees for inland waterway and harbor infrastructure during the 1970s and 1980s, Congress retained a significant role for general revenues in its funding. This infrastructure, especially the locks and dams on the inland waterways, is used for other activities besides commercial transportation, including recreational boating, flood control, water supply, and the generation of electricity. Indeed, the Corps of Engineers is required to examine these other uses and their benefits in the planning of infrastructure projects and their operations.

Recent Developments in User Financing of Navigation Projects

Acceptance of user financing by MTS users has been mixed. In FY 2003, the fuel tax on inland waterways is expected to generate nearly $90 million in revenues, which is equivalent to half the Corps of Engineers' $185 million budget for inland lock and dam construction. Over the years, the IWTF surplus has grown, as fuel tax revenues have tended to exceed half the total federal funds appropriated to inland waterway construction. The surplus, which is estimated to exceed more than $400 million by the end of FY 2003, has been a long-standing matter of contention among inland waterway users.

The harbor maintenance tax is expected to raise about $730 million in FY 2003. This tax has been challenged repeatedly in federal court and in Congress since its inception in 1986. Because the tax is assessed on the value of cargo, it has been criticized as not representing the true costs of

federal services used by different categories of shippers and carriers. For instance, users of vessels transporting high-value shipments generally pay higher taxes than users of vessels transporting lower-value goods. Moreover, because the tax is uniform across the country, it does not reflect the variation in federal maintenance costs associated with different harbors. Users of harbors that require little or no federal dredging to maintain channels, for instance, must still pay the tax.

In 1998, the U.S. Supreme Court nullified portions of the harbor maintenance tax, ruling that taxes on exports are prohibited by the U.S. Constitution. Hence, the collection of the ad valorem tax on exports ceased in April 1998, although it remains in effect on cargo imported through U.S. ports and harbors. (The long-term prospects of this tax on imported goods remain unclear because foreign governments have repeatedly protested that it conflicts with the tariff rules of the World Trade Organization.) In its 2000 budget request, the Clinton administration proposed a repeal of the harbor maintenance tax and the introduction of a "harbor services fee" to be assessed on the basis of vessel characteristics that are most associated with harbor maintenance services utilized, such as tonnage capacity and draft. The proposal called for the fee to be used to cover federal costs for all harbor services, including infrastructure construction. The proposal failed to gain requisite support in Congress.

The misgivings of MTS users concerning the introduction of user fees 15 years earlier were reiterated in the debate over the harbor services fee. Many users—even those standing to benefit from a restructured fee—worried that receipts from the user fees would not be fully reinvested in the system as desired.

Trust Funds and Coordination of Federal Marine Transportation Programs

Both the IWTF and HMTF, which were created from tax receipts from waterway users, are intended for specific Corps of Engineers navigation projects. The former is intended to be used by the corps for construction and major rehabilitation of locks and dams on the federally controlled inland and intracoastal waterways. The latter is intended to be used by the

corps to maintain channels and associated waterway infrastructure in harbors. In neither case are the revenues intended to be used for other federal programs related to the MTS, such as Coast Guard aids to navigation and traffic management services and NOAA surveying and charting activity. Although Congress has not appropriated to the corps all of the revenues in these trust funds, it has refused to expand the scope of expenditures authorized from the trust funds to other federal programs, as proposed by the executive branch.

In the next chapter, the broader-based trust funds created by Congress for the federal aviation and highway programs are reviewed. These trust funds cover a much larger portion of program expenses than the portion of the federal marine program that is covered by the Inland Waterways and Harbor Maintenance Trust Funds. Unlike the marine program, the federal aviation and highway programs are administered almost entirely by single federal agencies (FHWA and FAA), and they are under the jurisdiction of a limited number of congressional committees. The concentration of administrative and legislative responsibilities has, in effect, permitted the creation of broad-based trust funds that can be used to cover nearly all federal expenditures in each program area.

SUMMARY ASSESSMENT

The federal government has long had a major role in the development and functioning of the MTS. Its influence on the system is extensive. The focus of this chapter has been on the federal government's direct roles in the provision of navigation infrastructure and services to further the national interest in ensuring marine safety, environmental protection, the facilitation of commerce, and security. These responsibilities are held by multiple federal agencies providing infrastructure and services, such as search and rescue, oil spill prevention, the operation of locks and dams, and the development and distribution of nautical charts and hydrographic data.

The federal government pursues these responsibilities through a number of programs spread across several agencies and cabinet-level departments. To a large extent, these agencies have found ways to work with

one another to fulfill their shared responsibilities, despite an absence of budgetary integration. The greatest challenge is in coordinating agency decisions and activities across areas of responsibility—for instance, in ensuring that the federal marine safety, environmental protection, and navigation infrastructure programs are complementary and aimed at meeting the highest-priority needs. There is no overarching national policy or institutional framework for setting national marine transportation priorities or for guiding federal program actions and resource allocations in accordance with these interests. Interagency bodies have been formed to coordinate processes, but their substantive effects have been limited by the absence of coordinated budgeting and legislative authorities. Funding levels for each of the many programs and agencies are determined separately by a commensurate number of congressional oversight and appropriating committees.

The dispersion of federal MTS-related responsibilities among many agencies operating under the jurisdiction of multiple congressional committees has led to no single entity having responsibility for viewing the MTS as a whole. Consequently, no one is routinely demanding comprehensive, national-level information on system performance—information that could be used to assess progress being made in meeting national priorities and to identify opportunities for furthering progress. Whether the gathering and evaluation of such information would prompt more integrated federal decision making is unclear. Performance information at the system level is collected for other federal transportation programs. As discussed in the next chapter, these programs have more concentrated sources of funding, administration, and congressional guidance and oversight.

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Abbreviations

TRB	Transportation Research Board
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard

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Comparison of Federal Roles in Highway, Air, and Marine Transportation

The federal roles in the aviation and highway modes are discussed in this chapter, and they are compared with federal involvement in marine transportation. Differences in these roles stem from a number of factors, including each mode's scale, scope, and patterns of use.

History has also influenced the current federal roles. In the case of highways, the federal government began providing infrastructure and related services long after the private sector and other nonfederal entities had assumed key roles and responsibilities. State and local governments built and operated roads decades before the federal government, at the start of the automobile age less than 100 years ago, began contributing to highway funding and standard-setting. In contrast, almost from its inception

the federal government began constructing, maintaining, and operating the infrastructure of the nation's waterways, most of which cross state boundaries. State, local, and private entities retained the responsibility of providing port facilities and other waterfront infrastructure to accommodate waterborne traffic.

By the time aviation became a major mode of transportation after World War II, the federal government had established a role similar to the one in the marine domain. It preempted control of the airways while leaving the responsibility for providing airports and terminal facilities to state and local governments and the private sector. However, rapid advances in aircraft capacity and range, especially after the introduction of fast jet airliners, compelled the federal government to seek ways to influence airport development. Because traffic constraints at one airport can quickly affect air traffic throughout the system, the federal government had a strong interest in ensuring that local facilities were well equipped and well run.

An appreciation of the unique history and characteristics of each mode is helpful in understanding the evolution of differences among the modes in federal involvement, institutional arrangements, funding, and divisions of public- and private-sector responsibility. There are also similarities, which suggests that some features of federal programs can be adapted to others. The aim of this chapter is to identify aspects of the federal role in the highway and aviation modes that have been beneficial and may have application for marine transportation.

The chapter begins with an overview of the structural and institutional settings of the federal highway and aviation programs, including historical circumstances that have influenced them. Consideration is given to how decisions are made in these programs. The focus is on the role of user financing, national trust funds, and system performance information and analyses.

The review does not cover the two other major modes of long-distance transportation, the railroad and pipeline sectors. Although they are important modes for freight movement, their infrastructure is paid for largely through private means. The aim of this chapter is to identify elements of other federal transportation programs that have proved valu-

able to federal decision makers and that may be transferable to the marine transportation system (MTS). Inasmuch as the federal roles in the highway and aviation sectors have more in common with the federal role in the maritime sector, they are the most suitable candidates for comparison.

PROGRAM STRUCTURES AND INSTITUTIONS

Federal Highway Program

Today's federal highway program is best understood in the context of its history, which can be divided into three distinct phases relating to the creation of the Interstate highway system. The pre-Interstate phase began in the decade before World War I, when automobiles began to proliferate and the federal government began to provide state and local governments with added resources to improve and connect their local and county road systems into a national system. In the decade after World War II, Congress greatly expanded this role by planning and funding the 44,000-mile Interstate highway system. Most of this freeway network was completed by the early 1980s. Over the past two decades, the federal government has continued its program of aid to state and local governments for highway and public transportation development, but with fewer stipulations on how the aid can be spent. During each phase, the level of federal involvement in the development of the highway system has changed, but the basic nature of this involvement has stayed the same. State and local governments continue to own and operate the nation's highways, while the federal government provides technical advice and significant financial aid to improve their operations and safety and to increase their linkages with one another and with the nation's other transportation modes.

Congress began regularly authorizing federal aid to states for the construction and improvement of public roads beginning in 1912. In the decades that followed, it defined several important features of the federal-aid highway program that would have lasting effects on the federal role. One was that the federal agency administering the aid, then the Bureau of Public Roads (BPR), would not choose the highway projects of the states

receiving the aid. Funds would be apportioned among the states annually according to formulae defined in legislation and based on factors such as land area, highway mileage, population, and motor vehicle registrations. Rather than prescribing the use of funds for specific projects, Congress called on the states and BPR to define a system of primary highways that would take priority in the distribution of federal aid. Within these broad parameters, states could use the funds for eligible projects as they wished. BPR was thus given no role in deciding how much federal aid individual states would receive or precisely how they would use the aid. BPR was expected to work in a consultative and cooperative manner with the states. To a large extent, it did so and offered technical advice and guidance on major project selections and design decisions (Seely 1987).

BPR found the mechanism of apportioning federal funds by statutory formula to be advantageous. Because it did not have to decide the amount of federal aid to be given to each state on a project-by-project basis, it was insulated from certain political conflicts. It could exercise oversight without having to be a regulatory agency committed to establishing the detailed parameters of the program. In fulfilling this stewardship role, BPR became comfortable with the use of research and information dissemination as instruments of policy and program guidance. Moreover, the agency engaged in a great deal of institution building. It sought to raise professional standards and the level of technical knowledge in the state highway departments.

In the decade after World War II, Congress designated and began allocating funds for the construction of the Interstate highway system. This program brought important changes in the character of the entire federal highway program. By defining the specific routes to be included on the Interstate system, as opposed to simply specifying eligibility for federal aid, Congress substantially expanded the federal role. Nevertheless, many of the basic tenets of the federal-aid program were unchanged. For instance, Congress provided a statutory formula for apportioning funds among states for Interstate construction. Accordingly, BPR—which was later renamed and reorganized as the Federal Highway Administration (FHWA)—remained free from having to make politically sensitive

decisions about each state's share of the federal distribution. Such policy decisions were left to the legislative process, where they remain today.

In recent years, Congress has made additional changes in the federal-aid program, which were prompted in part by the winding down of the construction phase of the Interstate system. The states no longer had costly Interstate highway construction projects to drive their programs, and they faced increasing demands in many other areas, such as relieving highway congestion, maintaining an aging highway infrastructure, and addressing air quality and other environmental concerns. Therefore, they sought greater flexibility in how federal funds could be used. In passing the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), Congress granted this flexibility. The dominant theme of ISTEA was that states and local authorities should be allowed to choose the best ways to invest their federal aid to provide well-functioning and efficient surface transportation; investments could include public transit, bikeways, and walkways. ISTEA, therefore, created major block grant programs for states to use in improving their surface transportation systems, with the input and acceptance of local interests represented by metropolitan planning organizations. ISTEA also called for the designation of a 160,000-mile National Highway System that would encompass the Interstate highways and other major primary routes. Federal aid would go to the system, but states would have significant leeway to use the aid as they wished on the eligible segments.

As in the past, the federal highway program today is largely run by the states, but with an increasing role for local interests through metropolitan planning organizations and other entities in more rural areas. FHWA serves mostly in a stewardship role centered on distributing and accounting for the federal aid and providing research and strategic planning. In fulfilling this role, FHWA conducts and encourages research and analysis and facilitates technology transfer and information dissemination. As discussed later in this chapter, the information developed by FHWA for measuring and monitoring the condition and performance of the nation's highways has proved especially helpful to Congress and other federal decision makers.

FHWA is joined in the U.S. Department of Transportation (DOT) by the National Highway Traffic Safety Administration (NHTSA) and the Federal Motor Carrier Safety Administration (FMCSA), both of which have highway-related roles. NHTSA's main responsibility is to monitor and regulate the safety and fuel efficiency of motor vehicles, particularly the manufacture and design of passenger cars. FMCSA is responsible for monitoring and regulating the operation of intercity trucks and buses with regard to safety.

Federal Aviation Program

The aviation system has been influenced by the federal government to a greater extent than has the surface transportation system, either because it is so different in form and function or because it emerged at a much later date. It is helpful to review some of the history of air transportation in the United States to understand how the federal role has evolved to its present state.

The United States had roads long before the federal government began helping with their financing and development into a national system. By the time the federal highway program started to take shape early in the 20th century, the automobile era had begun and Americans owned millions of motor vehicles (McShane 1988). In comparison, the federal government had a high profile earlier in the development of the aviation industry's military and civil components. An active federal presence in the air transportation industry was viewed as essential, first to promote its technological and commercial development and then to ensure a consistently high level of safety and service.

Like most other transportation modes, the aviation sector functions as a public- and private-sector enterprise. Federal, state, and local governments share many infrastructure and oversight responsibilities, and the private sector owns and operates the vehicles that use the infrastructure. Airport runways and terminal buildings are provided mostly by state and local authorities. Air traffic control services and navigation aids are provided by the federal government, which also regulates the safety of aircraft and their operations. These federal functions are comparable with

those in the marine sector; the divisions of responsibility among state, local, and federal authorities with regard to airside (federal) and landside (state, local, and private) elements were modeled after the divisions that had long existed in maritime domain for waterside and landside elements (Horonjeff and McKelvey 1983, 17).

Although the federal roles in the aviation and maritime domains mirrored one another in basic design, the ways in which these roles have been carried out have followed markedly different paths. When Congress created the Federal Aviation Administration (FAA) in 1958, its aim was to consolidate the responsibility for air traffic control, navigation aids, and safety regulation into one federal agency. In little more than a decade, it greatly expanded the agency's authorities and capabilities to influence the quality and capacity of the nation's airports. To build an integrated and efficient national aviation system, Congress extended increasing amounts of financial aid to public airports to help them invest in longer and more durable runways, modern towers, and larger terminal facilities capable of handling the larger jet airliners. However, acceptance of this aid would obligate the airports to abide by federal criteria for the design and operation of their facilities, limits on the fees they could charge airlines and other aviation users, and restrictions on how they could spend their revenues. In addition, FAA control over air traffic, which was viewed as essential by Congress to achieve a safe and orderly system, meant that state and local authorities would have little control over the number, type, and scheduling of aircraft using their airports. This federal power became increasingly controversial as noise from jet aircraft impinged on the communities surrounding many large and growing urban airports.

FAA's main functions now encompass regulation, operations, and grant-making. Its regulatory role focuses on ensuring aviation safety and covers nearly all aspects of aviation production and operations. It regulates the design, testing, and manufacturing of aircraft in great detail. It sets the standards for pilot training and licensing, airline operations, and the use of general aviation aircraft. It has a major operational role in the daily running of the nation's air traffic control system and in its planning and capital investment. The agency is responsible for certifying airports,

distributing airport capital grants, and developing the specifications governing the design of airport facilities and equipment eligible for grants.

The varied roles and responsibilities of FAA make it unique among the agencies responsible for federal transportation programs. The federal roles in the other modes are either more limited (as is the case for highways and public transit) or more dispersed among a number of agencies (as is the case for marine transportation). In no other mode of transportation are federal responsibilities so extensive and concentrated within one agency.

USER FINANCING AND TRUST FUNDS

Creation of Trust Funds for User Fees

The federal highway and aviation programs are financed largely from the federal fees and taxes levied on the users of these transportation systems. Receipts from the fees are credited to national trust funds that cover most federal program costs. User financing of highways was first introduced by state governments and then adopted by the federal government to finance its federal-aid program. A number of states began taxing motor fuel soon after World War I, and by 1930 most were doing so. The first federal gasoline tax of 1 cent per gallon was enacted in 1932 to raise revenue to reduce the national deficit. The tax was barely changed over two decades. Just before congressional passage of the 1956 Highway Act, it stood at 2 cents per gallon.

Increases in the federal fuel tax (to 3 cents per gallon) and the creation of a national Highway Trust Fund for the receipts from these tax revenues were part of the 1956 legislation underlying the funding of the Interstate highway program. Congress chose "pay-as-you-go" financing for the Interstate system; annual appropriations to states were based on the revenues generated by the fuel tax. Because many states and highway interests were concerned that Congress might divert fuel-tax revenues to nonhighway purposes, the Highway Trust Fund account was established as a political compromise (Rose 1979). Revenues from other highway-related excise taxes, including taxes on tires, tubes, and truck sales, were also credited to the account.

The Highway Trust Fund has remained largely unchanged in function over the course of nearly five decades. Fuel tax rates have been raised and some other taxes have been added. Congress has changed the definition of eligible expenditures—for instance, to include public transit and bicycle and pedestrian facilities. Various groups of highway users (e.g., heavy trucks, urban motorists, rural motorists) account for different proportions of revenues, which are not necessarily directly related to a group's level of system usage or to the benefits conferred on it. In general, however, the revenues generated from highway users have been devoted to the trust fund and spent on the federal highway and transit programs.

The Highway Trust Fund, which was modeled after the Social Security Trust Fund, was the forerunner of trust funds for financing other federal transportation programs, including the federal aviation program. The Airports and Airways Trust Fund (commonly known as the Aviation Trust Fund) was established by Congress to credit the federal tax revenues generated from users of the aviation system. The principal tax on aviation users is the passenger ticket tax, which was first imposed during the early 1940s to help finance the war effort. A similar tax was imposed on intercity rail and bus tickets, and the revenues in all cases were credited to the general fund. The Aviation Trust Fund was created in 1970 for essentially the same reason that Congress created the Highway Trust Fund: to provide more predictable funding for the air traffic control and airport capital programs and to guard against diversion of revenues to nonaviation purposes. All passenger ticket tax revenues were credited to the account, along with the revenues generated from other aviation-related taxes, such as aircraft tire and tube taxes and impositions on aviation fuel.

While Congress originally intended the Aviation Trust Fund to be used exclusively for funding capital improvements for the nation's airports and air traffic control system, it gradually expanded its coverage to include most of FAA's budget. Today, the trust fund covers more than 90 percent of the agency's budget and provides more than $3.5 billion per year in aid to public airports for capital improvements.

Effects of Trust Funds

Both the aviation and the highway trust funds are more than just accounting devices for crediting revenues and debiting expenses. They have legal and political effects. In a legal sense, the trust funds provide long-term contracting authority. Because Congress authorizes the aviation and surface transportation programs on multiyear cycles, each reauthorization specifies annual obligation levels for the covered years. Contracting authority means an agency can obligate funds over the course of several years without having to wait for annual appropriations. This enables state and local transportation agencies to contract for multiyear highway and aviation projects and procurements with considerable assurance that the federal government will meet its obligation or risk causing state and local governments to default.

In a political sense, the trust funds provide some predictability to the highway and aviation programs, at least in terms of the overall funding levels. The ability to estimate the magnitude of the revenue streams credited to the funds each year makes Congress more willing to vote for long-term authorizations that obligate use of the funds for several years. And because these revenue streams are derived from taxes and fees paid by users, there is a positive relationship between funding levels and usage of the system, which has a correlation to need.

Of course, the establishment of a trust fund with dedicated revenue sources does not, by itself, guarantee that Congress will continue to reauthorize the revenue sources or devote all credited trust fund receipts to the targeted program. It can divert the funds to other uses. Nevertheless, the political influence of an established trust fund is significant. All trust funds have their origins in past political agreements that are difficult for Congress to reshape fundamentally.

As a practical matter, Congress has more latitude in deciding how trust fund revenues will be allocated within the overall aviation or surface transportation programs during each reauthorization period. Revenues credited to both the aviation and highway trust funds are used for nearly all federal activities in their respective modes. During each reauthorization,

Congress must decide whether more or less money should go to safety initiatives, environmental programs, research and development, capacity enhancement, and other areas of interest. Apportionment formulae may be changed, new programs may be added, others programs may be ended, and funds may be shifted among activities. Congress makes these decisions with input from the administering agencies and the president and on the basis of its own assessments of priorities and needs.

ISTEA provides an example of how Congress can change program emphasis and approaches in fundamental ways. In this landmark legislation reauthorizing the federal highway and transit programs in the post-Interstate phase, Congress emphasized flexibility and local (not just state) participation in the selection of projects eligible for federal funding. It encouraged states and localities to manage their transportation infrastructure by defining transportation objectives aimed at national goals, such as congestion mitigation and air quality improvements, and then to apply the most suitable means to achieve them. The act set aside funds for states to use for new and nontraditional investments and activities that had previously not been eligible for federal aid—for example, bicycle paths, carpooling incentives, and transit facilities. The act did retain limitations on the use of funds, especially for projects and programs that could not readily be linked to national highway and transit program goals and benefits. Because ISTEA-authorized funding was drawn from the Highway Trust Fund, highway user groups and other highway interests objected to the funds going too far afield. Nonhighway projects serving intermodal freight, such as a rail line to a port, were deemed ineligible unless the project could be shown to reduce motor vehicle pollutant emissions in a region not attaining federal air quality standards.

In enacting ISTEA and thus expanding the scope of federal interest in the performance of the surface transportation system, Congress also began demanding that DOT provide more extensive information and analyses on highway and transit system performance and conditions. In making funds available to achieve a wider range of surface transportation goals through more flexible means, Congress recognized the importance of hav-

ing good information for assessing system needs and progress toward achieving these goals.

INFORMING DECISIONS

In the federal surface transportation and aviation programs, investment and expenditure decisions must be made at both the broader program level and for specific projects—and, ideally, consideration should be given to the overall effects on the transportation system. The kinds of information and analyses used to inform these decisions are described in this section.

Both the legislative and the executive branches have sought out data and analyses to support decisions on how to spend money credited to the aviation and highway trust funds, and they have benefited from improvements in such information. In particular, reports on the condition and performance of the aviation and surface transportation systems have helped Congress and others better understand the physical condition of these systems; their operating performance; and their effectiveness in meeting user needs in a safe, secure, and environmentally sound manner. They have helped decision makers assess the effectiveness of federal programs, determine where additional federal attention and investments are warranted, and examine policy options.

Condition and Performance Reports for Surface Transportation

Perhaps the most informative and widely referenced report on the federal highway and transit program is the *Report to Congress on the Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* (C&P report).[1] Developed by the Secretary of Transportation with assistance from FHWA and the Federal Transit Administration (FTA), this report is intended to provide an objective appraisal of the nation's highway and transit systems. The C&P reports, which are produced every 2 years, consolidate information and analyses on system conditions, performance, and finances. Much of the information is provided by state and local govern-

[1] For the latest C&P report, see www.fhwa.gov/policy/2002cpr/.

ments and other federal agencies [such as the Environmental Protection Agency (EPA) for air quality and NHTSA for vehicle safety]. The information is derived from samples of thousands of highway segments, state bridge inspection reports, national personal transportation surveys, highway and transit accident records, and various financial, operating, and capital reports from state and local transportation agencies. These data are supplemented with information from special studies, national demographic and economic surveys, and highway and transit finance and expenditure reports.

In these reports, the following patterns and trends concerning the surface transportation system are summarized:

- Scale and scope (mileage by highway type, bus route miles, transit vehicle fleet size),
- Condition (roadway alignment, pavement ride quality, percentage of deficient bridges, rail vehicle condition),
- Usage (demographics of passengers, passenger miles, trip purposes, freight ton-miles),
- Operational performance (travel per lane mile, hours of delay, bus operating speeds, passenger waiting times, percent of travel under congested conditions), and
- Environmental and safety performance (changes in criteria air pollutants, crash statistics, seat belt usage).

The C&P reports also contain projections of future demands on the system. They report the result of economic and engineering analyses of probable impacts of alternative federal investment levels on various dimensions of system performance. The models used for these projections seek to quantify the benefits and costs to the nation of alternative types and combinations of improvements in the highway and transit systems, including effects on vehicle operating costs, travel time, and safety. The models are used to estimate future system demands and capital investments and

other spending requirements to improve system conditions and performance. The reports also review the relationship between past investments in the highway and transit system and measures of system performance. To a limited degree, the C&P reports also review policy options, such as congestion pricing, regulatory changes, and alternative approaches to infrastructure management.

The information and analyses presented in the C&P reports have proved especially useful to Congress in reshaping the federal highway and transit programs every 4 to 6 years. In fact, Congress has repeatedly demanded improvements in the reports. The reports were introduced by DOT and FHWA for the highway program in the 1960s. Congress mandated that the reports be expanded to cover transit, with help from FTA, during the 1990s.

Informing the Federal Aviation Program

FAA also collects and analyzes a wide range of information to assist it and Congress with policy and investment decisions as well as day-to-day program management. Unlike FHWA and FTA, FAA owns and operates an extensive network of infrastructure—the nation's air traffic control system. Congress and the agency must make short- and long-term resource decisions that require information on aviation demand, infrastructure conditions, and system use and operations. As a result, many FAA reports and databases have been developed to inform decisions. For years, the agency has published 10-year aviation demand forecasts (updated annually) that are used to guide investments in the air traffic control system, develop long-range estimates of budgetary requirements, and assess the impacts of changes in federal policies and regulations. The forecasts are also used by Congress to project Aviation Trust Fund revenues and to assess future program funding requirements. FAA also surveys general aviation use on a regular basis, monitors and estimates aircraft operations in all of the major airspace terminals, and tracks the capacity enhancement plans of the nation's largest airports.

When airport managements seek funds for capital projects in excess of $5 million, FAA requires that they use benefit–cost analysis and consider

impacts such as time saved from reduced delays and lives saved from crashes avoided. FAA is accustomed to benefit–cost analyses, which it must use in issuing and revising safety regulations. In contrast, FHWA is not in the habit of using benefit–cost analyses as an ordinary part of its program to administer federal highway aid, although it has developed benefit–cost guidelines for states to use in assessing projects. As noted earlier, most federally funded projects are selected by the states themselves, and individual states may or may not use benefit–cost evaluations to prioritize their selections.

ROLE OF INNOVATIVE FINANCING

One way in which Congress has sought to ensure that its transportation project investments are sound and to make federal funds go farther is to require the use of nonfederal funds in the financing of new construction. The federal-aid highway program has long required state and local governments to contribute funds to federally aided highway projects. The percentages have varied on the basis of the type of project (for instance, states were required to contribute more to the construction of secondary highways than to construction of highways on the Interstate system).

During the 1990s, Congress expanded its reliance on nonfederal contributions by establishing new transportation financing programs aimed at attracting private investment in highway and transit capital projects. In the National Highway System Act of 1995, it authorized an innovative financing program called state infrastructure banks (SIBs) and appropriated $150 million to it. Interested states could use these funds to offer a range of loans, loan guarantees, and other credit enhancements to qualified borrowers ranging from regional authorities and municipalities to private firms. Underlying the SIB program was the idea that federal funds could be used as seed money to attract bond financing and other sources of public and private capital. The program was designed to allow federal funds to be spread among more projects and to provide a market-based test for project selection. Projects not demonstrating sufficient return on investment would not attract the requisite nonfederal funds.

In reauthorizing the federal highway and transit programs in 1998, Congress established additional innovative financing programs in the Transportation Infrastructure Finance and Innovation Act (TIFIA). TIFIA authorized DOT to provide credit assistance through secured loans, loan guarantees, and lines of credit for large surface transportation projects (i.e., those costing at least $100 million) of national or regional significance. The idea underlying TIFIA is similar to that underlying the SIB program: capital markets can help finance large and complex transportation infrastructure projects and, in doing so, provide a market-based test for project prioritization and selection. TIFIA projects must have a public-sector sponsor and be supported in whole or in part by user charges or other dedicated revenue sources. As of March 2003, about one dozen projects were under way or being planned with assistance from this program.

To date, the effects of these innovative financing programs have not been assessed, in part because the programs are so new; many projects have yet to enter repayment. Project sponsors and the public agencies, including DOT, are still learning how to best use the credit assistance. Such innovative financing techniques, however, have been used in other federal programs, such as EPA's revolving loan programs for brownfields cleanup and water treatment plants, the Maritime Administration's loan guarantee programs for shipbuilding, and several other credit programs administered by the Department of Commerce's Economic Development Administration.

A prominent example of a federally aided project using innovating financing methods is the Alameda Corridor in Southern California, which was begun in 1993 and opened for traffic in spring 2002. It consists of a consolidated rail route and improved highway routes (high-speed, high-capacity, and grade-separate routes) that carry traffic to and from the Ports of Long Beach and Los Angeles in San Pedro Harbor. The project cost $2.4 billion, which was covered in part by a $400 million loan from DOT to the Alameda Corridor Transportation Authority. The remaining financing was obtained through the sale of municipal bonds by the port authorities and grants from state and local governments. A key feature of this project is that it leverages federal funds to attract private

investment. The requirement that shippers and carriers help pay for the project through user fees to retire the debt obligated the sponsors to carefully assess the feasibility and utility of the project.

The Alameda Corridor Transportation Authority estimates that these infrastructure improvements have cut the time it takes to transport cargo containers by train between the San Pedro Harbor ports and downtown Los Angeles by more than half, to approximately 45 minutes. The corridor has been in use for less than 18 months, and thorough assessments of its benefits and costs have yet to be undertaken. Whether this project can serve as a model for financing other large and complex transportation projects is not yet clear. The Alameda Corridor project and other innovative financing programs represent a changing federal role in transportation infrastructure investment—one that suggests more selectivity (subject to market demand) but also more flexibility in the way federal funds can be used.

Whether these new federal approaches to assisting in the financing of transportation projects can be expanded to other transportation modes remains to be seen. If such approaches are to be used more routinely, more consideration will need to be given to their effectiveness in addressing the market imperfections, externalities, and public needs that led to government involvement in the provision of transportation infrastructure in the first place.

RESEARCH AND TECHNOLOGY DEVELOPMENT

As discussed above, the federal highway program has long emphasized providing research and technical support for state and local governments to build, maintain, and operate the highway system. Almost from the beginning of the program, research was viewed as an important means by which the federal government could influence highway development nationally. As the Interstate highway system neared completion in the 1980s and use of the system escalated, it became evident that the focus of federal research had to change in favor of finding and deploying ways to better maintain and manage the system. Building more highways to accommodate increasing user demands would need to be balanced with, and in some cases supplanted by, efforts to use the infrastructure more efficiently.

The federal role in researching ways to increase the efficiency, as well as the safety, of the highway system is perhaps best demonstrated by the program to further the development and deployment of intelligent transportation systems (ITS) beginning in the early 1990s. During the past dozen years, the ITS Joint Program Office has collaborated with FHWA, FTA, NHTSA, FMCSA, and DOT on researching, developing, evaluating, and deploying advanced computer, communications, and sensor technologies to improve travel on highways and transit. The technologies being pursued include electronic toll collectors, in-vehicle crash-avoidance sensors, traffic surveillance, and transit vehicle-tracking and fleet management systems.

Congress, which initiated the program in ISTEA, has continued to support this research as a solution to growing congestion in the surface transportation system, especially in metropolitan areas. In recent years, the program has sponsored projects in more areas, including those aimed at improving the security and efficiency of freight movements. As an example, electronic, tamper-resistant seals for cargo containers have been the subject of ITS technology development and testing. The aim of this research is to spur the development and introduction of security enhancements having ancillary benefits, such as reduced paperwork and improved tracking of shipments, that lead to more widespread application.

The ITS program is an example of the federal government's responsiveness to the changing needs of the surface transportation system and its users. From the 1950s to the 1970s, the federal government was committed to building a new system of interstate highways. In the past two decades, the emphasis has changed to making the system as a whole work better from the standpoint of efficiency, safety, environmental quality, and now security. The relationship between the federal government and state and local highway agencies has remained essentially the same. However, the federal role has adapted to changing circumstances.

COMPARISON WITH MARINE TRANSPORTATION

The basic features of the federal marine transportation program were described in the preceding chapter, and those of the federal highway and

aviation programs have been described in this chapter. Program comparisons will be made in this section. First, however, the influences of the basic physical and transportation use characteristics of each system on the federal role will be reviewed.

Nature and Extent of the Transportation Systems

The scale and scope of the highway system are enormous. It extends into every jurisdiction of the country and involves a large number and diversity of users; there are 4 million miles of public roads in the United States and more than 200 million vehicles operating on them. Highways are used for passenger transportation, freight movement, and the provision of services, both local and long-distance. In addition, highways are the most interconnected of all the transportation modes. They are linked to one another and to every other major mode of transportation. Almost all freight shipments and most travelers make at least part of their journey on highways, whether in an automobile, a truck, or a transit bus. The ubiquity and diversity of use, as discussed later, have had implications for the highway system's organizational and institutional structures.

The aviation system also extends widely. Almost every county in the United States has an airport, whether a large commercial complex or a small general aviation facility. The aviation system is both national and international in scope, and it is a highly connected network. Traffic flows in one part of the network affect flows elsewhere, especially since the advent of the hub-and-spoke system for airline operations. However, the air transportation network is less dense; it has fewer nodes and limited interconnectivity with other transportation systems, especially in comparison with the highway system. About 500 public airports account for nearly all commercial air transportation of passengers and freight in the country, while about 4,500 others open to public use serve general aviation (TRB 2003, 9–13). The latter facilities are used mainly for local and short-distance flights. The aviation system is much more manageable in scale and scope than the highway system. The users of the aviation system, both general and commercial, are much smaller in number and more uniform than is true of the highway system. And the aviation sector has much less inter-

connectivity with other modes of transportation than either the marine or highway systems. These characteristics have enabled the federal government to wield greater influence and control over the aviation system.

The MTS has its own particular physical and use characteristics. First, it comprises two largely separated networks: the inland and ocean systems. The inland waterways form a series of transportation corridors in their own right. The Mississippi River system, in particular, traverses thousands of miles and passes through multiple states and jurisdictions. However, the inland system is not nearly as extensive as the highway system, and its transportation uses are less diverse, consisting largely of long-haul bulk freight movements. The ocean system primarily serves long-distance freight movements and is international in scope. The ocean ports are nodes not only on the MTS but also on the networks of the nation's highways, railroads, pipelines, and inland waterways. The ports are more than a part of the MTS; they integrate this system with all other major freight transportation systems.

Basis for Federal Involvement in Each Mode

The physical and use characteristics described above have influenced the nature and scope of the federal role. Because highways are ubiquitous and used for so many transportation activities, they are built and presided over by multiple jurisdictions. They directly affect the daily lives of Americans—where they work, live, shop, and socialize. As a result, the public demands a high degree of control over this transportation infrastructure by state and local governments, where public influence is most direct. The federal role has focused largely on ensuring uniformity and connectivity of main highways across state lines. These goals are implemented through funding assistance and incentives and the provision of information and research support. The federal aim has been to encourage the building of a national system for longer-distance travel and commerce, while respecting the prerogative of state and local governments to design their highways, locate them, and operate them as they see fit.

In contrast, the aviation system is used largely for longer-distance transportation that, by its very nature, crosses state and international borders.

The federal government has taken a much more direct role in its provision, especially in the design, governance, and operation of the airways. All of the nation's airspace is under federal control. Although airports are primarily state and local enterprises, the federal government has jurisdiction over the operation of most of the airside components, including runways, traffic control towers, and navigation aids. It has a strong interest in ensuring that airports operate efficiently, because shortcomings in capacity at a single large airport can have immediate implications for air traffic flows throughout the national, and even international, airways. The federal government has sought to improve airports by regulating them, providing them with funding assistance for capital improvements, and prescribing how they are to be designed and operated.

The MTS shares some important characteristics with the aviation system, and the federal role in the maritime sector set an early precedent for the federal role in aviation. Like the airways, the waterways cross state and international borders and function primarily as a long-distance means of transport. The federal government has thus taken the lead in building, maintaining, and operating the waterways, as it has for the airways. As discussed in more detail below, the implementation of these roles differs, but the basic roles themselves are quite similar. The federal government has left the responsibility for airports to state and local governments; similarly, it has left the responsibility for providing and operating marine ports and their landside facilities to state and local governments and private entities. A notable difference between the two modes is that the federal government provides little funding for marine port and terminal development. Perhaps because of a tradition of belief that ports serve mostly local markets, the federal government has avoided such involvement, in contrast to its active role in providing airports with funding assistance and standards for design, equipage, and operations.

Implementation of the Federal Roles

Agency Responsibilities and Use of Trust Funds

The federal roles in the marine transportation system are dispersed among several federal agencies in a number of cabinet-level departments. The

U.S. Army Corps of Engineers (Department of Defense) has a lead role in providing the channels and other waterway infrastructure on both the coastal and inland systems. The Coast Guard (Department of Homeland Security) regulates the traffic on these systems. The National Oceanic and Atmospheric Administration (Department of Commerce) supplies the nautical charts and hydrographic information needed for safe and efficient navigation. The Maritime Administration (Department of Transportation) promotes the merchant marine, among other responsibilities. Other federal agencies provide other marine services and infrastructure. In most cases, separate congressional committees have jurisdiction over these programs, which are reauthorized in separate legislation and funded through separate appropriations. This mix of agency roles and responsibilities has evolved from more than 200 years of federal involvement in the maritime sector.

In comparison, the federal government's roles in the highway and aviation systems are concentrated in a smaller number of agencies, all housed in DOT. FHWA has most of the responsibility for the federal highway program,[2] whereas FAA has almost exclusive responsibility for the federal aviation program. This program concentration is accompanied by a similar concentration in congressional committee jurisdictions, and thus in the legislation authorizing the programs and in funding appropriations. Congress enacts comprehensive legislation authorizing each of these two programs, in contrast to the process for the MTS.

Funding for the federal surface transportation and aviation programs is also concentrated. The funding is derived from national trust funds, which represent the revenues generated from a variety of federal taxes on system users and cover nearly all program expenditures for all federal spending categories. There are no separate trust funds or user fees dedicated specifically to funding particular kinds of activities (e.g., bridge construction, safety programs) or particular components of the system (general aviation airports, commercial-service airports). The funding sources and the uses

[2] NHTSA and FMCSA have responsibility for safe motor vehicle design and operations. Both are housed in DOT.

of the funds are broad-based. In seeking to program these funds effectively among areas of need, both the agencies and Congress have invested in information on system use, conditions, and performance. DOT's biennial highway, bridge, and transit C&P report, required by Congress, is the most prominent example of such efforts.

The federal marine transportation programs are also funded in part from fees derived from users and applied to national trust funds. However, in contrast to the highway and aviation trust funds, these trust funds have more limited purposes and are derived from a more limited set of user fees. The two most significant funds are the Inland Waterways Trust Fund (IWTF) and the Harbor Maintenance Trust Fund (HMTF). The purpose of the former is to help pay for the federal cost of constructing inland waterway infrastructure, especially lock and dam improvements. The revenues are derived exclusively from taxes on the users of the inland waterways. The purpose of the latter trust fund is to cover part of the federal cost of maintaining the dredged channels in harbors. Revenues are derived from taxes on harbor users. Both trust funds have much more limited purposes than either of the trust funds used for the federal aviation and highway programs. They are intended for specific kinds of activities only (lock construction and harbor channel maintenance).

Comparative Effects of Trust Funds

Because of the limits placed on the trust fund uses in the federal marine transportation program, Congress and the executive branch have less latitude to use the funds for other marine-related activities. For example, the HMTF is not viewed as a source of funds for new harbor dredging projects, Coast Guard harbor safety initiatives, or National Oceanic and Atmospheric Administration charting activities. Funds for these activities are drawn from the general fund. Whereas the highway and aviation trust funds cover the array of federal programs in each mode, the two major marine trust funds are separate and largely uncoordinated accounts administered by one federal agency (the Corps of Engineers) among the several involved in the federal marine transportation program. Even most of the

corps' navigation budget is derived from the federal government's general fund rather than from the user-financed trust fund accounts.

The aviation and highway trust funds have been in existence for several decades. The users of the respective transportation systems have come to expect that the trust fund revenues that they contribute through user fees will be reinvested in their systems. For the most part, these expectations have been met, although individual groups of users (e.g., trucking companies, airlines) may take issue with how funds are programmed at any given time and political debates have led to delays in authorizations and appropriations. The multiyear authorizations accompanying the use of these trust funds and giving multiyear project contracting authority to fund recipients have obligated the federal government to appropriate funds on an annual basis that are commensurate with the authorized (and contractually committed) levels.

The trust funds employed for the federal MTS have tended to be more controversial among users. In the case of the IWTF, Congress established a Users Board consisting of shippers and carriers to advise on project spending priorities. However, because Congress has seldom appropriated all of the collected revenues for their intended purpose, inland waterway users have repeatedly raised concern about the efficacy of the trust fund and the associated user charges. Similar concerns have arisen with regard to the HMTF. In neither instance does Congress authorize spending from the trust funds on a multiyear basis, as it does for the highway and aviation trust funds. Funding from both of the marine trust funds is authorized and appropriated by Congress on a project-by-project basis. The multiyear authorizations and resulting contracting authorities that are used for the aviation and highway programs have, in effect, limited the ability of Congress to withhold spending or divert significant trust fund revenues to other uses.

Informing Decisions

State and local government contributions to construction projects have long been required in both the federal highway and aviation grant pro-

grams. They are intended in part to encourage good decisions on project selection, and they allow federal funds to be spread among more projects. The harbor dredging program administered by the Corps of Engineers similarly requires that nonfederal interests contribute a portion of the cost of deep dredging projects. These cost-share requirements, enacted in 1986, are intended to compel project sponsors to assess project benefits and then to demonstrate confidence in their assessment by contributing their own funds to the project. As the Interstate highway program has moved toward completion, the federal government has explored other ways of instilling such discipline in project selection. One example is the use of innovative financing programs aimed at attracting more private capital to transportation infrastructure projects, which guides expenditure decisions by adding a market test of project viability.

The above devices are examples of how the federal government has, in effect, sought to inform its decisions at the project level. To the extent that a project is successful in attracting capital from public and private sponsors, the federal government shares project risks and has greater assurance that the project is viable, at least compared with a project paid for in full with federal funds. Other methods of informing decisions, such as formal benefit–cost studies, are also used for decisions at the project level, especially by the Corps of Engineers for navigation projects. FAA employs benefit–cost analyses as part of its own capital investment decisions and in reviewing applications for capital grants from airports. To a great extent, FHWA lets states prioritize their projects by whatever means they prefer.

How the federal government makes decisions at the overall program level—that is, about the amount of resources that should go into the federal aviation, highway, and marine transportation programs and their major activity areas—may be even more important than how decisions are made at the individual project level. The differences in the federal transportation programs in this regard are significant. Federal responsibilities in the MTS are fragmented among several congressional committees and administering agencies. The resulting dispersion of program authorizations, budgeting, and funding has led to fragmentation in the information

collected and analyzed by the federal government on the performance, conditions, and needs of the system. Each agency has come to rely on different sets of information and analytical tools to inform its decisions. For the most part, this information is not coordinated in a way that allows for federal funding and investment priorities to be examined with regard to national interests or across the federal agencies with relevant responsibilities.

The result is that no single entity has the responsibility to gather and analyze information on system performance and needs or the ability to act on this information in a comprehensive way. The situation differs in the federal aviation and highway programs. Each of these programs is administered largely by a single agency and under the jurisdiction of a relatively small number of congressional committees, and comprehensive information on system performance and needs can be collected by one organization. As demonstrated by congressional requests for DOT to produce the national highway, bridges, and transit C&P report, there is a demand for such information.

The federal agencies responsible for aspects of the MTS do collect a great deal of information helpful to decision making. The data collected and analyzed by the Corps of Engineers on the performance of the inland waterways and the Coast Guard's safety and environmental databases are particularly useful. Some of this information, and what can be learned from it about MTS performance and needs, is discussed in the next chapter. However, a comprehensive effort to integrate and analyze this information in support of federal decisions across agencies and for the MTS as a whole is needed.

SUMMARY ASSESSMENT

The nation's aviation, highway, and marine transportation systems differ in scale, use, and history. All these differences have influenced how the modes have developed and how the federal government has taken on responsibility for providing the infrastructure and support services for each.

The federal role in the highway mode is large but less direct than is its role in the aviation or marine modes. Highways are viewed primarily as

state and local responsibilities, and the federal role has focused primarily on providing funding assistance to encourage greater system uniformity and interconnectivity. Because states and localities have long held responsibility for building and operating highways, the federal agency that administers the federal highway program, FHWA, serves mainly in an advisory and grant-making capacity. It administers federal aid to be used by state and local governments within broad expenditure categories defined by Congress. In comparison, the federal role in the aviation system is much more extensive, and many authorities are concentrated in one federal agency, FAA. Early in the development of the nation's aviation sector, Congress placed most federal aviation activities and authorities in one agency to better ensure system safety and capacity.

The federal aviation and highway programs are both financed from taxes on users of the systems. The revenues from the taxes are credited to trust funds, which Congress reinvests in the two systems. Decisions about how to spend the trust funds are made by Congress in multiyear program authorizations. The trust funds and the multiyear authorizations have helped ensure that user-generated revenues are spent and not diverted to other federal programs. The spending decisions are informed in part by objective evaluations of transportation system use, conditions, and performance by each of the administering agencies and DOT. Congress often shifts program priorities to improve certain aspects of system performance, in part on the basis of these system-level evaluations. The commitment demonstrated by the legislative and executive branches to better understand system performance and needs, coupled with research aimed at improving performance, has helped in assuring users that their contributions will be invested in the system.

The federal role in the MTS is dispersed among several federal agencies, each having responsibility for different components and aspects of system performance and under the jurisdiction of different congressional committees. Funding for these programs is likewise dispersed, coming from different groups of users and the general fund. Program coordination is complicated by this fragmentation of agency responsibilities, congressional

jurisdictions, and funding sources. While each agency has an interest in improving the performance of its element of the MTS, none is responsible for monitoring and furthering the performance of the system as a whole.

Reshaping the federal marine transportation program to emulate the single-agency structures of the federal highway and aviation programs would present challenges. The multiagency institutional structure of the MTS has deep roots. Nevertheless, some of the important features of these other transportation programs may be applicable and helpful to the federal marine transportation program. Routinely monitoring and assessing the condition and performance of the MTS is one such feature. Congress has mandated the development of system-level information in the other modes, and legislative action may be desirable to ensure its provision and use for decision making in the federal marine transportation program.

Comprehensive information on system performance that helps guide federal decisions has helped assure users of the highway and aviation systems that the taxes and fees they contribute to help pay for the system are well spent. This assurance has been accompanied by a willingness by Congress to reinvest these user-generated revenues back into the systems, prompted in part by multiyear authorizations and contractual obligations of trust fund revenues. Congress has not demonstrated a similar commitment to reinvest all user-generated revenues back into the MTS; the experience of these other modes suggests ways to bring about such a commitment.

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Abbreviation

TRB Transportation Research Board

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5

Information on Marine Transportation System Conditions, Performance, and Needs

The nation's marine transportation infrastructure and services are owned, maintained, and operated by many private and public entities. Each makes investment and operating decisions for its own reasons that collectively have wider effects on the functioning of both the marine transportation system (MTS) and the nation's freight system as a whole. The decisions of private terminal operators, carriers, and shippers are driven largely by commercial interests. Public port authorities must meet the demands of private users while serving the public interest. State and local governments must balance the responsibility of building the highways connecting to ports with other demands on their limited transportation resources. The many federal entities with marine- and transportation-

related responsibilities have their own mission requirements, statutory obligations, and budgetary constraints that influence their capital investment and operating decisions.

The focus of this study is on the federal role in the MTS and on the system's performance with regard to key national interests. Earlier chapters described the federal role in furthering several such areas of interest: ensuring marine safety, protecting the marine environment, facilitating commerce, and promoting national security. Multiple federal agencies have responsibilities relating to aspects of these interests. In monitoring and seeking ways to improve performance, each agency is inclined to focus on its own domain rather than on needs and opportunities for improving performance overall.

An overview of the information available for measuring and monitoring the performance of the MTS with regard to these national interests is provided in this chapter. The kinds of databases and analyses available to help guide federal program and policy decisions are described. As discussed in the preceding chapter, federal policy makers, especially Congress, have found comprehensive system condition and performance information helpful in guiding decisions in the federal highway and aviation programs.

SAFETY PERFORMANCE

The Coast Guard has primary federal responsibility for ensuring safety on the waterways, including responsibility for setting forth and enforcing safety regulations. This responsibility requires the gathering of accident and other safety-related data that are used to identify safety problems and assess the costs and benefits of alternative regulations to address them. In addition, the agency must monitor the safety performance of the waterways to deploy its own resources most effectively.

The Coast Guard collects various safety-related data, including the number of calls from mariners in distress, maritime worker fatalities, fatalities aboard passenger vessels, and fatalities in recreational boating. Through its Marine Casualty and Pollution Database, it collects data on the incidence and location of commercial vessel accidents, such as ground-

ings and collisions with other vessels and structures. These data are analyzed to determine accident causes and contributing factors. They are used by the Coast Guard to develop vessel design, construction, and operational requirements for safety and pollution prevention and to guide enforcement activities pertaining to the operations of domestic and foreign vessels. The agency also uses the information in developing specific safety initiatives, such as the Commercial Vessel Safety and Recreational Boating Safety programs.

The extent to which this safety information is used regularly by other federal agencies and Congress to guide overall federal investments within the MTS is unclear. There is little evidence, for instance, that the information is used routinely in developing federal plans for navigation infrastructure improvements, such as lock and harbor channel projects, or in assessing charting, surveying, and hydrographic information provided by the federal government. Accidents attributed to human error may be preventable, at least in part, through changes in channel design, maintenance, and markings, which are largely Corps of Engineers' responsibilities (Waters et al. 1999).

The importance of viewing safety more broadly and from a systems perspective has become apparent over the years as costly and vexing problems such as oil tanker accidents have compelled comprehensive evaluations of accident causes and remedies. The previously cited industry study by the International Association of Independent Tanker Owners (INTERTANKO 1996) indicates that safety performance must be considered not only in vessel design requirements but also in decisions concerning waterway management, channel design and maintenance, navigation aids, and the provision of nautical charts and hydrographic data.

Periodically, the Corps of Engineers examines Coast Guard casualty and incident data to identify harbors and channels that are candidates for safety-related changes in channel design, maintenance, markings, and piloting requirements (see Waters et al. 1999). This is an example of how the data collected by one agency for its own purposes could be helpful for decision making in related areas if the data collection were designed for a wider range of applications. However, this is not a routine activity, and the Coast Guard safety databases are not designed with the intent of

supporting such evaluations by the Corps of Engineers. For the most part, the corps evaluates safety impacts as part of its calculations of the net benefits of navigation projects aimed at enhancing capacity. Its investment decisions are not guided by overarching goals for system safety, and they are not made within the context of broader federal strategies for improving performance through combinations of infrastructure investments, vessel design and operating regulations, and other means such as improved crew training and hydrographic data.

As discussed in Chapter 3, the Oil Pollution Act of 1990 compelled the Coast Guard to be more comprehensive and systematic in its approach to reducing vessel spills and accidents. However, other federal agencies besides the Coast Guard have important safety-related responsibilities that require an even greater level of coordination. Examples are the Corps of Engineers' responsibility to maintain and improve the navigable channels and the National Oceanic and Atmospheric Administration's responsibility to provide accurate and reliable hydrographic information and nautical charts.

In contrast, the federal aviation program has long pursued safety through systematic means. Safety is treated not as a side effect of a planned investment but as a specific dimension of system performance. Accordingly, the Federal Aviation Administration (with help from the National Transportation Safety Board) gathers and maintains extensive information on the safety of the aviation system. It sets measurable targets for safety performance and establishes strategies and plans for meeting them that cut across the agency's offices and program areas, such as air traffic control, airport research, the setting of pilot training, and aircraft certification standards (FAA 2003).

It is noteworthy that in 1997 the Coast Guard and the Maritime Administration (MARAD), in an effort to expand the quality and utility of marine safety data, examined the concept of a national marine incident reporting system modeled after the aviation reporting system. The idea was to encourage voluntary reporting of near-miss groundings, collisions, and pollution events, which are not normally reported to the Coast Guard. Safety analysts understand that there is much to be learned about how and

why accidents are avoided; for one thing, this information can provide an early warning of potential problem areas and emerging concerns (Waters et al. 1999). However, the near-miss database for marine accidents was not established, in part because of legal and practical concerns about assuring mariner confidentiality.

Developing a more systematic approach to the federal role in marine safety will require cooperation among the federal agencies with safety-related responsibilities. A more systematic and data-driven process for identifying safety problems and solutions may result from such cooperation.

ENVIRONMENTAL PERFORMANCE

The environmental performance of the marine transportation system is related to safety performance. However, environmental databases, like marine safety databases, are designed mainly to meet the particular operational and regulatory needs of the specific agencies that collect the information. For example, the Coast Guard's Vessel Oil Spill Incident database provides information on oil spills in U.S. waters for the past 30 years. Although it is designed primarily for the purpose of tracking spills and responses, the database can be used to monitor the total volume and number of spills by source (e.g., barge, tanker, offshore pipeline), location, water body (harbor, lake, river), and oil type. This information has clear value in planning, designing, and prioritizing channel maintenance and improvement projects to improve the environmental performance of the MTS.

Environmental concerns related to the MTS extend beyond the waterways to port landside facilities and their operations, including rail and highway connections. Federal, state, and local agencies have responsibility for monitoring and regulating these effects, which include air pollution, noise, and the effects of vessel operations on terrestrial and aquatic communities. Because port facilities and their land transportation connections are owned, operated, and regulated by a mix of private and public entities at all jurisdictional levels, many of the data pertaining to the environmental performance of the MTS remain site- and program-specific.

The data are often not conducive to tracking environmental performance over time and space—information that would be helpful in assessing the overall accomplishments of the many federal programs and in establishing shared program goals.

The idea of measuring and monitoring environmental performance in a comprehensive manner is not new, and prominent examples of such "benchmarking" efforts exist. One is the *National Coastal Condition Report* (EPA 2001). The Environmental Protection Agency collaborates with the National Oceanic and Atmospheric Administration, the Corps of Engineers, the U.S. Fish and Wildlife Service, and the U.S. Geological Survey in preparing these reports, which contain data on water and sediment quality, biota, habitat, and ecosystem integrity that are summarized into indices of the overall condition of the nation's navigable waters and coastlines. The indices in the report are intended to provide benchmarks for monitoring changes in coastal conditions over time and an overall assessment of the need for federal attention in improving coastal conditions.

Federal efforts to improve the environmental performance of the MTS must be viewed from multiple perspectives and take into consideration the roles of the many agencies with related responsibilities. A great deal of information is being gathered that can shed light on performance; however, the information must be made accessible and useful to policy makers.

PERFORMANCE IN FACILITATING COMMERCE

The provision of waterway infrastructure is a federal responsibility to a greater extent than any other component of the MTS. State and local governments provide the highway connections and much of the landside infrastructure at ports. The merchant vessels operating on the waterways and the shippers that employ them are nearly all private. Therefore, the public sector must be attentive to the use and performance of the system in facilitating commerce.

Monitoring and measuring MTS performance in facilitating commerce at the national level present numerous challenges. In 2001, the

Transportation Research Board (TRB) and its Marine Board held a 2-day workshop consisting of more than 70 participants from the port and waterway community.[1] They sought measures and indicators of waterway performance and capacity at the national level. However, they found that most of the available information focuses on the performance and needs of specific components of the system, such as locks, harbor channels, and ports. Little information is collected on the overall performance of the MTS in facilitating commerce, which is essential for focusing federal efforts in furthering this national interest.

The kinds of data and analyses available for assessing the condition and performance of particular components of the MTS are discussed in the following subsections, along with the results of recent federal and industry efforts to examine needs from a broader perspective.

Waterway Infrastructure Needs and Performance

For nearly 30 years, the Corps of Engineers, through its Navigation Data Center, has gathered, analyzed, and published statistics on the physical and operational characteristics of its individual lock chambers. The information includes each lock's age and dimensions, the number and types of vessels lifted, quantities of cargo passing through, the number of delayed vessels and tows, the incidence of unscheduled closures, and the duration of delays. The data are used to calculate various statistics on each lock's performance, such as the total hours of accumulated delay, percentage of all vessels and tows delayed, average processing time, and average duration of delays.

The Lock Performance Monitoring System data, which are rich in detail, are used by the Corps of Engineers to monitor the performance of each of its locks and analyze proposals to upgrade specific locks and lock systems. The Inland Waterways Users Board uses the data as part of its

[1] See Testimony of Rodney Gregory before the Subcommittee on Coast Guard and Marine Transportation, Committee on Transportation and Infrastructure, U.S. House of Representatives, May 23, 2001 (submitted for the record on June 14, 2001). The testimony reports the results of the April 23, 2001, TRB Seminar on Waterway and Harbor Capacity, which Mr. Gregory chaired.

efforts to prioritize lock improvements in recommendations to Congress. To a limited extent, the data are used by the corps to track and model trends in the pattern of system usage and the frequency and magnitude of delays over entire river systems, such as the Upper Mississippi River system. However, the data are not used on a regular basis to track system-level trends in the performance of the inland system—information that could be helpful to policy makers in assessing overall investment requirements for the MTS.

With regard to harbor channels, Congress has charged the Corps of Engineers with undertaking regular national dredging needs studies that project future cargo growth, vessel sizes, and vessel usage. Included in these studies are evaluations of existing and planned channel depths, the types and sizes of ships in use today and forecast for use in the future, and world trade projections. The corps' extensive databases on waterborne commerce (e.g., Waterborne Commerce Statistics series) and vessel fleet characteristics (e.g., Waterborne Transportation Lines of the United States) are used in making these projections. These databases are valuable in documenting use of the MTS. Over the years, the dredging needs studies have proved helpful to the corps in promoting its dredging program. For example, the May 2003 report estimates that 40 percent of containership calls will be constrained by 2020 without planned dredging projects (USACE 2003). It further estimates that only 4 percent of these calls would be constrained if all planned dredging projects are funded and completed.

However, the regular dredging needs studies do not take into account the effect of factors other than channel dimensions on MTS usage. Channel dimensions are not the only constraint on demand, and dredging is not the only, or a sufficient, means of accommodating future demand. From the standpoint of federal policy making, consideration must be given to other factors that affect system use, including the capacity and performance of ports and their intermodal connections.

Port and Intermodal Access Needs and Performance

Congress requires MARAD to report on the status of the public ports every 2 years. The reports include statistics (derived from Corps of Engi-

neers data) on the trade flowing through the sea and inland waterway ports, capital expenditures by facility type, port funding sources, and estimates of the economic impact of ports. However, the reports seldom attempt to measure port performance or identify specific port needs.

Twice during the 1990s, the American Association of Port Authorities (AAPA) surveyed its members on their most significant needs. The needs cited most frequently in the first survey, conducted in 1993, were facility financing, compliance with environmental regulations, dredging and material disposal, new revenue sources, and railroad and highway access improvements. Similar needs were identified in a survey conducted by the association in 1999 (see Table 5-1).

In 2000, the U.S. Department of Transportation and the Federal Highway Administration attempted to examine, in a systematic manner, all the highway connectors that serve the nation's port facilities (DOT 2000). The study was requested by Congress. All road segments in the National Highway System that connect to ports were studied. Each was examined and then ranked on the basis of objective criteria for pavement quality, geometry (e.g., turning radii, shoulders), traffic service levels, and other physical and operational characteristics. The study found that 20 percent of the mileage had multiple geometric and physical deficiencies and that 10 percent regularly experienced heavy traffic congestion and delays. On the basis

Table 5-1 **Results from Surveys of AAPA-Member Ports on Their Needs, 1993 and 1999**

1999 Survey	1993 Survey
1. Facility expansion and modernization	1. Facility development and capital requirements
2. Ability to secure funding and financing	2. Environmental regulation
3. Pricing pressures and new revenue sources	3. Dredging and disposal
4. Environmental regulation	4. Pricing pressures and new revenue sources
5. Railroad and highway intermodal access	5. Railroad and highway intermodal access
6. Global economic trends	6. Land acquisition and site development
7. Land acquisition	7. Pressures on use of waterfront property
8. Dredging and disposal	8. Labor costs and union work rules
9. Federal legislation and regulation	9. Federal legislation and policies
10. Introduction of larger ships	10. Pressures from state and local government

Source: AAPA 1999.

of these criteria, the report rated 15 percent of the highway mileage connecting to ports as in "poor" or "very poor" condition.

In August 2001, MARAD reported findings from its own survey of intermodal access conditions at 15 U.S. container ports (MARAD 2001). Ports receiving the questionnaire were asked to rate aspects of the intermodal system (e.g., turning radii on local roads, availability of on-dock rail) on a scale from "excellent" to "very poor." The condition of access roads and grade crossings was most often cited as "poor" or "very poor."

Assessments of Overall MTS Performance in Facilitating Commerce

In recent years, efforts have been undertaken by both public and private entities to assess the performance of the MTS as a whole with regard to national commerce. The MTS Task Force sought to do so through a series of conferences involving participants from the maritime industry, labor, and government agencies (DOT 1999). It identified the following needs:

- Deeper and wider channels to accommodate more and larger ships;
- Modernized locks and dams to increase service reliability, capacity, and speed;
- New information and navigation technologies to integrate the supply chain and security and safety systems; and
- More efficient use of land for marine terminal operations and environmental protection.

More recently, MARAD sponsored a study aimed at identifying infrastructure needs to achieve the "national goals" of capacity expansion and congestion relief; system efficiency, productivity, and competitiveness; and reduced negative quality of life effects (MARAD 2003). Public- and private-sector officials from the marine transportation industry were asked to identify their most important infrastructure needs related to these goals. The information was derived from a small and select group

of surveyed individuals; hence, the results cannot be portrayed as representative of the marine transportation community at large. Because the study focused on infrastructure needs, the results provide little, if any, sense of the environmental, safety, and security issues facing the MTS community. The infrastructure needs most commonly reported are shown in Table 5-2, grouped by region.

At the same time as the MARAD study, the U.S. Chamber of Commerce released a report identifying MTS needs and priorities from the perspective of private industry, particularly shippers, carriers, and terminal operators (National Chamber Foundation 2003). It too lacked quantitative evidence and analyses of system performance and needs; it relied primarily on insights gleaned from a panel of shippers, carriers, and other transportation industry experts. Acknowledging the paucity of data on MTS use and performance to inform policy making, the authors urged the creation of a National Freight Data System that would track cargo volumes, identify major freight corridors, and monitor methods of transportation. The purpose of the database would be to allow systemwide assessments of infrastructure requirements to help guide federal funding priorities.

SECURITY PERFORMANCE

The Coast Guard has primary responsibility for securing the nation's waterways and enforcing U.S. laws that pertain to them, including interdicting illegal drugs and undocumented migrants and detecting foreign fishing vessel incursions. The Coast Guard collects information to measure its performance in these areas: seizure rates for drugs, estimates of the number of undocumented migrants interdicted or deterred, and the number of detected foreign fishing vessel incursions. MARAD has long published periodic maritime security reports that focus on cargo theft and international criminal activities that pose threats to ports and commercial maritime interests. The data are gathered from the Bureau of Customs and Border Protection (Customs), the Office of National Drug Control Policy, and other sources. The advent of the Department of

Table 5-2 **MTS National Infrastructure Needs Identified by MARAD (2003)**

Region	Waterside	Port Interface	Intermodal	Support Areas
Northeast	Increased water depth at major ports to handle fully loaded, large-capacity containerships Availability of U.S.-made vessels for short-sea/barge transshipment for short-sea activity	More terminal capacity and efficiency More on-dock rail infrastructure for container operations	More rail access points between marine terminals and railroad mainlines Less congested roadways in terminal areas and increased access to Interstate highways	Security, especially in Port of New York/New Jersey Greater availability of real-time information on weather and sea conditions to improve the efficiency and safety of vessel movements in busy harbors
Southeast	Increased water depth at major ports to accommodate larger cargo ships and containerships	Greater terminal capacity to meet future growth in cargo and provide alternative to West Coast ports	More rail linkages to marine terminals Improved road access to ports	None identified
Great Lakes	Continued active maintenance dredging to maintain safe channel depths Year-round access or lengthening of season	None identified	None identified	None identified
Pacific Northwest	Continued active maintenance dredging and lock development to maintain safe channel depths	Potential need for increased terminal capacity if demand grows significantly	Potential need for increased mainline feeder capacity to support future growth in cargo volumes Improved linkages between on-dock intermodal terminals and railroad mainlines	None identified

			Less congested roadways in terminal areas and increased access to Interstate highways	
West Coast	Increased water depth at major ports to handle fully loaded, large-capacity containerships	More terminal capacity and efficiency More on-dock rail infrastructure for container operations	Increased rail access capacity to handle large increases in cargo volume Less congested roadways in terminal areas and increased access to Interstate highways	Development of an integrated cargo information system to increase the efficiency of rail, truck, and maritime operations
Gulf Coast	None identified	More container storage space at marine terminals	Increased Interstate highway capacity to better link ports to the interior	More affordable U.S.-made vessels Greater recognition of intermodalism and policies that integrate the modes
Inland waterways	More electronic ("intelligent") aids to navigation Continued maintenance dredging of channels, especially in tributaries Modernized locks and reduction in backlog of lock maintenance	More container-on-barge terminal capacity	Greater access of inland waterway terminals to rail, highway, and pipeline networks	Security measures comparable with those in coastal ports More information about potential markets and more awareness among shippers of the advantages of inland waterway transportation More integration of inland waterways in regional transportation system planning

Homeland Security (DHS), which houses the Coast Guard, Customs, and the Transportation Security Administration, is expected to prompt more integration and systematic reviews of these security databases to better assess security performance and needs.

Research into opportunities for deploying security technologies will also require information on the structure and functioning of the freight system in the United States and abroad. This information is essential for ensuring that the technologies work as intended and to find ways to encourage their use by industry.[2] Customs, in particular, has recognized the importance of such information and a system-level understanding. As part of its modernization program, the agency is planning to automate and integrate its varied information systems on imports and exports and shipment manifests (TRB 2003, 70–74). This information, once automated, is expected to provide the agency and DHS with a better understanding of commodity flows and conveyances. Such an understanding will be helpful for enforcement and security planning and may provide insights into the performance of the MTS in facilitating commerce.

SUMMARY ASSESSMENT

Various databases and sources of information are available to measure and monitor the performance of parts of the MTS. For the most part, however, the databases are disconnected from one another and are designed to meet specific legislative and program requirements. The data are seldom used to address the systemwide issues that decision makers face in allocating resources and responsibilities to the various federal programs in support of marine transportation, and they are not always well suited to this purpose. Much of the information gathered by industry and government on system performance and needs is based on narrowly construed surveys of users, which do not provide a complete and objective

[2] See TRB 2002 for a more detailed discussion of the need to understand freight system operations for security.

assessment. The absence of systemwide performance data and the lack of efforts to bring such information together have hindered evaluation of the critical needs facing the marine transportation sector. Such information is needed to guide and assess the effectiveness of federal programs in furthering marine safety, environmental protection, commerce, and national security.

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Abbreviations

AAPA	American Association of Port Authorities
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
INTERTANKO	International Association of Independent Tanker Owners
MARAD	Maritime Administration
TRB	Transportation Research Board
USACE	U.S. Army Corps of Engineers

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6

Information and Analysis for Decisions

The central task of this study is to develop an analytic framework for federal policy makers to use in identifying key needs of the nation's marine transportation system (MTS) and in targeting efforts to meet them. To develop such a framework, the federal sponsors of this study asked the committee to

- Review how federal agency investments in the MTS are now made, including the degree of interagency coordination of investment decisions and the policy issues associated with patterns of investment;
- Review and interpret projections for future maritime demand;

- Assess plans for MTS maintenance and expansion by industry, state and local governments, and federal agencies;
- Describe the likely impact on the MTS over the next two decades if federal funding remains constant; and
- Identify options for federal funding of the MTS, including analyses of the federal financial role in other transportation modes and the factors and trade-offs that must be examined when alternative federal financing roles are considered.

For reasons given in Chapter 1, the committee chose to address these tasks by

- Examining 20-year forecasts of marine transportation demand;
- Reviewing the federal programs related to the MTS and the interests these programs are intended to serve;
- Examining available government and industry reports on the performance, condition, and needs of the system; and
- Comparing the federal roles and responsibilities related to the MTS with those of other major modes of transportation.

The study results are presented in Chapters 2 through 5. In the committee's judgment the results suggest that a more systematic and analytical approach to federal decision making is warranted. Such an approach would make more efficient use of federal resources and ensure that federal decisions are compatible with furthering national interests and capable of meeting the growing demands placed on the MTS. In particular, the results indicate the following:

- Anticipated growth in production and trade over the next several decades will cause the MTS to become even more heavily used and critical to the functioning of the national economy. Even today, the

performance of the MTS affects the operations, structure, and efficiency of many other transportation modes and industries throughout the economy. The system, which is a public- and private-sector enterprise, is becoming increasingly enmeshed in the nation's surface transportation system to form a vast multimodal freight system. As pressures for such integration intensify, they will almost certainly be accompanied by changes in federal, state, local, and private-sector responsibilities, investments, and services.

- Federal involvement in the MTS stems from a commitment to ensuring marine safety, protecting the marine environment, facilitating commerce, and providing for national security. Not only are these important national interests, they are fundamental responsibilities of the federal government rooted in the U.S. Constitution. Yet, the responsibilities are carried out through many different and often unconnected laws, policies, programs, and agencies—some having origins that extend back to the nation's founding. As a result, federal involvement in the MTS is dispersed among more than a dozen agencies and cabinet-level departments, which has made it difficult to understand and coordinate the federal influence on the system and to gauge progress in furthering national interests. In general, the division of federal responsibilities does not correspond well with how the MTS is structured and functions today.

- There is a pressing need for well-informed and well-coordinated federal decision making with regard to the MTS. As the MTS has become more heavily used and integrated into the economy, demands have grown for it to perform more safely and securely and with fewer adverse environmental effects. The challenge before all parties with responsibility for the MTS, including the federal government, is to elevate system performance in all these dimensions and to simultaneously meet the demands of commerce. Because so many federal decisions affect MTS performance, it is essential to make them with an understanding of their effectiveness, consistency with one another, and broader implications.

- Decision makers in the federal aviation, highway, and transit programs depend on objective and national-level information on system conditions, use, and performance. The development of this information has helped assure users that federal programs are aimed at bettering the systems. Users of these transportation systems have come to accept broad-based user charges and national trust funds as means of financing the federal transportation programs.
- By themselves, good system performance data and analyses cannot ensure more consistent and effective public choices. Information must be accompanied by the political and institutional structures, incentives, and capabilities to use it. To a great extent, the federal aviation and highway programs are administered by single agencies under the jurisdiction of a handful of congressional committees, which have required the agencies to gather and report system performance and condition information on a regular basis. In fact, Congress has repeatedly sought improvements in data quality, coverage, analysis, and policy relevance. It puts this information to use as it authorizes spending from the national trust funds to improve transportation system capabilities and performance.

The beginnings of an analytic framework are offered in this chapter. Within that framework, decision makers can view the components of the MTS, their uses, and federal programs in a more systematic and comprehensive manner and with more explicit consideration of the national interests that underlie federal involvement. The framework is intended to facilitate, and even compel, the identification of federal priorities on the basis of multiple interests and perspectives, including many that are hard to recognize from the narrower vantage points of individual agencies, users, and system components.

Implementing such a framework will require good data on system use, performance, conditions, and needs. The framework itself will provide a structure, or template, for organizing this information in ways that will better support the making of investment decisions and the setting of performance goals by federal policy makers. The federal agencies now involved in the MTS already gather and analyze much information, but

on specific aspects of the system. The fragmentation of federal programs and decisions related to the MTS has led to a fragmentation of information. National-level, crosscutting information on system performance and impacts is unavailable or limited.

The chapter concludes with recommendations for the gathering and analyzing of information on MTS performance, condition, and needs in a more concerted manner. Recommendations are also made with regard to other actions that should be taken to address particular concerns identified in this report.

A FRAMEWORK TO SUPPORT DECISION MAKING

The development of an analytic framework and the information to support sound decision making is a focus of this report. Federal roles and responsibilities related to the MTS are dispersed, which makes it difficult for federal decision makers to know how their own policies and programs relate to one another and to the concerns of shippers and carriers, providers of MTS infrastructure and services, and the public. An issue appearing to be minor in one context may be viewed as crucial in another. For example, the federal agencies and congressional committees responsible for ensuring adequate waterway capacity may have little direct interest in ensuring that the ports on the waterways have sufficient highway and rail connections. However, shippers may view such connections as integral. Similarly, while federal attention may be directed at regulating vessel design as a way to ensure marine safety, vessel operators may view improved hydrographic data and the training and retention of qualified crew as having comparable importance.

Recognition of these different perspectives is important in ensuring that federal decisions are consistent and aimed at furthering priorities. In particular, four national interests are referred to repeatedly in this report in discussing the federal role in the MTS:

- Ensuring marine safety,
- Protecting the marine environment,

- Facilitating the nation's commerce, and
- Promoting national security.

In the committee's view, furthering and balancing these interests are central to federal involvement in the MTS, but individual federal agencies may not view their own roles and contributions in direct relation to them. Decisions are often aimed at meeting specific statutory, program, and budgetary commitments, which may not align well with national interests. More generally, the federal government itself has chosen to focus attention on certain components of the MTS while leaving others to state, local, and private entities. Accordingly, when federal policy makers seek to enhance MTS performance with regard to these national interests, they are inclined to focus first on highly visible system components that are most directly within the federal domain. Opportunities to advance national interests from outside this traditional domain may be neglected.

Four major components of the MTS warrant consideration when federal involvement is examined:

- Harbors and seaways,
- Inland and intracoastal waterways,
- Ports and terminals, and
- Intermodal connections.

Each of these components is important to MTS performance with regard to the four national interests listed above. However, the federal domain consists primarily of the first two components, which comprise the navigation and waterside elements of the MTS.

A simple matrix, as shown in Figure 6-1, provides a framework to begin thinking more systematically and broadly about federal opportunities for furthering national interests. Each interest and MTS component presents its own challenges and concerns. Even a cursory listing offers a starting point for assessing federal priorities.

	Safety	Environment	Commerce	Security
Harbors and Seaways				
Inland Waterways				
Ports and Terminals				
Intermodal Connections				

Figure 6-1 **Matrix for assessing the relationship between MTS components and national interests.**

Additional dimensions can be added to the matrix for a more comprehensive decision-making framework. For example, the perspectives of MTS users such as the passenger, dry bulk, liquid bulk, and container segments (Figure 6-2) and federal agency roles (Figure 6-3) can be added.

This framework can be used to

- Identify needs from the multiple perspectives of federal agencies, users, operators, and infrastructure providers;
- Assess current efforts to address needs across institutional and public- and private-sector domains;
- Identify gaps in responsibility for addressing needs or in coordinating actions to address them; and
- Assess options for meeting needs and improving performance.

Such a framework should compel consideration of the federal influence on the MTS in a more systematic fashion that recognizes the interrelationships among national interests, the components and users of the system, and the roles and responsibilities of federal agencies. This process will raise many questions about the scope and scale of federal involvement

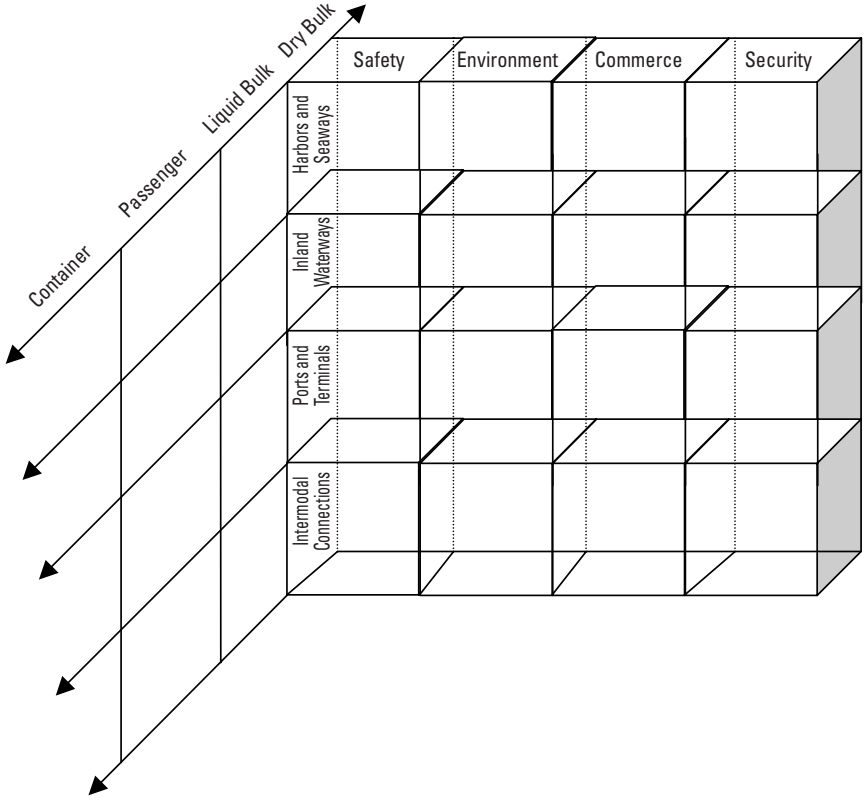

Figure 6-2 **Matrix for assessing the relationship between MTS components, national interests, and user segments.**

in the MTS and the performance of federal agencies. Among the questions are the following:

- What are the safety and environmental challenges associated with liquid bulk transportation, where are the challenges the greatest, and how are the federal agencies, individually and collectively, performing in meeting these challenges?
- Which federal agencies have responsibility for ensuring that the MTS meets the needs of national security, and for which system components

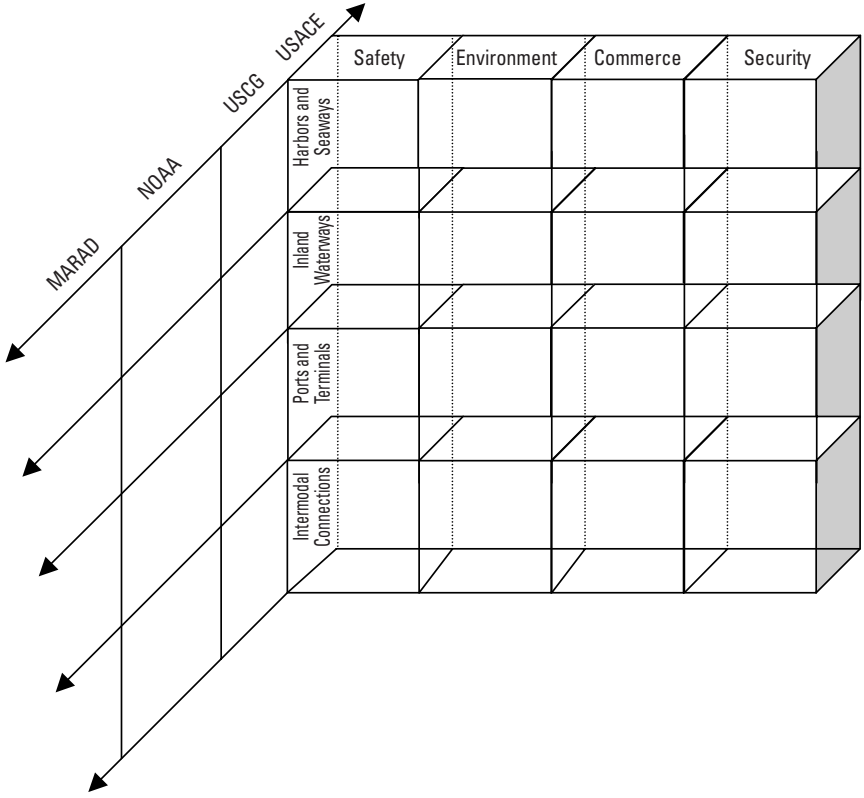

Figure 6-3 **Matrix for assessing the relationship between MTS components, national interests, and federal agency roles (MARAD = Maritime Administration; NOAA = National Oceanic and Atmospheric Administration; USCG = U.S. Coast Guard; USACE = U.S. Army Corps of Engineers).**

is each agency responsible? Are there security issues associated with specific uses of the MTS, and are they being adequately addressed? Are crosscutting security concerns being recognized as such by the multiple federal, state, local, and private entities with security roles and responsibilities?

- Where are the constraints on MTS capacity to accommodate commerce, and what is the federal role in addressing them? How does this

role relate to the federal role in providing capacity-enhancing infrastructure and services in other parts of the system, such as connections from the waterways to other modes of transportation?

Many of the questions raised will undoubtedly require more information and analyses to answer. One of the advantages of such a framework is that it can be used to identify data and analysis capabilities that are needed to support policy making. During the course of this study, the committee interviewed users of the MTS and reviewed reports identifying critical system shortcomings and needs. A number of concerns were raised repeatedly. When these concerns are examined from the perspective of the above framework, it is evident that many fall outside or transcend the jurisdictions of individual federal agencies. Often they have been allowed to persist because they require the attention of more than one federal agency, are emerging and not well defined or understood, or arise in part from efforts to address other concerns. All are candidates for the kinds of performance measuring and monitoring urged in this report. Some, in the committee's opinion, deserve early attention because they have the potential to be exacerbated by escalating transportation demand. They include the following:

- **The capability of highways and other intermodal facilities at major ports to handle increasing container traffic.** The challenges involved in integrating the nation's freight transportation systems, and the jurisdictional issues that arise, are perhaps most apparent at the interconnections of the nation's public seaports, public highway systems, and private railroads. At these points, federal, state, local, and private-sector interests and responsibilities intersect, but they are especially difficult to coordinate because of differing planning horizons, resource constraints, and investment priorities.

- **The ability of the federal government to respond effectively to changing vessel traffic, sizes, and uses in the provision of navigation infrastructure.** As it seeks to provide harbor channels, locks,

and other navigation infrastructure, the federal government faces multiple and sometimes conflicting demands. Most notably, demands for the increased use and capacity of the nation's waterway infrastructure often conflict with demands for environmental protection.

- **Absence of systematic and comprehensive efforts to strengthen marine safety, security, and environmental protection.** The fragmented roles of the federal agencies in promoting marine safety, security, and environmental protection have led to many prevention, mitigation, and response activities, each tending to focus on specific subsets of problems. The result is a mix of efforts, such as economic protections afforded domestic shipbuilders and carriers in the name of promoting national security and the regulation of vessel designs and operations to promote safety and protect the marine environment. Other options to help achieve these goals may be considered, such as improving infrastructure and navigation information, but seldom in a systematic way. An examination of safety, security, and environmental needs will be important in ensuring that the nation's commerce is unhindered and that pressures from increased commerce do not compromise such needs.

To address these concerns, policy makers will need good information on the condition, performance, and utility of the MTS. They will need more objective measures of how well the various components of the MTS are performing with respect to safety, the environment, commerce, and intermodal access. They will need to know how resources are committed by the various federal programs and how the resources correspond to performance expectations and results. However, performance-related information on the MTS is limited, as discussed in the preceding chapter. The information that is collected is designed and used mostly for assessing the performance of individual parts of the system and is seldom related to overall system performance. Actions aimed at making the gathering, analysis, and use of such performance information a requisite part of federal policy making are recommended in the next section.

RECOMMENDATIONS

U.S. Department of Transportation to Monitor, Advise, and Regularly Report on MTS Conditions and Performance

Each of the four broad areas of national interest that underlie the federal role in the MTS is being pursued to varying degrees by several federal agencies and programs. In some cases, a single federal organization has a clear leadership role (e.g., the Coast Guard for marine safety), while in other cases leadership responsibility is not well defined. No single entity is responsible for examining how the many federal activities and decisions related to the MTS affect all of the national interests that underlie federal involvement.

The transfer of the Coast Guard from the U.S. Department of Transportation (DOT) to the newly created Department of Homeland Security (DHS) in March 2003 has altered federal agency linkages and responsibilities. This transfer—along with that of the Transportation Security Administration, the Bureau of Customs and Border Protection, and other federal agencies—has consolidated and made more prominent the federal role in ensuring the security of the MTS. At the same time, it has revealed the extent to which the Coast Guard served, mostly informally, as coordinator and facilitator of an MTS that is not only safe, secure, and environmentally sound, but that is responsive to the needs of commerce. The agency was transferred to DHS with the understanding that it will continue to meet its long-standing environmental and safety responsibilities. Of course, the Coast Guard is expected to meet its statutory responsibilities; however, it faces a greater challenge in maintaining the facilitator and coordinator roles that it long filled as the largest marine-focused transportation agency within DOT. Not only has the creation of DHS further dispersed federal involvement in the MTS, it threatens to diminish DOT's role in the marine sector.

The Coast Guard's transfer has left the Maritime Administration (MARAD) as the primary DOT agency with responsibility for carrying out federal programs directed at marine transportation. MARAD's statutory responsibilities encompass only certain aspects of the MTS. They

focus on the training of merchant mariners, the domestic shipbuilding industry, and the maintenance of a merchant marine capability and reserve fleet for military use. The MTS encompasses much more, even within DOT. For instance, the federal highway program, administered under DOT by the Federal Highway Administration (FHWA), is important to intermodal access. Responsibility for ensuring that such institutional and program connections are recognized and strengthened lies in DOT's Office of the Secretary.

In the committee's view, the policy office of the Secretary of Transportation is the logical place for monitoring and coordinating all federal involvement in the MTS. No other federal agency involved in the MTS has this overarching perspective or charge. DOT can communicate this information to Congress and the Office of Management and Budget, where the connections among federal agency budgets and policies must take place. The committee therefore urges the following:

> **The Secretary of Transportation should seek a mandate from Congress for DOT to take the federal lead in measuring, monitoring, and assessing options to strengthen the MTS's contribution to the furthering of key national interests, including commerce, environmental protection, safety, and security. While legislative authorization is imperative to sustain such an effort, DOT should assume this leadership role immediately—thereby demonstrating the value to Congress.**

Acting in this capacity, DOT can be expected to work closely with the responsible federal agencies across cabinet departments in developing measures of system performance with respect to all MTS components and for all dimensions of performance. It should be charged with assessing federal resource requirements to strengthen performance, identifying critical gaps and shortcomings in performance that may benefit from increased federal attention, and evaluating and recommending policy options to meet performance goals. The analytic framework described in this chapter offers a starting point for undertaking such assessments in a systematic manner.

Much can be learned from the experience of other federal transportation programs about how to build a more integrated federal marine program. DOT and its other modal administrations have experience in gathering and analyzing system performance and condition information to assess future needs and estimate federal funding requirements. The *Report to Congress on the Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* (C&P report) produced every 2 years by DOT, FHWA, and the Federal Transit Administration is a particularly good model of the kind of policy-oriented performance analysis and reporting that should be done for the MTS.

DOT should immediately begin to develop, and seek a mandate from Congress to produce on a regular basis, reports on the use, condition, performance, and demands of the MTS modeled after the biennial C&P reports developed for the federal highway and transit programs. Not only should these reports portray current conditions and performance, they should also look to the future by assessing the funding levels and investments required to improve system conditions and performance over time.

The kinds of data and analyses included in the C&P reports for highway and public transit are described in Chapter 4. These reports include information on patterns and trends in the scale and scope of the system, the age and condition of infrastructure, the extent and types of use, operational performance (e.g., percent of travel under congested conditions), and environmental and safety performance. Furthermore, the reports contain projections of future demand and the results of economic and engineering analyses of probable impacts of alternative investment levels on various dimensions of performance. The C&P reports for the MTS should contain similar system-level information and assessments. In addition, the C&P reports should assess policy options for improving performance. They should be both analytical and prescriptive. The reports should be designed specifically to help Congress formulate MTS-related policy across federal agencies and programs. Analyses should focus on solutions to identified needs; for instance, how the innovative financing techniques

used by the federal government for other transportation investments might be used to meet the infrastructure needs of port facilities and to improve intermodal access.

A wide range of metrics, data, and analyses will be required to measure and monitor aspects of the MTS. The focus should be on metrics that translate into performance (e.g., trends in safety and transportation costs) as opposed to simple measures of program output (e.g., miles of channel dredged, number of vessels inspected). None can be expected to be comprehensive, and all will be open to interpretation. Information will need to be obtained from many different sources, including federal agencies, state and local authorities, and the private sector. The very act of gathering, synthesizing, and analyzing such information and relating it to performance should prompt more critical thinking about the scope and effect of federal involvement in the MTS. It should provide many insights into system performance trends that are not now apparent from the scattering of information across parts of the system. The idea is to provide credible, objective, and accessible information on a regular basis that will be useful in prioritizing investments and making policy decisions relating to national interests.

Once DOT has the responsibility for producing such reports, it will undoubtedly find many deficiencies in the information available. For example, a more concerted approach to measuring and improving marine safety is likely to reveal shortcomings in the information required to understand all the relevant factors. The accident information that is currently collected by the Coast Guard may need to be supplemented by other information, such as near-miss incident reports by mariners. Such information may prove helpful in assessing safety investments by other programs, such as the Corps of Engineers' dredging and the National Oceanic and Atmospheric Administration's surveying and charting activities.

Whether efforts to measure, monitor, and assess ways to improve MTS performance will improve coordination across federal agencies and programs remains to be seen. In any event, such efforts will provide policy makers with a better understanding of how federal programs, taken together, can help advance national interests. Much can be learned from

the federal experience in other transportation modes, particularly with respect to reliance on user financing. Fees on users of the aviation and highway systems have provided predictable sources of revenue for the federal aviation and surface transportation programs. Comprehensive information on system performance has proved essential to retaining user support for this funding approach. The performance information both helps guide federal decision making and demonstrates to users a federal commitment to bettering the system.

Reinvest All User and Trust Fund Revenues in the MTS

Another important lesson learned from the other federal transportation programs is that revenues generated from system users must be promptly reinvested back into the system. Efforts by the federal government to monitor system performance and identify critical needs will help assure users that federal investment decisions are based on a desire to improve overall system performance. However, these efforts must be accompanied by a commitment to spend the user-generated revenues on performance enhancements.

The General Accounting Office (GAO) estimates that total federal expenditures on the MTS averaged $3,900 million per year between 1999 and 2001 (GAO 2002, 3). The construction, operation, and maintenance of navigation infrastructure accounted for about 45 percent of the total federal expenditures, or about $1,750 million per year (GAO 2002, 12). Fees charged to commercial users of inland waterways (about $90 million per year) and harbors (about $750 million per year) cover about half the federal outlay on infrastructure. GAO estimates that about 25 percent of total federal expenditures on the MTS are derived from user fees.

Whether more or less user financing of the MTS is warranted was not considered by this committee. Congress has chosen to pay for much of the federal MTS and services through general fund revenues, in part because some of the infrastructure and services have other benefits to the public (e.g., recreation, flood control). However, where user fees have been established for specific federal activities, such as lock improvements

and harbor maintenance, the revenues generated have not been reinvested back into the system at the rate promised when the fees were established. The federal highway and aviation programs, which are paid for almost entirely from user fees, demonstrate the potential for user financing to provide a reliable source of funds for system improvements. In both cases, Congress demonstrated its commitment to fully reinvest revenues in the systems—a commitment that has, in turn, led to greater reliance on user fees and increased acceptance by the user communities.

The committee is convinced that for user financing to succeed in the MTS, it must be accompanied by a federal commitment to reinvest all of the generated funds back into the system. It therefore urges the following:

> **The administration, supported and informed by DOT and the U.S. Army Corps of Engineers, should seek from Congress the commitment to fully and promptly reinvest all user-generated revenues back into the MTS. The commitment should be accompanied by the kinds of statutory and political devices used in the federal aviation and surface transportation programs to make it binding.**

Apply to the MTS What Works in Other Federal Transportation Programs

As mentioned earlier, a number of concerns were raised repeatedly during the committee's interviews with MTS users and reviews of reports:

- Insufficient capacity of highways and other intermodal facilities connecting to the major ports that handle container traffic;
- Delays in the dredging of harbor channels to accommodate larger vessels and in the modernization of locks and other inland waterway infrastructure; and
- Absence of systematic and comprehensive efforts to strengthen marine safety, security, and environmental protection.

Experiences from other federal transportation programs suggest opportunities for addressing these concerns. In the committee's view, such opportunities should be vigorously pursued to help bring about integration of the nation's freight transportation systems. The following recommendations are offered in this spirit:

The Secretary of Transportation should seek from Congress a more balanced set of tools to make national transportation investment and policy decisions that recognize the increasing integration of the transportation modes and the effects that federal decisions concerning one mode have on other modes. As a first step, DOT should examine and advise Congress on ways to expand the scope and flexibility of existing federal transportation investment and finance programs so that they can be used more effectively for the development of multimodal and intermodal transportation facilities. It is not enough to encourage federal policy makers to take a multimodal perspective on transportation investment and policy making; they must also have sufficient tools at their disposal to act from this perspective.

The Secretary of Transportation should seek from Congress the means to undertake, in collaboration with industry and other federal agencies, an applied research and technology program aimed at furthering the capacity, safety, environmental protection, and security of the nation's ports, intermodal connections, and other marine facilities and services. This effort should include collaboration with the U.S. Army Corps of Engineers to explore opportunities for applying technology, including intelligent transportation systems, to the inland waterway system and with DHS and its agencies to pursue technologies to strengthen system security. Experience from other federal transportation programs suggests the value of federal support of research in improving the national transportation system; thus, a comparable supporting role in the furthering of the national MTS deserves consideration.

As part of its efforts to measure and monitor MTS performance, DOT should aim to develop a more thorough understanding of the operations, capacity, and use of the system, and of the freight system in general. Such an understanding will help identify ways to better integrate security, environmental protection, and safety features and capabilities into the system as it facilitates the nation's commerce. Examining the implications of federal investments and activities across modes will also be important in ensuring that these investments are compatible with one another and with these national interests. Such outcomes can no longer be treated as mutually exclusive or conflicting goals of national policy, but rather as interdependent and essential to one another.

CONCLUDING OBSERVATION

The integration of the nation's transportation modes, particularly for the movement of freight, is a long-term phenomenon that may ultimately compel changes in federal responsibilities and institutions. Short of such change, much can be done to ensure that the federal government remains responsive to the needs of commerce and the public. The actions recommended in this report represent first steps in ensuring that the MTS, and intermodalism in general, has a meaningful influence on federal policies and decision-making processes.

REFERENCE

Abbreviation

GAO General Accounting Office

GAO. 2002. *Marine Transportation: Federal Financing and a Framework for Infrastructure Investments.* Report GAO-02-1033. Washington, D.C.

Appendix A

Statement of William O. Gray

OVERVIEW

My reason for offering a supplementary statement to the committee report is that I feel that the report, as drafted, gives a seriously distorted view of what the current U.S. marine transportation system (MTS) is and where it came from and of the role played by the federal government. I fear that to the extent this is true, readers of the report, especially policy makers, may draw mistaken conclusions both on the current state of the MTS and on what action the federal government should take in the future concerning the MTS in order to ensure "safe navigation (. . . charting, marine safety, . . . weather and oceanographic information . . .), environmental protection. . . ." (task statement). Thus, while I generally support

the committee recommendations, I feel that they fail to address adequately a number of more important steps the government should take in the interests particularly of safe navigation and environmental protection. To better understand what the MTS has become in the 50-plus years since World War II, two key points should be made:

- U.S. international trade has grown from an almost insignificant amount in the 1950s to nearly 2 billion tons per year now (*Wall Street Journal,* Sept. 9, 2003) and is worth more than 20 percent of U.S. gross domestic product (GAO/RCED-95-34, Cargo Preference Laws), and nearly all of this moves by ship.
- The nation is now dependent on seaborne imports for a major share of its energy, food, and consumer goods. If the ships (and the MTS) stopped, major shortages would occur in a few days or weeks, whereas 50 years ago the United States was virtually self-sufficient in most respects.

These changes of the last half century were brought about largely through the ingenuity of a number of individual Americans and the world marine industry with virtually no U.S. governmental support (some would say despite the federal government). It is therefore revealing to look more specifically at the performance of both the marine industry and the government to get a proper perspective on the nation's very large dependence on marine transportation for much of the prosperity and living standard Americans now enjoy.

KEY MARINE INDUSTRY EVENTS FOR AMERICANS, 1939–2003

The most significant events leading to growth in U.S. international marine commerce, which were nearly all led by American industry, include the following:

- Between 1939 and 1945 the United States built nearly 6,000 merchant ships that helped save Europe. Most responsible were retired

Navy Admiral Emory S. (Jerry) Land, who supervised wartime shipbuilding for President Roosevelt, and industrialist Henry Kaiser, who pioneered efficient ship "manufacturing" techniques.

- In the early 1950s D. K. Ludwig, Elmer Hann, and Edward Deming improved Kaiser's ideas and took them to Japan and Europe, where they have continued to improve and lead the world in efficient, economical ship production.
- Ludwig also pioneered much bigger and simpler ships (tankers and bulkers). In 25 years (1950 to 1975) ships grew from 20,000 deadweight tons (dwt) to more than 500,000 dwt, and the savings were such that the cost of much sea transportation is almost as low today as it was 50 years ago (*A Century of Tankers,* John Newton, 2002).
- In the late 1950s U.S. naval architect J. J. Henry invented liquefied natural gas (LNG) ships, hundreds of which now exist, and which may be the fastest-growing ship type for imports into the United States in the next 10 years (Chapter 2 describes LNG forecasts).
- In the early 1960s U.S. trucker Malcolm McLean invented the containership, which almost completely replaced break bulk ships, reduced load and discharge time from weeks to hours, and nearly eliminated pilferage. In the 1980s APL (then an American containership company) pioneered "post-panamax" ships (ships wider than the canal) and "double stack" trains (for container moves across the United States). The ability to move high-value goods rapidly over oceans made many foreign goods affordable and desirable to American consumers.

Each of these innovations was the result of private American ingenuity and entrepreneurship with virtually no help from the federal government. So were most of the new terminals and techniques needed to handle larger and faster ships (lightering of tankers, single buoy moorings, container cranes, self-unloaders for dry bulk, etc.). During these major developments, which helped to fuel American prosperity and growth, it was a continuous struggle for industry to get the channels and infrastructure needed to handle these much larger and more efficient

ships of all types. Even today the United States is still incapable of receiving the largest or even most larger ships of any type—tanker, bulker, or containership—whereas developed and developing nations in many parts of the world have built "world-class" ports, often in totally new "grassroots" fashion most suitable to fast, safe handling of cargoes of all types. In contrast, in the United States since World War II, we have created only one truly new "port": Louisiana Offshore Oil Port (for tankers only), which is really not needed. The oil industry created other means of serving the Gulf Coast (lightering) when lengthy federal government delays and "red tape" threatened to slow oil imports.

FEDERAL GOVERNMENT PERFORMANCE IN MTS SINCE WORLD WAR II

The draft report correctly describes the widely dispersed responsibilities for marine matters in the federal government, even among the four most directly involved parties [the U.S. Coast Guard (USCG), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Army Corps of Engineers, and the Maritime Administration (MARAD)] from shipping's point of view. This division of responsibilities may also be a significant reason why so many involved in the marine industry find the performance of parts of the federal government so frustrating. They cite examples such as the following:

- Incredibly slow action on deepening/widening of important channels like Houston, where the current improvements did not start until 31 years after being deemed necessary, and New York/New Jersey, which is taking nearly as long. And neither of these projects, when completed, will be able to handle the largest containerships now being built (in contrast to much of Europe and Asia).

- Despite (or some, like myself, would say because of) government policies intended to help promote U.S. merchant shipping, the state of affairs in regard to U.S.-flagged and U.S.-owned shipping is at a very low ebb. Of course, promotion or administration of U.S. shipping pol-

icy, while nominally a MARAD responsibility, is basically the product of the U.S. Congress and laws it has passed. The following are examples of how these policies have, in my opinion, hurt the nation:

- The nation has almost no international trading merchant shipping that is U.S. built or under U.S. flag. This results from a hugely inefficient large-ship shipbuilding industry and very high seagoing labor cost. After World War II, the "big ship" yards relied on CDS (construction differential subsidy), Jones Act "build U.S." law, and government business (the Navy) and hardly improved their productivity, so that today a ship built in a U.S. yard costs three to four times what it does in Europe or Asia. And alternative transportation (pipelines, tugs/barges, road, and rail) replaced most of the U.S. coastal fleet. The worst result now for the country is that much coastal traffic in the lower 48 that could move by sea instead clogs our busiest roads continually (like I-95 in the Northeast Corridor from Virginia to Maine).
- Bad tax law (Tax Reform Act of 1986) caused U.S. owners of foreign-flag tonnage (notably oil majors) to get rid of many ships that previously had been available to the government as "effective U.S. controlled" for use in times of national emergency.
- The Oil Pollution Act of 1990's (OPA 90's) nearly unlimited liability and criminal provisions for oil spills, together with a specific "nonpreemption" feature allowing all coastal states to have their own liability laws (mostly criminal), caused more oil companies (our nation's best-capitalized companies) to sell most ships.

While these congressional policy decisions are felt mainly in their adverse effects commercially (profits made offshore, not in the United States) and in the loss of a "U.S. fleet" for times of emergency, there are other adverse consequences from federal government actions, or inactions, that have a negative impact on safety and environmental performance in the U.S. MTS. Early in the study, I proposed that the committee discuss these negative consequences for safety in the report. This the committee has either not done or done totally inadequately.

MTS SAFETY ISSUES

The following are the first three MTS safety issues I proposed for committee endorsement and strong corrective recommendation:

- Accurate hydrographic data (chart information and real-time tide, current, weather, and water depth information) are mariners' (pilots' and crews') greatest safety need in U.S. waters, but they are frequently not available. At present funding rates NOAA cannot complete accurate surveys of critical areas for 15 to 20 years, and their real-time data system, PORTS, hardly gets funded at all (NOAA Annual National Survey Plans and FY 2004 Budget Summary).
- Groundings between federally maintained channels and private berths (and at private berths) are major issues in many ports (INTERTANKO PTS & UPDATE and RADM Henn Report to Commandant USCG 1992).
- Channel design and vessel maneuverability research is badly needed to safely manage large ships in restricted waters. There are no criteria for vessel maneuverability in restricted waters and at slow speed, and pilots are having increasing difficulty, particularly with the larger new vessels (SNAME Marine Technology, April 2003, "Channel Design and Maneuverability: Next Steps").

The problem in each of these cases is inadequate funding, a lack of assigned responsibility, or a combination of the two. Clearly the most pressing immediate problems are the first two, lack of accurate hydrographic and weather data and groundings in non-government-maintained waters. NOAA has the competence and tools to solve both problems. The money needed to do this promptly and correctly is almost trivial, but NOAA's National Ocean Service gets tiny budgets (NRC 1994, *Charting a Course into the Digital Era: Guidance for NOAA's Nautical Charting Mission*).

The fourth, and most important, MTS safety issue that I hoped the committee would recognize and deal with is the criminal and multiple liabil-

ity of crew and owners for oil spills, almost regardless of fault. In the eyes of owners and crews this is a big negative factor for recruitment and retention of competent crews and in their performance. This situation has caused a significant number of owners to refuse to bring black oil to U.S. waters, and it has aggravated morale and fatigue issues for mariners. Furthermore, prosecutors in the United States have pressed charges against mariners not only under OPA 90 and state laws, but also under the Migratory Bird Treaty and the Refuse Act, both of which have even stiffer penalties than OPA 90. Interestingly, within recent months European Union (EU) bureaucrats have proposed similar criminal sanctions against spillers in the EU, but after a position paper by the Industry Roundtable (INTERTANKO, Intercargo, International Chamber of Shipping, International Shipping Federations, and BIMCO) was circulated to the EC describing the negative effects of automatic criminality, the lack of due process or legitimate defenses, and the conflicts with international treaty law [the United Nations Convention on the Law of the Sea and the International Convention for the Prevention of Pollution from Ships (MARPOL)], European parliamentarians strongly rejected imposing European criminal laws on oil spillers (to the chagrin of their bureaucrats) (Lloyd's List, Oct. 13, 2003). Sadly to me, virtually all in the U.S. government, and now this MTS committee, have always rejected even considering changes to our federal and state laws to recognize spills for what they nearly always are—accidents. We should not automatically brand spillers as criminals. Such draconian measures should be reserved only for deliberate spills or gross negligence, as it seems the rest of the world is continuing to do.

OTHER POINTS FOR COMMITTEE CONSIDERATION

There are several other areas in which I feel this committee has missed the opportunity to make important observations and, ideally, recommendations:

- Several times I brought up at committee meetings the deplorable state of efficiency in most large U.S. container terminals. Although I am

basically a "tanker person," I think this is well known to most in our industry, especially after the labor work stoppages in West Coast ports last September, which by some press reports cost the nation $1 billion to $1.5 billion a day. The strike by about 10,000 stevedores reportedly making much more than others in their line of work and refusing to use various proven productivity improvements lasted for, I think, 11 days. In a number of specific productivity comparisons by experts like John Vickerman, Principal of TranSystems, we have heard that productivity at the best U.S. container ports is something like 15 to 30 percent of the "world-class" level because U.S. labor refuses to accept modern technologies or to work more than 1 to 1.5 shifts. To me, these are unacceptable trends costing all Americans a lot of money. I think this MTS committee is missing a golden opportunity to bring this disgraceful trend to the attention of decision makers in the federal government and elsewhere.

- The second sentence of Chapter 1 of the draft states, "People have long been fascinated by marine activity . . . the variety of ships and other vessels that ply the world's rivers, lakes, and oceans." Don't we in the industry wish this were so! It no doubt was in colonial times and the days of the clipper ships. But the sad fact is today that marine is a deeply "hidden" industry about which most Americans, and their congressional representatives, know or care almost nothing. The committee should say so, and it should recommend measures to let our citizens know how heavily our way of life is dependent on maritime commerce.

Finally, there are two other points that deal with safety and environmental protection in the MTS:

- Since the 1950s most maritime nations have agreed as a matter of international treaty law to ensure installation of oily water shore reception facilities (SRFs); MARPOL 73/78 states in part: "The Government of each Party undertakes to ensure the provision at oil loading terminals, repair ports and in other ports in which ships having oily residues

to discharge facilities for the reception of such residues and oily mixtures . . . from tankers and other ships adequate to meet the needs of ships . . . without undue delay to ships." Despite this clear mandate to governments "to ensure . . . reception facilities," the U.S. government (and many others) has not only failed miserably to carry out this mandate, it has hardly done anything, or even tried to encourage creative ways, to meet this mandate. And now with the major concerns over invasive species transmitted in ballast water—a problem that might be partly solved by SRFs and continual pressure from industry (INTERTANKO, ICS, the Roundtable, etc.)—nothing is being done by our government. This committee had the chance to at least point out to decision makers this perpetual failure of our (and most other) governments.

- My final point concerns an issue covered in the "Safety Performance" section of Chapter 5. Mention, albeit brief, is made there of efforts by the Coast Guard and MARAD to create a marine hazardous condition or "near-miss" reporting system depending on confidential reports by witnesses to events (mention of industry, which participated and some feel led the effort, is neglected). This committee draft fails to tell the whole story, saying simply, "The near-miss database, however, was not established, in part because of legal and practical concerns about assuring mariner confidentiality." What I feel the report should have said is that "after about 5 years of trying, Justice Department lawyers, and even USCG's own lawyers, flatly refused to agree with any provision that might shield anyone providing information from any possibility of prosecution—this despite the fact that the system that the industry/government team had designed closely parallels a highly successful near-miss system in the commercial aviation world that the National Aeronautics and Space Administration runs for the Federal Aviation Administration, which the big airline companies feel has saved many lives over the last 20 years." I would also add that to short-circuit a proven safety measure like this at the staff level (legal departments in USCG and the Justice Department) shows that the

federal system was unable to overrule this view, or perhaps it stemmed from the "trial lawyer mentality," which permeates so many in our Congress. Industry is now aiming its "near-miss" efforts at CHIRP (Confidential Hazard Incident Reporting Project), which is being created in Britain with industry, U.K. government, and International Maritime Organization blessing and participation. Maybe in a few years as CHIRP succeeds, just as with spiller criminality and the EU, we in the colonies may have to admit we can still learn something from the old countries.

I have concluded this dissenting statement with a "gut" safety issue because as a tanker man and former sailor, I empathize with the mariners, and as an MTS committee member I regard those at sea as my main constituency. Making the U.S. MTS safer will always be higher priority to me than simply making our container ports operate more efficiently. That may save money but not necessarily lives.

November 5, 2003

Appendix B

Statement of James R. McCarville

INTRODUCTION

In addition to describing mechanisms to measure marine transportation system (MTS) performance, the committee was asked to review projections of future freight demand, assess plans for public and private MTS maintenance and expansion, and describe the likely impact on the MTS over the next two decades if federal funding remains constant. I, along with some of the resource speakers, have brought to the committee's attention several disconcerting trends about system capacity that I believe were not sufficiently addressed in the main report. I am providing this supplementary report to address these issues, including the following:

- The growing gap between the aging inland waterway infrastructure, the increasing maintenance and replacement requirements, and the limited resources available to repair or replace them;
- The need to more fully address the intermodal connector issue; and
- Support for the issues related to navigation capacity; the incredibly long time it takes to plan, authorize, and build navigation projects; the need for accurate hydrographic data; the decline in the overseas U.S. fleet in the past 50 years; and the changes in business ownership of liquid bulk carriers in the past 10 years. Many of these issues have been identified in Appendix A but are applicable to the inland system as well.

Taken together, these issues present a picture of an industry in a state of serious deficiency and crisis that is not otherwise conveyed by the report.

AGING INLAND INFRASTRUCTURE AND CONGESTION

The U.S. Army Corps of Engineers (USACE) builds and maintains the infrastructure on the U.S. inland river system. According to information published by the corps, our inland water resources infrastructure, particularly our locks and dams, is aging. Reinvestment in USACE infrastructure has declined over time, resulting in more frequent scheduled and unscheduled closures for repairs, reducing system performance, and adding costly delays to customers. Half of all USACE lock chambers now exceed their 50-year design lives. By 2010, this will grow to 57 percent, including many critical high-use projects on key waterways.

Old locks require more maintenance. Downtime due to closures more than doubled in the 1990s and exceeded 120,000 hours systemwide in 1999. Repairs are taking longer, and unscheduled closures due to emergencies are more frequent. Scheduled service interruptions cost private industry customers time and money, but unscheduled closures are much more disruptive since customers have not planned for the outages. In neither case, however, are the costs to industry recorded in detail, nor are

they used to justify maintenance priorities or budgets. Increases in traffic, currently projected at about 1½ percent per year, will increase the use of the lock system and the need for maintenance and maintenance downtime, and they will add to congestion and system unreliability.

If the economy meets expectations and traffic congests other modes of transportation (with many commodities doubling by 2020), but federal investment in the MTS remains constant, the implication is that waterway infrastructure will continue to decline. This will impose a demand for additional road and railway infrastructure, which may come at an even higher social cost. On the other hand, if additional reliability were invested in the inland waterway system, then the waterways would be positioned to take some of the lower- to moderate-value container traffic off of the then even more congested roadways.

The Columbia–Snake River system already has significant containers-on-barge traffic, and similar services are growing along the Gulf Intracoastal and North Atlantic ports. Failure to strategically provide solutions will add more unreliability to the entire transportation system and pass the inefficiency costs on to customers and the nation as a whole.

MEASURING DELAYS

USACE measures average annual delays. But this measure hides the real impact of seasonal highs, peak periods, and delays caused by scheduled and unscheduled closures for maintenance or repairs. These can grow to 12, 24, or 36 hours or more—adding uncalculated costs to the navigation industry and its customers. A recent closure of the main chamber at Greenup Lock on the Ohio River (unexpectedly extended when the problems exceeded expectations) resulted in 80-hour delays for downbound tows. It is estimated to have cost power utilities millions of dollars to reroute coal by rail.

While USACE measures the length and frequency of delays, it also needs to quantify the impact such delays have on industry and the nation. Congress should then be informed of all the costs, including those costs passed on to the private sector.

OUTMODED LOCK SIZE, DELAYS, AND BUDGET CONSTRAINTS

Projects constructed in and before the 1930s, most of them with 600-foot chambers, are showing not only their age but also their capability limits. They are not designed for modern tow sizes. Therefore, the common 15-barge tow of today must be "broken" to pass through, tripling lockage times for tows and, in times of congestion, adding immensely to the backup queue. For example, above St. Louis, before the new 1,200-foot Mel Price Lock replaced the 600-foot Lock and Dam No. 26, delays of several days were common.

While Lock and Dam No. 26 has been replaced, it took the better part of a generation to plan, authorize, and build those improvements. Similar bottlenecks occur in other small lock chambers, with similar delays in scheduling repairs. In 1994, USACE began a 10-year Lower Monongahela River improvement project. Now, 10 years later, they are only one-third of the way through the project, due solely to inadequate budgetary allocations. This slow allocation of funding has doubled the cost of the project in terms of inflation and benefits forgone. A lack of multiyear budgeting, and conflicting messages from the administration and Congress, leads to fits of starts and stops in project implementation. The delays inherent in this process mean that projects studied today need to solve problems 25 to 35 years in the future. Therefore, the 50-year life of a project is really a time span starting from 25 to 35 years and running to 75 to 85 years in the future.

USACE NAVIGATION BACKLOGS

USACE projects that there is a $10 billion navigation infrastructure backlog to complete all authorized projects and active preauthorized projects in planning, engineering, and development. This includes harbor and waterway construction projects and the benefits forgone because of delays. It does not include another $6 billion for inactive and deferred projects.

USACE also projects a critical operations and maintenance (O&M) backlog of $1.01 billion. In addition, the corps has identified about

$1.9 billion of unfunded work to preserve the value of its assets that is not as time sensitive as the critical backlog. USACE believes that its vast and aging infrastructure, coupled with deferred O&M, will accelerate performance inefficiencies and require major reductions in service. This will hinder its ability to maintain even current levels of operation.

In addition to the types of performance measurements recommended in this report, USACE has undertaken internal improvements to streamline project process, measure performance, prioritize budgets, and improve benefit–cost analysis (on the basis of recommendations from the Oak Ridge Laboratories). While this should improve the process, the changes are only now under way and were not evaluated. In any case, even with better prioritization, the current levels of funding are unlikely to be sufficient to address these issues.

FUNDING NEEDS

Measured in constant dollars, USACE civil works construction has declined to about a third of what it was in the 1970s (from over $3 billion to just over $1 billion). O&M constant dollar funds for inland waterways have remained basically static (between $400 million and $500 million)—even as the portfolio of projects increased significantly, as the system aged, and as USACE was asked to include more environmental concerns in the projects.

Currently there are nine lock and dam projects under various stages of construction, including new locks already in operation at the Robert C. Byrd and Winfield projects (while dam rehabilitation and other work continue) and "high gear" new construction at Olmsted, Montgomery Point, and Braddock Dam. Work is in earlier stages at four other projects—McAlpine, Kentucky, Inner Harbor, and Marmet. There are also major rehabilitations under way at four sites on the Upper Mississippi and at London Locks and Dam.

Adding to the funding challenge is the need for emerging investments. There are two new authorizations for lock extensions at Greenup and Myers on the Ohio (Water Resources Development Act of 2000). The current shutdown at Greenup shows the urgency of this project. On the

Gulf Intracoastal Waterway (GIWW) there are possible lock improvement projects needed at Bayou Sorrel in Louisiana and channel improvements along the Texas coast (Matagorda Bay reroute). Also, the 2003 omnibus bill authorized replacement of the Tennessee Valley Authority's Chickamauga Lock, where serious concrete deterioration is occurring.

Further studies are under way for the Upper Mississippi and Illinois Waterway; for Emsworth, Dashields, and Montgomery Locks and Dam, and for the Ohio River main stem; for the Texas reach of the GIWW; for the Arkansas River; and for other major rehabilitations.

FUNDING SOURCES AND PROJECT IMPACTS OF CONSTANT LEVEL FUNDING

It was not in the committee charge to indicate where additional funding might come from, and it is not the purpose of this supplementary report to address that question. The charge did ask, however, for implications for the MTS if current funding remains constant.

If funding for inland navigation remains at current levels, the system will continue the present trend of experiencing increasing outages. While it will require increased maintenance, it is unlikely to get it, possibly leading to the loss of a valuable asset. If this happens, the system will become less reliable, more costly, and less likely to be able to play a role in alleviating the rest of the nation's congestion.

COMPARING THE SOCIAL COSTS OF WATERWAY INVESTMENTS

Currently USACE must justify a benefit–cost evaluation for the 50-year life of new projects. Aside from the questions of whether this is a higher standard than most transportation projects or if anything economically meaningful can be said about what will happen 50 years in the future, there is an important way that this tool can be improved.

Specifically, the current tools measure the transportation benefits of a project, but they do not compare those benefits with the costs of providing alternative transportation improvements. For example, if traffic is expected to grow by any given percent and such traffic is not provided for

by waterway or intracoastal transportation, then what would be the social cost of providing for that traffic via additional highway lanes or railway construction? Congestion on Interstate 95 would be a good illustration. Credible measurements need to be developed to evaluate the comparative social costs of providing for projected traffic via waterway, intracoastal, and alternative road or rail transportation means.

INTERMODAL CONNECTORS

Just as the age of intermodalism has made it easier to move international cargo quickly through ports to inland destinations, it has placed new burdens on the relationship of ports, highways, and inland points. The Intermodal Surface Transportation Efficiency Act and the Transportation Equity Act for the 21st Century acknowledged this concept but did not provide significant funding to address the issue.

Arguments regarding the use of gas tax money will likely restrict federal funding to facilities that directly affect highway maintenance and improvements. Highway maintenance is also accomplished by preserving highway infrastructure. But we lack the mechanisms to measure how a nonhighway project can preserve highway infrastructure.

Until such metrics are developed, the creation of a freight gateways program, similar to that in the administration's Safe, Accountable, Flexible, and Efficient Transportation Equity Act of 2003 (SAFETEA) proposal, would help correct these deficiencies. Some portion of the Surface Transportation Program funding could be set aside for those highway-related freight connectors, especially the last mile connector between ports and the National Highway System, intermodal freight transfer facilities, and intelligent transportation innovations linking ports with the broader transportation infrastructure. And the use of water highways, or short-sea shipping, on the intracoastal and inland waterway systems should become eligible for Congestion Mitigation and Air Quality Improvement Program funds, provided they meet the other requirements of that program to mitigate congestion and air quality problems.

December 1, 2003

Study Committee Biographical Information

Mortimer L. Downey, *Chair,* is President of PBConsult, Inc., the management consulting subsidiary of Parsons Brinckerhoff. Prior to joining PBConsult, he was Deputy Secretary of Transportation from 1993 to 2001. In this position he was the Department of Transportation's Chief Operating Officer. He also served on the President's Management Council, as Chairman of the National Science and Technology Council Committee on Transportation Research and Development, and as a member of the Board of Directors of Amtrak. Previously, he was Executive Director and Chief Financial Officer of New York's Metropolitan Transportation Authority, the nation's largest independent public authority. He is well known for developing innovative solutions to complex public policy

issues and has championed a systemwide approach to transportation decision making. He serves as the chairman of the Board of Directors of the National Academy of Public Administration and as a board member of the Eno Transportation Foundation. He received the Frank Turner Lifetime Achievement Award, which is cosponsored by a number of transportation organizations and administered by the Transportation Research Board (TRB); the Lifetime Achievement Award from the American Public Transportation Association; and the Leadership Award from ITS America. He was a member of the National Academies' Committee on Science and Technology for Countering Terrorism.

William O. Gray is President of Gray Maritime Company, a marine consultant whose primary clients are tanker owners and other shipowners and builders. He began his career with the U.S. Navy and then moved to Bethlehem Steel Company, the world's largest shipbuilder at the time. Subsequently, he went to Exxon Corporation, where he became manager of tanker research and supervised the development of large petroleum and liquefied natural gas tankers and their pollution prevention and safety measures. He was hired to manage the fleet of the Skaarup Oil Corporation in 1987. In 1994, he formed Gray Maritime Company. He has served as a council member of the International Association of Independent Tanker Owners, as Trustee of the Webb Institute, and as a member of the American Bureau of Shipping Council. He was a member of the National Academies' Committee on Implementing Advanced Information Systems for Safe and Efficient Maritime Commerce and was Vice Chair of the Committee on Tank Vessel Design. He is a Life Fellow and Land Medalist of the Society of Naval Architects and Marine Engineers. He earned a B.S. in mechanical engineering from Yale University and a B.S.E. in naval architecture from the University of Michigan.

Elvin R. Heiberg III is President of Heiberg Associates, Inc. He is former Chief of Engineers for the U.S. Army Corps of Engineers. He served for 35 years in the corps, with responsibilities in environmental engineering, privatization of infrastructure, government acquisition of engineering and construction services, and water- and harbor-related projects.

He served on the TRB Executive Committee, the Commission on Engineering and Technical Systems, and the Board on Infrastructure and the Constructed Environment. He chaired the Federal Facilities Council and was a member of the Board of Army Science and Technology. He was elected to the National Academy of Engineering in 1995 and was cited for professional and managerial contributions to civil, environmental, and space technology.

Thomas D. Hopkins is Dean of the College of Business at Rochester Institute of Technology. He was previously on the faculties of American University and Bowdoin College and taught regulatory policy at the University of Maryland's School of Public Affairs. In the early 1980s, he was Deputy Administrator of the Office of Information and Regulatory Affairs in the federal Office of Management and Budget. His research interest is in analyzing the impact of regulatory policy on businesses. He consulted for the Office of Technology Assessment on studies of alternative user fees and other benefit charges for financing infrastructure. He has examined the costs associated with ship design regulation and was a member of the Marine Board's Committee on Tank Vessel Design and TRB's Committee for the Study of Public Policy for Surface Freight Transportation. He earned a Ph.D. in economics from Yale University.

Geraldine Knatz is the Managing Director of Development for the Port of Long Beach, California. Appointed to her current position in March 1999 after 11 years as planning director, she now oversees the port's engineering, properties, and planning divisions. She directed the port's reuse planning for the former Long Beach naval complex and has been involved in the Alameda Corridor rail improvement project since its inception in the early 1980s. She is active in the American Association of Port Authorities and chairs its Harbor and Navigation Committee, which deals with dredging and environmental issues. In 1994, she was appointed to the National Sea Grant Panel, which oversees certification and funding of sea grant colleges. She is a member of the National Academies' Committee on an Assessment of U.S. Army Corps of Engineers Methods of Analysis and Peer Review for Water Resources Project Planning. She received an

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Thomas D. Larson is a transportation consultant and was Administrator of the Federal Highway Administration from 1989 to 1993. He served as Secretary of Transportation for the Commonwealth of Pennsylvania from 1979 to 1987. Before entering the government, he was Institute Professor of Civil Engineering at Pennsylvania State University and Director of the Pennsylvania Transportation Institute. Dr. Larson is a past Chairman of the TRB Executive Committee and the Strategic Highway Research Program Executive Committee and served as President of the American Association of State Highway and Transportation Officials. He received the Frank Turner Lifetime Achievement Award in 2003. Dr. Larson was elected to the National Academy of Engineering in 1985.

Sally Ann Lentz is the Executive Director and General Counsel of Ocean Advocates, Clarksville, Maryland, a national, nonprofit environmental organization that promotes marine policy positions within the U.S. government and international organizations. She develops and coordinates policy positions for coalitions of domestic and international environmental organizations on shipping, coastal, and marine issues. She represents these organizations at international conventions related to oil pollution from tanker accidents. Ms. Lentz is a member of the District of Columbia and Maryland Bar Associations and has served as a member of U.S. environmental delegations to the International Maritime Organization. She is a member of the Marine Board and served on the Committee on Tank Vessel Design and the Committee for Evaluating Double Hull Tanker Design Alternatives. She earned a B.A. from Oberlin College and a J.D. from the University of Maryland.

Henry S. Marcus is Professor of Marine Systems and Chairman of the Ocean Systems Management Program in the Ocean Engineering Department of the Massachusetts Institute of Technology (MIT). He was previously Naval Sea Systems Command Professor of Ship Acquisition and

Chairman of the Graduate Program in Shipbuilding and Shipbuilding Management. His research has focused on competition issues in the container and charter shipping markets, marine freight infrastructure needs, competition among ports, and the impact of changes in technology on the shipping industry. He has served on a number of National Academies' committees, has chaired the Committee on Tank Vessel Design, and was a member of the Committee on Productivity of Marine Terminals and the Committee for a Study of the Effects of Regulatory Reform on Technological Innovation in Marine Container Shipping. He earned a B.S. from Webb Institute of Naval Architecture, two M.S. degrees from MIT, and a doctorate in business administration from Harvard University.

James R. McCarville is Executive Director of the Port of Pittsburgh Commission. The Pittsburgh Port District, which spans 11 counties, encompasses more than 200 miles of commercially navigable waterways in southwestern Pennsylvania. The port complex supports more than 200 river terminals and barge industry service suppliers and is served by three major railroads and four Interstate highways. Mr. McCarville has 30 years of port experience, having previously served as executive director of ports in Superior, Wisconsin, and Richmond, Virginia. He has directed the Port of Pittsburgh Commission since 1994. From 1990 to 1993, he was a private consultant, advising governments in Brazil, Uruguay, and Mexico on port organization, operational efficiency, and privatization. He also advised Panama and the U.S. government on the strategic transition plan for the operational transfer of the Panama Canal. He is chairman of Inland Rivers' Ports and Terminals and a member of the U.S. Secretary of Transportation's Marine Transportation System National Advisory Council. He earned a B.A. degree from Denver's Regis College and master's degrees in foreign service and urban studies from Georgetown University and Roosevelt University, respectively.

Reginald E. McKamie, Sr., is a private attorney active in the Maritime Law Association of the United States. He has served as lead counsel for the Port of Houston Authority in major oil spill cases and worked for

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Richard R. Mudge is Vice President of Delcan, Inc., a transportation consulting firm that specializes in project management, contracting, and finance. He was previously a senior advisor to ICF Consulting, Inc., and President of the Compass Services division of U.S. Wireless and was responsible for developing transportation applications for the company's network. He was a cofounder and Chairman of the Board of Apogee Research, a transportation consulting firm that later merged with Hagler Bailly. While serving as Senior Vice President of Hagler Bailly and head of the firm's transportation practice, he was responsible for developing innovative finance techniques that merge funding from public and private sources. Earlier in his career, he was chief of the public investment unit for the Congressional Budget Office, where he directed the organization's advice to Congress on transportation. He served as a member of the ITS America Coordinating Council, chairing its Committee on Benefits Evaluation and Costs. He earned Ph.D. and M.A. degrees in regional economics from the University of Pennsylvania and a B.A. in geography from Columbia College.

Robert C. North is President of North Star Maritime, Inc., which specializes in consulting in merchant marine safety, port safety and security, waterway management, merchant marine personnel qualifications and

training, and marine environmental protection. He served for 34 years as a commissioned officer in the U.S. Coast Guard and retired as a rear admiral. He led the public–private effort, which involved 14 federal agencies and industry stakeholders, to develop the concept of a marine transportation system. He also directed the creation of "Qualship 21," a unique incentives program to enhance safety and environmental protection among foreign vessels calling in U.S. ports. He holds a B.S. degree in marine engineering from the State University of New York Maritime College.

John B. Torgan is the Narragansett Bay Keeper with Save the Bay in Providence, Rhode Island. He leads the organization's program to protect the environmental integrity of the bay and its tributaries through sampling, research, and education. He develops outreach activities and other communications programs to bring problems to the attention of the public. He has also conducted research on wildlife habitats in the region and provided testimony on ecological issues. Before assuming his current position, he conducted ecological research and field studies in New York and Michigan, as well as fishery studies in rivers near hydroelectric dams. He served on the TRB Committee for a Workshop on Environmental Windows for Dredging Projects and the Marine Board's Tank Vessel Lightering Committee. He cochaired the Regional Risk Assessment Team for the U.S. Coast Guard's District 1. He earned a B.S. degree in environmental studies and biology from Union College.

Robert C. Waters is Professor in the School of Engineering Management, George Washington University. His research interests include R&D management, productivity, economic analysis, water resources, transportation management, and technological change and innovation. He began his academic career at the University of Missouri–Rolla in 1972 as Associate Professor of Engineering Management. In 1976, he was assigned to the U.S. Water Resources Council as Chairman of the Economics Committee. He joined George Washington University in 1979. He has written extensively on the effect of federal regulations on

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