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Special Report 271

Freight Capacity for the 21st Century

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Freight Capacity for the 21st Century

Committee for the Study of Freight Capacity for the Next Century

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

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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.

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Preface

In every sector of the U.S. freight transportation industry during the past decade, alarms were sounded, by service providers and their customers, that facilities were becoming inadequate to deal with the demands of traffic growth. Trucking companies saw highway congestion eroding performance and profits, rail customers experienced painful service disturbances as the aftermath of mergers in the industry, and port operators sought federal assistance to cope with unprecedented growth in international trade. Responding to capacity demands is complicated by conflicts between the requirements of passengers and freight sharing the same facilities and by the need to balance demands to maintain environmental quality, preserve communities, and accommodate economic growth.

The Transportation Research Board (TRB) convened the Committee for the Study of Freight Capacity for the Next Century to consider the long-term implications of trends in freight transportation markets and how government policy can allow more efficient provision of freight transportation system capacity. The committee's study was sponsored by the Federal Highway Administration, the U.S. Army Corps of Engineers, the state departments of transportation through the National Cooperative Highway Research Program, and TRB. The work of the committee built on the reports of three past TRB policy study committees that addressed related issues: *Policy Options for Intermodal Freight Transportation*, Special Report 252 (1998); *Paying Our Way: Estimating Marginal Social Costs of Freight Transportation*, Special Report 246 (1996); and *Landside Access to U.S. Ports*, Special Report 238 (1993).

The committee examined historical data and case studies to gain an understanding of the capacity problems the freight industry is experiencing today. It did not forecast future capacity or traffic volumes. The committee's conclusions emphasize the importance of adopting government policies that promote more efficient management and use of facilities and better investment decisions and that allow institutions to respond more effectively to changing needs and circumstances.

The title of this report and the charge to the committee highlight government's role as the supplier of facilities for freight transportation. In the United States, government builds, owns, and operates highways, airports, the air traffic control system, waterways, and port facilities. However, government policies affect not only the supply of freight transportation facilities but also the demand for use of these facilities. The impact of government policies on the demand for freight transportation will be one of the factors determining the adequacy of capacity in the future. Government demand management practices include charging fees for the use of facilities and traffic control measures to keep facilities operating smoothly. Environmental regulations, for example, land use controls, sometimes influence freight transportation demand. The committee has considered the role of demand management, and especially the significance of user fees, in efficiently balancing capacity and use in the future.

One traditional approach to examining the adequacy of infrastructure capacity has been the needs study, which entails compiling an inventory of facilities, comparing the capacity of

these facilities with projected future usage to identify capacity shortfalls, and computing investment needs to maintain the present level of service at the projected level of usage. An example is the series of Conditions and Performance Reports submitted to Congress periodically by the U.S. Department of Transportation, which examines highway spending requirements. Over the years these reports have become more sophisticated, taking into account the relationship between the level of future highway investment and the volume of travel and comparing benefits and costs of projected investments. The committee did not adopt the needs study methodology, for two reasons. First, within the resources of the study, compiling the necessary data would not have been possible. More fundamentally, freight transportation is a mixed public and private enterprise, operating in part in the free market, with management authority largely decentralized; whereas the needs study methodology is most relevant for a centrally planned system. Therefore, instead of attempting to identify particular capacity shortfalls and investment needs, the committee has considered how the federal, state, and local governments make decisions on operating and expanding the transportation facilities they control, with the goal of identifying opportunities to improve these ongoing decision-making processes.

In its report, the committee did not comprehensively review the performance of all components of the U.S. freight transportation system or all policy issues related to freight. The case studies and discussions of performance trends emphasize the domestic surface modes. Performance and policy issues relating specifically to airport capacity, air traffic control, and on-site seaport facilities were not examined, although these facilities are important components of the freight transportation system. The committee's general recommendations on principles for managing government transportation programs to ensure adequate future capacity are applicable to all the system's components. The recommendations regarding particular government programs are presented as illustrations of these principles rather than as a complete freight transportation program.

In addition to the management improvements that the recommendations call for, the committee recognizes that technological progress will be necessary to continue improvement of freight transportation system performance. In the past, technological advances have been critical in allowing the system to serve growing demands. Technological progress will depend on adequate support and sound planning for research in the public and private sectors; however, public-sector transportation technology research priorities and research funding needs are not considered in this report.

Since the final meeting of the committee in 2001, events with far-reaching economic and social significance have occurred. The economy experienced a recession, and the terrorist attacks in New York and Washington have forced a reordering of priorities in many endeavors. The committee recognized throughout its study the need to distinguish cyclical from long-term developments. However, the committee did not anticipate how security would become a consideration of overriding importance in transportation. Security requirements certainly will have consequences for the cost of constructing and operating transportation facilities, the design of facilities and operating practices, and demand for freight transportation services. TRB and other units of the National Academies have projects under way to help operators meet the new security requirements. Panels are developing methods of assessing vulnerabilities and mitigation

methods and are identifying opportunities for applying technology to the solution of security problems in transportation. TRB's Special Report 270, *Deterrence, Protection, and Preparation: The New Transportation Security Imperative* (2002), is an initial report on this work. In the new environment, the committee believes that its recommendations remain relevant to the problem of efficiently planning and operating the nation's freight transportation system.

The study was managed by Joseph R. Morris, who drafted this report under the direction of the committee and under the supervision of Stephen R. Godwin, Director of TRB's Studies and Information Services Division.

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 National Research Council'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 published 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 reviewers of this report were Leigh B. Boske, University of Texas at Austin; David J. Forkenbrock, University of Iowa, Iowa City; Lance R. Grenzbeck, Cambridge Systematics, Inc., Cambridge, Massachusetts; Marion Hart, Jr., Florida Department of Transportation, Tallahassee; Theodore E. Keeler, University of California, Berkeley; James R. McCarville, Port of Pittsburgh Commission, Pennsylvania; Daniel R. Smyser, Pennsylvania Department of Transportation, Harrisburg; and Michael W. Wickham, Roadway Express, Inc., Akron, Ohio. Although the reviewers provided many constructive comments and suggestions, they were not asked to endorse the findings and conclusions, nor did they see the final draft before its release.

The review of this report was overseen by Henry W. Riecken, University of Pennsylvania (emeritus) and by Lester A. Hoel, University of Virginia, Charlottesville. Appointed by the National Research Council, they were 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 this report rests entirely with the authoring committee and the institution.

Suzanne Schneider, Assistant Executive Director of TRB, managed the report review process. The report was edited and prepared for publication under the supervision of Nancy Ackerman, Director of Reports and Editorial Services. Special thanks go to Frances E. Holland for assistance with meeting arrangements, communications with committee members, and report production.

Benjamin J. Allen
Chairman, Committee for the Study of Freight
Capacity for the Next Century

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Executive Summary

The Transportation Research Board's (TRB's) Committee for the Study of Freight Capacity for the Next Century was convened to examine indications that the freight transportation sector, which has in recent decades facilitated productivity growth, instead threatens to become a hindrance to the economy. Participants in the industry have noted that in some segments investment in capacity is not growing at the same rate as traffic, shifts in freight patterns are creating bottlenecks that degrade performance, and adding capacity is becoming more expensive and difficult. The committee undertook two tasks: first, to examine the trends in the sector that have been the sources of concern in order to assess the risk that efficiency gains might not continue; and second, to propose changes in government policy that will increase capacity by enhancing the efficiency of freight transportation and promoting more rational investment.

CONCLUSIONS

Prospects for Freight Capacity

The committee examined aggregate trends in traffic, performance, capital expenditures, and capital stock for the freight modes; developments related to congestion at freight terminals, at border crossings, and in urban areas, especially on facilities shared by passengers and freight; and underlying trends in productivity, finance, and technology. Taken together, developments in these areas have indicated to many observers a pattern of unprecedented tight capacity in certain parts of the system. Concern has been magnified by extrapolating the trends: in the next two decades, the nation's total output of goods and services probably will increase by 70 percent, highway travel and all domestic freight traffic will increase by about 40 percent, and international container traffic may more than double. The strong economic growth of the 1990s and the resulting traffic growth placed exceptional demands on the transportation system and accentuated its weaknesses. In making decisions about transportation capacity, it is important to distinguish long-run trends from cyclical peaks in traffic. The economic performance of the 1990s may not represent the trend of the next several decades; nonetheless, even sustained, modest growth will bring about deteriorating performance if freight capacity is allowed to stagnate.

The committee's task was to consider the implications of historical developments for freight system capacity and performance in the long run and the need for public-sector responses. The evidence appears to be consistent with the following assessment and qualitative predictions about developments over the next few decades.

The prominent developments in recent decades that formed the basis of concern for the future performance of the freight system included growing congestion on important highway segments and slowing of the rate of addition of highway capacity, rail infrastructure downsizing and service disturbances, congestion at terminals and border crossings, lengthening lead times

and rising costs of infrastructure projects, and freight–passenger conflicts in cities. These trends represent serious challenges to public- and private-sector providers of freight transportation services and facilities. However, to obtain a balanced view, it must be recognized that certain developments, although they do not diminish the legitimacy of concerns about capacity, have positive implications. Demographic trends, in particular the slowing of the rate of labor force growth compared with the 1970s and 1980s, will moderate highway traffic growth. Moreover, the evidence is mixed on how much average highway trip times are actually increasing; apparently highway users' behavior changes are partially offsetting the effect of increased traffic density. Part of the trend toward greater traffic density in all modes reflects productivity improvement, a positive rather than harmful development.

Furthermore, capacity is being added. For highways, recent additions more often take the forms of widening, alignment improvements, improved traffic management systems, and intersection improvements than construction of new routes. Overall, highway capital stock is being added faster than it is wearing out (although this circumstance does not demonstrate that the rate of growth is optimal).

Railroads and ports report ambitious infrastructure spending plans, although it is uncertain how much of planned spending will occur. Market developments, including future global patterns of trade and commodities production, will determine the scale of the U.S. rail industry and which transport markets it will serve. It appears possible that the rail industry trend of consolidation and network rationalization will continue. An important uncertainty about future port development in the United States is where additional capacity will be located, that is, which ports and regions in the United States and neighboring countries will attract the facility expansions that will be needed to handle trade growth.

Congestion in the freight transportation system remains localized; it is not severe in all urban areas and as yet affects only small parts of the rural Interstate highway system and of the intercity links of the other modes. However, congestion at a bottleneck can have severe systemwide repercussions. The growth of international trade may exacerbate the bottleneck problem by concentrating freight traffic at a small number of nodes, including certain ports and border crossings.

Productivity growth in freight transportation has historically been impelled by a series of breakthroughs, both technological and institutional. Major boosts to productivity of this sort probably will occur again. Improvement in vehicle and infrastructure technology will continue to be important. Possibly most important will be information technology applications that improve coordination of transport operations. In public administration, ample opportunities exist for reforms in management, operations, and finance that could yield dramatic gains in transportation efficiency.

There will be serious challenges. Increasing population density, urbanization, and wealth ensure that conflicts between freight and passenger traffic; conflicts between freight transportation and residential, recreational, and other competing land uses; and requirements to control pollution will increase. These forces will increase the cost of expanding capacity and add to the risk of investment.

The United States has ample resources for expanding the transportation system; however, if capacity addition does lag traffic growth and congestion worsens, as seems likely, the long-run consequence will not be massive breakdown. Freight markets have self-correcting capabilities. Users will adjust to accommodate or avoid congestion. Workplaces and residences will move away from congestion within metropolitan areas and from more-congested to less-congested regions within the United States. Such adjustment has been the most important means of accommodating growth throughout U.S. history. Congestion will be a constraint on the growth of some urban areas. Some production will move from the United States to other countries if congestion costs cause the United States to lose comparative advantage in some industries.

Therefore, one plausible course of development is that the nation will continue to accommodate growing freight traffic volumes by increasing capital spending on infrastructure, by accepting more congestion, and by moving away from the most congested locations. This resolution might be tolerable, but will certainly be far from the economic optimum, for two reasons. First, the available capacity will continue to be used poorly on those parts of the system where users do not pay prices that reflect costs and where operators lack incentives to be responsive to user costs and preferences. Second, obstacles exist to effective targeting of capital expenditures, particularly in the public sector. Public capital spending will dissipate much of its impact because some high-payoff projects are passed by and some low-payoff ones are carried out. Private-sector capital expenditure may not be efficient if a suboptimally small number of firms dominate a market, hindering competition. Changes in government policy that would allow the nation to make better use of existing capacity and better investment decisions, compared with this scenario, would have important economic benefits.

Institutional and Management Factors

The committee examined transportation projects as case studies to illuminate the institutional setting of project-level decision making and sought views of freight industry executives on study issues. The cases suggest that certain basic questions about the management of public transportation programs are not being adequately examined. Government evaluations of projects sometimes are not broadly conceived, do not employ proper analytical techniques, or are not subjected to expert review. Governments often fail to recognize and take advantage of the link between project finance and performance. Consequently, public agencies usually do not evaluate how alternative funding mechanisms or user fee arrangements would affect the performance of transportation programs or follow project funding practices that maximize the chance of producing successful projects.

The case studies did not document systematic misallocation in government investment decisions in favor of projects primarily serving passengers over projects of particular importance to freight because the project evaluation methods governments used in the cases did not compare returns from the freight-related projects selected for funding with returns from alternative transportation uses of the funds. They do illustrate that freight capacity problems in those parts of the transportation system for which government is responsible often are simultaneously passenger transport capacity problems. Solutions to freight and passenger capacity problems may often be complementary. The case studies as well as the aggregate trends indicate how

capacity problems often originate in operating practices that are not optimal. A common theme in the cases is that obstacles to problem resolution, as well as poor management decisions, can arise from inadequate communication among the private sector, government transportation agencies, and other government bodies at the federal, state, and local levels.

The views of freight executives communicated to the committee highlighted that physical plant is not the only potential capacity constraint on the freight transportation system. Short-run constraints often are equipment or labor shortages rather than shortages of road space or trackage. Although labor supply is a problem that carriers and workers can resolve, public policy regarding education, workplace regulation, immigration, and rights of foreign carriers to enter the United States will affect the labor outlook.

RECOMMENDATIONS

A general recommendation is presented first, concerning principles to guide decisions on government programs affecting freight capacity and the need for consistent policy direction across the broad range of public programs relevant to freight capacity. This is followed by specific recommendations related to investment, management of facilities, decision-making methods, and regulation. The main recommendations are italicized.

A Comprehensive Federal Government Freight Program

The committee urges that the Congress, as well as the federal agencies responsible for transportation infrastructure and regulation, recognize the full range of federal programs that affect freight and endeavor to make decisions in all these programs that are consistent with the principles outlined below.

The Comprehensive Policy Agenda

Freight transportation is a joint venture of government and the private sector. Therefore, the performance of the system and the adequacy of freight capacity in the next decades will reflect the outcomes of government decisions on numerous spending, regulatory, and operational questions. Decisions on these matters often seem to address narrow concerns and to be guided by short-run considerations. What is needed instead is a coherent government effort at the national level to improve freight efficiency and provide adequate capacity that takes into account the cumulative long-run consequences of these government decisions and applies consistent principles to guide decision making.

Present government activities that directly affect freight transportation fall into four categories: provision of infrastructure; operation of facilities; finance of the construction and operation of facilities and collection of fees from their users; and regulation to reduce environmental and safety costs, protect consumers from monopoly power, and control international commerce. Although freight transportation system development in the United

States is a decentralized rather than centrally planned enterprise, the government influence is pervasive. The success of government efforts to ensure adequate future capacity will depend on the quality of decisions in these four areas of established responsibility.

Principles to Guide Government Freight Programs

Experience in the United States and other countries demonstrates that respecting the following four principles will enable the freight infrastructure system to provide the level of capacity and performance that makes the greatest contribution to the nation's economic well-being:

- Economic efficiency ought to be the primary goal of government transportation policy; that is, those capital improvements and operating practices for public facilities should be selected that yield the greatest net economic benefit, considering all costs.
- Government involvement should be limited to circumstances in which market-dictated outcomes would be far from economically efficient. These include preventing exercise of monopoly power and dealing with nonmarket costs. Government also is responsible for management of facilities for which it has a historically established responsibility that could not feasibly be altered in the near term, and in settings where institutional complexity necessitates government leadership. The federal government is responsible in instances where a conflict exists between nationwide and local interests and for ensuring transportation facilities for national defense.
- A government responsibility to provide facilities or leadership in developing a project does not necessarily justify government subsidy of the costs. Wherever the important benefits of a public-sector freight-related project are the direct benefits that users of the facilities receive in the form of reduced transportation and logistics costs, users should pay the costs.
- Finance provisions in public-sector transportation programs are a major determinant of performance, affecting both the quality of investment decisions and the efficiency of operations. Reliance on revenue from users, and from local matching funds in federal grant programs, will increase the likelihood that the most worthwhile improvements will be carried out and that facilities will be operated and maintained efficiently.

Application of these principles frequently is controversial, and many government investment and operating decisions are not consistent with them. Controversy is especially likely when proposals are made for changing existing practices regarding user fees or funding sources (e.g., instituting user charges on previously uncharged public facilities) and when particular industries or local interests argue that a project's national significance justifies federal or state subsidy instead of funding through project-generated revenues. Consideration of the distribution of benefits commonly is a factor in public-sector transportation spending decisions; however, this practice has efficiency costs. It is important to economic welfare that resources be concentrated on the high-payoff capital investments that are available, rather than diverted to constructing facilities that will be high-cost or underutilized.

Government has in the past attempted to direct transportation and infrastructure programs as the committee recommends, that is, by defining general principles to be applied across programs. The U.S. Department of Transportation's (DOT's) 1997 National Freight Transportation Policy Statement is one example. Implementation of this approach has had only limited success. The obstacles have been not only conflicting interests, but also lack of planning and administrative follow-up. After the principles are established, the necessary next steps are to identify all the government activities to which they apply, considering operations and regulation as well as construction, and then to analyze how each program must be changed to align with the principles. A start at this planning and analysis task has been made in this report, but a comprehensive policy review would require a greater effort.

Action to continually extend the application of these principles affords the only realistic prospect that the nation can continue to enjoy the benefits of freight transportation productivity growth in the long run. The program recommendations below identify opportunities for application.

Recommendations on Specific Programs

The recommendations that follow are illustrations of how the principles stated above can be applied to government decisions on investment, operations, finance, and regulation. The examination of freight capacity problems in this study points to numerous immediate, practical opportunities for incremental improvements in government performance that will substantially contribute to ensuring adequate future capacity. Adjustments will allow the established public works programs to start producing better results: better project selection and better facility operation. The recommendations are grouped under three headings: federal infrastructure programs, decision-making processes and planning, and regulatory issues.

Federal Freight Infrastructure Programs: Capital Expenditures, Finance, and Operations

Surface Transportation Act Reauthorization

Because trucking accounts for the majority of U.S. freight transportation expenditures and the federal government has a leading role in national highway programs, no federal activity has greater significance for freight capacity than the federal-aid highway program. Highway services are essential to the functioning of the rail, air freight, port, and waterway systems. *The next federal surface transportation program should further these three goals:*

- 1. Maintain and reinforce the principle of user financing, reforming the structure of fees so that they more closely relate to costs each highway user imposes.*

Measures that Congress can take to improve the system of federal highway finance include the following:

- Making adjustments to more closely align average user fee payments for vehicles with estimates of cost responsibility in DOT's most recent federal highway cost allocation study. Better matching of fees to costs could provide incentives for shippers to make logistics decisions and for carriers to make equipment and operating decisions that reduce the costs of truck transportation and permit better utilization of existing capacity. The adjustments would not necessarily entail raising average user fee rates. Congress should ensure that federal truck size and weight regulations (which historically have been addressed in the highway program legislation) are consonant with user fees. Motor carriers should be allowed to operate equipment that minimizes their costs, provided that the equipment is consistent with safety and fees on the equipment cover the cost of providing infrastructure for it.
- Continuing the Value Pricing Pilot Program and the provisions of the Transportation Equity Act for the 21st Century (TEA-21) and the Intermodal Surface Transportation Efficiency Act that encourage highway development using toll finance, and strengthening incentives for state and local governments to take advantage of these provisions.
- Considering measures to reduce obstacles and provide incentives to private participation in highway development, as pilot programs with continuation dependent on evaluation of the results.

2. Support improved operation and maintenance of existing highway facilities.

Congress should instruct DOT to review, in cooperation with the states, experience with the state infrastructure management systems, in order to develop ways that the federal-aid program can help improve the effectiveness of these management tools in all states. Congress should strengthen oversight and evaluation of state administration of federal motor carrier safety and size and weight regulations. Congress should continue support for research on highway maintenance practices and methods and on intelligent transportation system applications for traffic management.

3. Provide funding adequate to ensure that the states have resources to maintain the overall performance of the highway system.

In deciding on justifiable highway spending levels, Congress should consider the estimates of benefits of alternative highway funding levels in DOT's Conditions and Performance studies. The DOT C&P reports have significant imperfections, but are the best available projections of returns on federal transportation investments.

Freight Priorities in the Federal-Aid Program. *Any programs that Congress enacts for the purpose of redirecting state and local government project selection toward freight-related projects should satisfy the following criteria:*

- They should sustain the user-pays principle that underlies the federal-aid program; that is, capital and operating costs should be paid from the revenues of fees charged to the direct users of the facilities.
- They should sustain the broad support of the affected parties that the federal user fee financing system enjoys by funding projects that fee payers recognize as having value to them.
- To ensure that the market outcomes of competition between trucking and other modes are in the public interest, primary reliance should be placed on adjusting user fees rather than on supplying offsetting subsidies to the competing modes.
- Rules for federal multimodal credit assistance programs should include requirements for ongoing and retrospective evaluation of the performance of the programs.

New Systems. Congress should direct DOT, in cooperation with the states and the private sector, to study the costs and market potential of exclusive truck facilities and to examine needs for additional ancillary highway facilities for trucks to reduce truck–car conflicts, such as rest areas and parking and staging areas. Such facilities should be paid for by user fees.

Port Development

The Administration and Congress should reexamine the planning process for new projects as well as the present rules on funding formulas and sources for harbor and channel improvements, with the goal of ensuring that available funding is concentrated on the projects with greatest net benefits. The following reform measures should be considered:

- Deauthorization review, that is, systematic review of the justification for all authorized harbor and waterway projects;
- Regional planning for port capacity or regionalization of port investment decisions;
- Greater reliance on local cost-sharing and user fees; and
- Strengthened requirements for independent review of evaluations of federal harbor and waterways projects.

Congress should sustain the cost-sharing reforms of the 1986 Water Resources Development Act by refraining from waiving or bypassing local match requirements.

Harbor Maintenance

A new revenue source for maintenance dredging of navigation channels is needed. Options that have been proposed for harbor maintenance finance include general revenue funding, a new harbor services user fee, and dedicating a portion of customs revenues to a fund to finance federal harbor expenditures. A fourth option would be a fee scheme more closely matching fees to costs; for example, fees related to vessel operating draft and to the costs of specific channels. Although the committee makes no specific recommendation about the appropriate new revenue sources, it urges Congress to recognize that tying channel capacity expansion and maintenance to project-specific user fees would have certain economic benefits. With current technology, all users can be identified and their use can be charged for as is the use of a toll road.

Operation and Management of the Inland Waterways

Congress and the Administration should direct the Corps of Engineers to improve the efficiency of congested locks on inland waterways through demand management. In its authorizations and appropriations for Corps Civil Works activities, Congress should begin to rely on revenues from user fees to fund inland waterways operation and maintenance as well as capital expenditures. Increased reliance on segment-specific user fees would tend to discourage expenditures on little-used waterway segments. For the longer run, new institutional arrangements should be sought for inland waterways management—for example, operation by regional authorities—that would entail less federal subsidization of waterway operation and expansion.

To promote efficient use of waterways and harbors and to be perceived as fair by the payers, fee structures should take into account the costs attributable to all users, including commercial navigation, other private navigation, and public and nonnavigation uses of facilities.

Public–Private Joint Funding of Freight-Related Public Works Projects

States and local governments should routinely conduct evaluations to quantitatively test the economic rationale for government involvement in their freight transportation infrastructure projects, prospectively for each new proposal for government participation and retrospectively for each completed project. The rules of federal programs should require such evaluations of projects receiving federal assistance. Congress should base its future decisions on whether to adjust federal-aid program rules to encourage such projects on review of the outcomes of prospective and retrospective evaluations of past projects.

In recent years, governments have experimented with expanding their involvement in freight transportation infrastructure. Nontraditional projects typically have involved public–private joint undertakings and complex financing packages with support from multiple sources, often center on intermodal facilities, and often entail public support for facilities that are commonly provided by the private sector. The first step in considering public funding for such a project should be a quantitative analysis to demonstrate that the rationale for government support is sound. The analysis would estimate the benefits, costs, and government budgetary impacts and compare them with alternative means of serving freight and with alternative institutional arrangements. If the proposal is for government support of a project that cannot obtain private-

sector financing, the evaluation should demonstrate that public benefits exist that raise the public rate of return above the private rate.

Decision-Making Processes and Planning

DOT Data and Analysis Programs

Congress should give continued support to the development of DOT capabilities for economic analysis of the federal-aid highway program and federal highway user fees and to the application of this analysis in support of decisions. Congress should provide for joint state–federal efforts to transfer and adapt these federally developed policy guidance tools to state and local needs.

DOT has made progress in recent years in the development of methods and data for its C&P reports, its Highway Economic Requirements System, and its highway cost allocation studies. However, better guidance for federal decisions would be possible with improvements to these tools. For this purpose, Congress should provide for the ongoing collection of freight transportation statistics by DOT, through the Bureau of Transportation Statistics. The Commodity Flow Survey and the Corps of Engineers' waterborne freight transportation data programs should be continued.

Evaluation Methods

As one means of promoting more useful evaluation at the federal and state levels, Congress should create a clearinghouse devoted to evaluation methods within DOT, where DOT program agencies and local and state governments could share and compare methods and examples of evaluations. The clearinghouse would not supplant any agency's evaluation responsibilities, but would work to define best practices. The scope would include project evaluation, regulatory evaluation, follow-up evaluations of programs and projects, and evaluation of excise tax and user fee schemes. This activity must not add to delay by creating additional layers of project approval requirements. Rather, the clearinghouse ought to contribute to streamlining through development of clearly defined and accepted methods and by providing supporting staff expertise.

Public infrastructure investment choices are made more difficult by weak analysis capabilities. The sources of this problem lie in the lack of an explicitly defined evaluation framework, political incentives that discourage evaluation, and failure to devote resources to research and data collection.

The following guidelines are applicable to government freight-related infrastructure projects: (a) Evaluation requires use of benefit–cost analysis. Traditional engineering standards for judging projects are insufficient. Transportation benefits should be evaluated in terms of users' willingness to pay for the change in service produced by the project. Estimating the demand response to changes in transportation cost is necessary. (b) Evaluations of capital improvements must include comparison with noncapital alternatives including traffic

management and pricing. (c) External costs must be included and specification of alternatives must give consideration to opportunities for modifications to project design that mitigate these costs. (d) The evaluation must include analysis of risks and sources of uncertainty, including uncertainty in traffic projections, and consider strategies for reducing risk.

Regulatory Issues

Reducing Project Delivery Time

Infrastructure providers see curtailing the growth of project delivery times as essential to controlling the costs of capacity expansion. Legally required environmental reviews of infrastructure projects serve an essential function, but also have costs and can add to completion time and uncertainty. Changes in practices and policies that shorten delivery time would greatly reduce the difficulty of efficiently matching capacity to demand. The goal of reforms should be to speed project delivery without compromising valuable environmental safeguards. The following actions would be steps toward reducing excessive delay:

- *The Secretary of Transportation should implement a streamlined environmental review process at the earliest possible date that furthers the congressional intent of improving the efficiency of project delivery expressed in TEA-21. DOT should not overlook opportunities to streamline reviews of more common, smaller-scale rehabilitation projects.*
- *Congress should consider allowing federal agencies reviewing highway projects to accept funds from nonfederal public agency applicants to pay administrative costs in order to speed project review.*
- *Congress should direct DOT to conduct, in cooperation with the states and the federal environmental agencies, the following studies:*
 - *An assessment of the effects of required environmental reviews of transportation projects, including impacts of reviews on project delivery times and on final project design.*
 - *A program of research to identify and document best practices in state transportation programs and in other federal and state infrastructure programs regarding innovative project development, design, and management aimed at reducing project delivery times. The review should consider methods of initial project planning that enable states to foresee and ameliorate potential environmental conflicts.*
 - *Evaluations of successful and unsuccessful projects to examine the distributions of the direct costs and benefits, among all the affected individuals and groups, of publicly supported freight infrastructure developments.*

Liberalization of International Air Freight

The committee endorses past U.S. government efforts to liberalize the international air freight market through bilateral agreements with other nations but recommends that the multilateral

approach be pursued as well, since it is the method with the greatest potential benefit. Increased competition and increased carrier flexibility would be expected to yield improvements in efficiency in the international air cargo system as they have in other transportation sectors. An alternative to the present regulatory system would be to govern international air cargo, as is trade in other international services, by a multilateral free trade agreement reducing barriers to ownership, market entry, and cabotage.

Chapter 1 Introduction

From 1991 to 2001, the U.S. economy experienced the longest uninterrupted expansion in its history. The emergence of capacity constraints in some sectors of the economy during the decade is not surprising. Certainly shippers experienced effects of constrained capacity in the freight transportation sector. Rail service disruptions, driver and equipment shortages in trucking, peak season congestion at west coast ports, strains on the air traffic control system, and extraordinary delays for traffic at U.S. land borders all contributed to the impression that the freight transportation system was under unusual stress.

Are recent episodes of capacity shortages in freight transportation normal cyclical phenomena, or are they symptoms of detrimental long-term trends pointing to persistent freight transportation capacity problems in the future? The answer to this question has considerable economic importance. The history of freight transportation in the United States has been one of nearly continuous, often dramatic, productivity improvement. The performance of the freight transportation sector has been instrumental in allowing the United States to become the world's largest integrated market and to participate successfully in global trade. The sector has in this way advanced economic welfare, and interruption of the historical trend of productivity improvement would be a substantial loss. The economic stakes are magnified because freight shares infrastructure with passenger traffic, so freight congestion adds costs to passenger travel.

In the past the freight transportation system has kept up with the growth of commerce while at the same time improving productivity through private-sector market-driven capital investment, public capital investment directed by the political process, technological progress, and management innovation. In addition, government institutions have been able, at critical junctures, to respond effectively to changing circumstances. To allow the freight system to continue to develop, all these means must continue to be available and applied effectively.

The Transportation Research Board (TRB) convened the Committee for the Study of Freight Capacity for the Next Century in response to observations of participants in the transportation industry about the possibly detrimental implications of certain trends in freight capacity. In this chapter the charge to the committee is described, the developments in freight transportation that motivated the study are identified, and the report is outlined.

CHARGE TO THE COMMITTEE

The committee was charged with two tasks: first, to examine the trends that have been the sources of concern in order to determine whether they indicate a risk that the efficiency gains in freight transportation of recent decades might not continue; and second, to propose changes in government policy that will improve the efficiency of freight transportation, especially over the long term. Government in the United States is responsible for provision and operation of major components of freight system infrastructure and for regulation of private-sector transportation

firms. The committee considered pending government decisions or immediate issues within established programs that have repercussions for freight capacity, and possible initiatives or departures from established practices.

From a practical point of view, the committee was concerned with three kinds of inefficiencies in the freight transportation system:

- First, cases where expansion of facilities would be economically worthwhile (that is, benefits to users would exceed the cost of the expansion) but the investment for expansion is not taking place. In the public sector, where investment decisions generally are not directly connected to the revenues that particular facilities generate, failure to invest may be the result of a shortage of funding or failure to recognize the investment opportunity. In the private sector, failure to make a worthwhile investment may be the result of regulation that blocks entry into a market, restricts pricing adjustments, or adds unnecessarily to costs. (Of course, the opposite circumstance also occurs—where facilities ought to be downsized but are not.)
- Second, cases where failure to consider the effects of transportation activities on the public as a whole cause a facility to be improperly sized, sited, or operated. For example, a rail line from a port through a city may function well from the point of view of the carrier and its customers, but the costs to residents from noise, pollution, and blockage of streets might cancel the shipper and carrier benefits.
- Finally, cases where existing facilities are poorly managed. Perceived transportation capacity shortages arise commonly from management problems. For example, a road with heavy congestion may appear to be a candidate for widening, but if a state-of-the-art traffic signal system sufficiently reduced users' costs, the widening would no longer appear attractive. Private-sector transportation firms manage use of their facilities through traffic control technology and through pricing (for example, charging higher rates in peak periods), which is essential to get the greatest benefit from existing capacity. The public sector uses technology but almost never pricing.

The committee's work was aimed at determining the prevalence of these sources of inefficiency, their costs, and whether changes in government policies could correct them.

Increases in freight transportation prices or declines in infrastructure spending that are caused by increases in the prices of the resources used to produce freight services generally are not problems requiring government intervention. Thus, for example, if transportation labor costs rise because workers with the skills transportation employers seek become more heavily in demand throughout the economy, or if land for terminals in cities becomes more expensive because its value for recreation or housing increases, then freight rates will rise. In response, shippers will economize on their use of freight by changes in the organization of production (e.g., maintaining larger inventories and shipping in larger quantities) and the location of facilities (e.g., moving manufacturing closer to consumers). These adjustments will be the best way to minimize total production costs in the face of the rise in labor or land costs. There is no need in such circumstances for government to respond by attempting to drive freight rates down through subsidies. The committee has not been concerned with these kinds of cost increases in

private-sector freight transportation activities because shipper and carrier management can respond appropriately to them.

The committee did not devise measures of system freight capacity. A generally accepted definition of system capacity is not available. The public policy decisions with which the committee was concerned, regarding incremental additions to capacity and effective management of capacity, do not depend on such measures. The problem of defining capacity is discussed in Chapter 2.

Physical plant is not the only potential capacity constraint on the freight transportation system. The institutional and management environment determines whether the physical plant is used efficiently. For example, the reduction of federal and state regulation of rates and service in the 1980s affected how the railroads use their plant; and road authorities' pricing and user fee policies affect the trucking industry's use of roads. Technological progress (e.g., increasing use of information technology to manage transportation systems) also can increase the effective capacity of existing physical plant. Short-run capacity constraints are more likely to be equipment or labor shortages than shortages of road space or trackage. Labor and equipment supply are primarily short-run problems that carriers, suppliers, and workers can resolve in private markets. Public policy does influence these markets; for example, government education programs and regulation of workplace conditions may be important for the labor outlook.

The committee has addressed its conclusions to federal and state government legislators and administrators, private-sector executives and industry associations, and the public. Significant change in the public sector's approach to provision and management of freight capacity would require legislation, which could only come about at the demand and with the support of industry, the public, and transportation professionals.

In reaching its conclusions, the committee relied on four kinds of information:

- Aggregate trends and projections of freight traffic volumes, the extent of freight infrastructure, capital spending, and freight system performance.
- Case studies examining specific freight projects and planning efforts, to learn about the perceived needs these activities are responding to, the obstacles they have had to overcome, and the causes of success and failure. Cases reveal factors that cannot be observed in aggregate trends—capacity problems are predominantly local, and institutional bottlenecks generally underlie physical ones.
- Interviews with participants in the freight transportation industries, including carriers, shippers, and public-sector infrastructure managers, to discover how they perceive capacity problems today and threats in the future.
- Conclusions of several recent objective studies of related transportation questions from the federal government, the National Research Council (NRC), and others.

SOURCES OF CONCERN

Recent problems in the performance of the freight system are perceived in different ways by shippers, carriers, public officials responsible for government-supplied infrastructure, and travelers who experience the consequences of competition for capacity between freight and passenger traffic. Nonetheless, the apprehensions most commonly expressed by the affected parties relate to certain trends in markets, performance, and investment patterns that appear to be unsustainable:

1. Stagnant highway spending combined with continual traffic growth: From 1970 to today, highway travel has more than doubled, while inflation-adjusted annual capital spending for highways has barely grown at all. Highway trucking is the major freight mode in terms of expenditures for freight services, and combination truck traffic is growing at a rate 50 percent greater than other highway traffic.

2. Railroad infrastructure downsizing and service disturbances: The number of ton-miles of freight carried by Class I railroads increased by 87 percent from 1970 to 1999, while miles of roadway operated by Class I railroads declined by 43 percent. Shippers complain of service deterioration in the past several years, including unusual disruptions following rail mergers in the 1990s. Rail capacity constraints and recent service problems are discouraging to the hopes of state and federal officials, environmentalists, and motorists that rail can relieve highways of part of the burden of truck traffic growth.

3. Growing congestion at terminals and border crossings: Congestion at container ports, Mexican and Canadian border crossings, terminals where containers are transferred between rail and truck, and air cargo terminals has been the object of special attention in part because these transport nodes are vital to some of the most dynamic sectors of the U.S. economy.

4. Lengthening delivery times and rising costs of infrastructure projects: Major infrastructure projects commonly require one to two decades to plan and complete. Therefore, infrastructure adjustment to changing markets will be slow, and investment decisions must be based on highly uncertain long-term forecasts. Infrastructure projects costing from 100 million to several billion dollars are becoming more common, especially in urban areas. Increasing population density, community opposition, and stronger environmental regulations are among the factors that have added to the uncertainties of infrastructure development.

5. Urban congestion and freight-passenger conflicts: Most major freight nodes (ports, airports, and railheads) and the origins and destinations of most shipments are in cities. Freight must compete with passenger traffic for use of transport facilities and with all other land uses for space for expansion.

These observations, which have indicated to many observers an outlook for unprecedented tight capacity in parts of the freight transportation system, were the starting point rather than a conclusion of the committee's work. Certainly, circumstances similar in some respects have existed in the past and have always been cited by transportation officials and private-sector transportation companies and shippers arguing for increased public spending. In a

1949 study of postwar national highway needs (MacDonald 1949), the federal Commissioner of Public Roads observed that:

Any complacency we may have as to the present adequacy of these major roads to serve in peace or war is shattered by the evidence presented. . . . The most serious deficiency of our highways today . . . is their lack of capacity to provide for the ever-increasing number of motor vehicles in service. . . . It seems unnecessary to argue that the annual addition of increments to overloaded and hence unsafe highways, cannot be continued at current rates without major enlargements and increases in the highway systems.

Of course, the nation responded effectively to this circumstance in the 1950s with a large and innovative public works program, the Interstate Highway System, created by the Federal-Aid Highway Act of 1956.

The assertion that forecasts of traffic growth justify public works spending has always been controversial. It has been argued, by environmental advocates and others, that conventional public works capacity planning (sometimes characterized as “predict and provide” planning) overlooks many of the costs of expanding systems and ignores important alternatives, and that past predictions of capacity crises have been exaggerated (Dittmar and Chen 1996; Department for Transport, Local Government, and the Regions 1998, Chapter 1). Economists as well as traffic engineers have been critical of conventional planning for overlooking the benefits of using pricing and technology to derive greater benefit from facilities. For example, an NRC study of the inland waterway system observed that “Rather than wait a decade for relief from . . . congestion by expanding the locks, shippers . . . could enjoy immediate improvements through better traffic management” (NRC 2001, 3–4); and a recent study of highway congestion by a market-oriented public policy organization argued that “innovative highway redesign, separation of types of traffic, toll financing, variable pricing, and electronic toll collection will allow us to offer auto drivers and truckers real alternatives to gridlocked freeways. . . . we need not be so pessimistic and defeatist about traffic. A large part of the problem is in the area of ideas” (Samuel 1999, Executive Summary).

The task for this study was to examine the validity of present-day perceptions of system needs and the implications of recent trends for freight system capacity and performance in the long run. The committee asked the following questions: Are any of the present trends genuinely unprecedented, or are they consistent with past traffic growth and with historical patterns of development of transportation facilities? Will the government and private sector be able to respond to growth as in the past, or are there new economic, demographic, or social factors that will render traditional solutions impracticable in the future and necessitate new kinds of solutions?

OUTLINE OF THE REPORT

In Chapter 2 the assumptions and principles that guided the committee’s study and conclusions are stated. They concern definitions of freight capacity, the proper way of judging the adequacy of capacity and the performance of the freight transportation system, and delineation of the

responsibilities of government related to freight capacity. In addition, immediate policy issues important for freight transportation, most of which concern pending government decisions in existing programs, are identified, and selected recent proposals for reform of government policies related to freight capacity are reviewed. Results of the committee's assessment of the three information sources to which it referred are summarized in Chapter 3: aggregate trends data on freight traffic, infrastructure, and system performance; the case studies of freight infrastructure projects or planning activities; and the industry interviews. A review of the evidence regarding the five perceived trends listed above is included in Chapter 3. The committee's conclusions and recommendations are presented in Chapter 4.

REFERENCES

Abbreviation

NRC National Research Council

Department for Transport, Local Government, and the Regions. 1998. *A New Deal for Transport: Better for Everyone: The Government's White Paper on the Future of Transport*. United Kingdom, July 20. www.dtlr.gov.uk/itwp/paper/.

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Chapter 2

Freight Capacity as a Government Policy Issue

The relationship of government policy to freight capacity is examined in this chapter. Freight transportation in the United States is a mixed public and private enterprise: government builds and operates the infrastructure of the highway and inland waterway systems as well as major components of airport and seaport infrastructure and regulates transportation firms. Private-sector firms provide rail infrastructure and parts of the other modes' infrastructure as well as most vehicles, and sell transportation services to shippers. In this complex environment, it is necessary to define the scope of government responsibility and to analyze how government actions affect the provision of capacity by the private and public sectors.

The criteria that the committee believes should be the basis for justifying government involvement in freight transportation and guide decisions regarding provision and management of publicly owned facilities are identified in the first section below. Economic efficiency is the primary criterion. The conceptual difficulties in defining freight capacity, which can be clarified by applying the efficiency criterion, are also discussed.

The important immediate government policy issues affecting freight capacity are identified in the next section, and selected recent statements and proposals on basic policy issues related to freight capacity from government, past NRC committees, and others are reviewed in the final section. Most of the immediate policy issues arise in the context of established government programs. They illustrate the practical scope of policy choices to which the committee's proposed principles ought to be applicable. Decisions on these programs are made continuously, and together they determine the influence of government on freight capacity. The policy statements suggest the range of options open for changes in policy, although not all the statements are consistent with the principles proposed in the chapter.

PUBLIC RESPONSIBILITIES IN FREIGHT TRANSPORTATION

Disputes over public policy issues regarding freight transportation usually arise from differing conceptions of the proper role of government in the sector. Therefore, it is appropriate to state the principles regarding the government's role that underlie the committee's recommendations. The 1998 TRB study *Policy Options for Intermodal Freight Transportation* examined government responsibilities in freight transportation. It described how government's historical responsibilities for construction, operation, and finance of transportation facilities and regulation of private-sector transportation firms have differed among the freight modes and have evolved over time (TRB 1998a, 20–28). The earlier TRB committee also analyzed the problem of defining government responsibility (TRB 1998a, 28–45, 94–98; Eberts 1998). The statement that follows is consistent with that committee's conclusions. Consideration of these principles helps to resolve certain problems concerning the definition of freight capacity, as described at the end of this section.

Principles on Government Involvement

Economic efficiency ought to be the primary goal of government transportation policy. Efficiency requires that those investments in system capacity that yield net economic benefits be made and investments that do not yield net benefits be avoided. Efficiency also requires that existing capacity be operated in such a way that service is provided to all freight system users who value the service more highly than the cost of producing it and is not provided to others. The cost of freight transportation services includes congestion, environmental costs, and accident costs.

Application of the efficiency criterion implies that the private sector should be relied upon to provide transportation systems and services except in certain defined circumstances where the market cannot produce efficient results. In particular, such circumstances include checking monopoly power and dealing with nonmarket costs, including pollution, congestion, and accident costs that are not borne by the parties responsible for the accidents. One solution to the problem of nonmarket costs is for government to bring them within the functioning of the market. Congestion pricing and creation of tradable emissions permits are examples. This solution ensures efficiency but is often difficult to implement. In lieu of creating a market, government often relies on regulations—for example, emissions limits, safety regulations, and traffic controls such as high-occupancy vehicle lanes—to reduce these costs.

Government also is responsible for ensuring transportation facilities needed for national defense and for management of parts of the system for which it has a historically established responsibility that is unlikely to be altered soon. Finally, under certain conditions institutional complexity may necessitate government leadership—for example, providing port access in large cities, where the difficulties of multiple government jurisdictions, dense development, and sensitive environmental issues must be overcome. Government leadership in these settings does not necessarily imply government subsidy of the costs of improvements.

In all these areas, the primary responsibility falls on state and local governments, while the federal government is responsible if a potential conflict exists between nationwide and local interests. For example, in the Interstate highway program, the federal government redistributes highway user excise tax revenue among the states, draws the national system map, and dictates design standards, on the grounds that completion of a nationwide network provides collective benefit beyond the benefit that each segment of the system provides to the residents of the state in which the segment is located.

There is a degree of consensus on these principles. They are partially reflected in the U.S. Department of Transportation's (DOT's) 1996 *National Freight Transportation Policy Statement*, which sets forth "principles of federal freight transportation policy" that include allocation of federal resources to cost-effective projects supporting national goals, removal of unnecessary regulation, efficient pricing of publicly financed transportation infrastructure, assurance of safety and environmental protection, application of technology advances to promote efficiency and safety, and satisfaction of defense needs (DOT 1996). The 1994 Presidential Executive Order "Principles for Federal Infrastructure Investments" requires that "infrastructure

investments shall be based on systematic analysis of expected benefits and costs” and directs that “since efficient levels of service can often best be achieved by properly pricing infrastructure, the Federal Government—through its direct investment, grants, and regulation—should promote consideration of market-based mechanisms for managing infrastructure” (Executive Office of the President 1994). Congress has supported similar principles, for example, in creating road pricing pilot programs through provisions in the 1991 and 1998 surface transportation acts [the Intermodal Surface Transportation Efficiency Act (ISTEA) and the Transportation Equity Act for the 21st Century (TEA-21)] and in the project eligibility requirements for credit assistance under the Transportation Infrastructure Finance and Innovation Act created in TEA-21, all of which encourage private-sector participation and user charge financing.

Nonetheless, application of these principles frequently is controversial. Controversy is especially likely when proposals are made for changing existing practices regarding user fees or funding sources (e.g., instituting user charges on previously uncharged public facilities) and when particular industries or local interests argue that a project’s national significance justifies federal or state subsidy instead of funding through project-generated revenues. These arguments overlook the power that user-fee financing and rational pricing have to discourage poor investment choices and inefficient use of facilities. Making users pay for costs reduces the risk of building projects that are not worthwhile and can ensure that funds are available to pay for ones that are. When users pay, shippers and carriers have the right incentives to make decisions about logistics, equipment, and operations that are the most economically beneficial. Aligning fees with costs is a necessary but not sufficient condition for economic efficiency. Efficiency also requires that the managers of facilities operate them in a way that minimizes costs, and that investment funds go to the highest-payoff projects. While competition in the private sector will tend to produce these outcomes. They are not guaranteed in the provision of public infrastructure, even if appropriate fees are levied; however, the effectiveness of appropriate fees as a demand management tool, and the guidance that fee revenues can provide regarding which components of the transportation system warrant expansion, can promote efficiency and increase the benefits derived from public transportation facilities.

In addition to political controversy, practical problems can pose obstacles to application of the principles stated above. Often the costs relevant to setting user fees are not well understood, and some forms of fee collection can be costly and burdensome. Problems with estimating and levying improved transportation user fees have been examined in several recent NRC reports. The TRB report *Regulation of Weights, Lengths, and Widths of Commercial Motor Vehicles*, which proposes a new structure of user fees for certain trucking operations, describes difficulties in more closely matching fees to infrastructure costs and proposes solutions (TRB 2002, 148-150). The NRC study *Inland Navigation System Planning: The Upper Mississippi River–Illinois Waterway* points out demand management techniques for the inland waterways, including congestion pricing and use of tradable lockage permits, and recommends that the government evaluate these techniques as alternatives to physical capacity expansion (NRC 2001, 3–4). *Paying Our Way: Estimating Marginal Social Costs of Freight Transportation*, TRB Special Report 246, reviews the state of the art in estimating the external

costs of individual freight movements by water, rail, and truck and considers policy applications of such estimates (TRB 1996, 115–123). That study concluded that:

Considering the effect of user fees on economic efficiency does not demand an all-or-nothing policy choice: developing sophisticated, complex schemes versus ignoring efficiency altogether. For any two fee options under comparison, one will always be more efficient than the other—one will encourage economically beneficial use of the facility more than the other. These differences ought to be weighed carefully in decisions on tax policy. (p. 128)

The Problem of Defining Freight Capacity

Because this study considers the outlook for freight transportation capacity, some measure of capacity might seem indispensable. However, there is no generally accepted measure or even definition of system capacity in transportation (Morlok and Riddle 1999, 1–2). Applying the criterion of economic efficiency makes it possible, in spite of the absence of such a measure, to examine whether capacity is adequate.

The capacity of a link in a system—for example, a segment of road between two consecutive intersections—has a conventional definition as an engineering concept. As the density of vehicles on the road segment (vehicles per mile) is increased, initially the output of the road (the number of vehicles passing a point on the road per unit time) increases. Beyond some density the average speed of the vehicles begins to decline, and it is observed that the output of the road reaches a maximum, beyond which increasing density reduces output. The maximum output is the capacity of the road. A variation is to define capacity as the greatest output possible while maintaining a specified minimum acceptable level of service (e.g., a minimum speed).

This definition seems clear when applied to a road segment during a peak hour, but it does not provide an unambiguous answer to the question, “What is the annual capacity of the road?” and the concept is still more difficult to extend to a network in a useful way. A transportation network comprises multiple origins, destinations, routes, and modes. It produces a great number of distinct kinds of outputs, each characterized by the origin and destination of the trip, the time of travel, the characteristics of the goods or persons in transit, and the quality (e.g., speed and reliability) of the transportation service provided. The multidimensional nature of the output of a transportation network is the source of the difficulty of defining a measure of capacity. A further important complication is the sharing of many facilities by passenger and freight services.

Although similar conceptual difficulties arise in attempting to define capacity in the goods-producing industries, measures of industrial capacity have been produced for many years by the Bureau of the Census and the Federal Reserve Board. The primary purpose of the estimates is as an economic indicator for short-term forecasting. The Bureau of the Census conducts an annual survey of plant capacity in manufacturing, in which it asks operators to report the value of their current quarterly output, the estimated value of production at full production capability, and their capability “under national emergency conditions.” According to the Bureau,

“Plant capacity is broadly defined as the maximum or optimum level of production or output.” The survey showed, for example, that capacity was 132 percent of output in all manufacturing in the fourth quarter of 1996 (Bureau of the Census 1998).

The Federal Reserve Board publishes monthly capacity utilization rates for 76 industry groups in manufacturing, mining, and utilities using the Bureau of the Census survey and various other sources. The Board explains that its capacity measures “attempt to capture the concept of sustainable practical capacity, which is defined as the greatest level of output that a plant can maintain within the framework of a realistic work schedule, taking into account normal downtime, and assuming sufficient availability of inputs to operate the machinery and equipment in place” (Federal Reserve 1999). The estimates show that during the business expansion of the 1990s, manufacturing capacity utilization peaked in late 1994 at 85 percent.

These definitions evidently are imprecise. They depend on mostly unstated assumptions about which inputs are fixed, which inputs can be expanded without constraint, and what level of production costs is acceptable; and they treat the output of each plant or industry as homogeneous. The definitions suggest that measuring capacity in manufacturing is actually not much simpler than in transportation.

Measures of capacity in the freight transportation industry could be developed by methods analogous to those used to develop the Federal Reserve indexes. As an alternative, it is possible to develop measures derived from network models. Rail network capacity has been estimated using an optimization model simulating distribution of rail container traffic from west coast ports (Morlok and Riddle 1999). The model can be applied to maximize traffic on the system subject to facility capacity limits and delay relationships and constraints relating to equipment and labor availability, minimum level of service, and traffic patterns. The model therefore yields a measure of system capacity; for example, it is estimated that the simulated portion of the network was operating at 78 percent of capacity in 1987. Such an estimate depends on strong assumptions about demand characteristics; in this example, each port’s and inland destination’s share of traffic is assumed to be fixed. If assumptions about demand patterns were changed, the capacity estimate would change.

Quantitative estimates of capacity like those produced by the Federal Reserve surveys or by a network simulation model could be useful as indicators of current conditions or in forecasting system performance. However, for the purposes of this study, a total capacity measure was not essential. The policy question that the study is to help illuminate is whether public investment or other public actions to expand capacity are justified, compared with alternatives that include changing operating and pricing practices. It is possible to decide whether specific freight system capacity expansion projects are economically justified without having a measure of total capacity.

The example of a single road segment subject to periodic congestion, described above, can illustrate this point. Even if traffic seldom reaches the road’s engineering capacity (that is, the traffic density at which the output of the road declines), the congestion that does occur might provide sufficient economic justification for capacity expansion. On the other hand, expansion of another road segment where traffic regularly reached the engineering capacity might not be

economically justified—for example, if the construction cost of expansion were very high. Typically, providing so much capacity that users are never affected by peaking is not worthwhile. The scale is efficient if the total traffic on the present facility could not be served at lower total cost with a facility of some other scale.

Deciding whether building a new-scale facility would be efficient requires knowing all the costs and benefits, including the cost of delay to road users, the temporal characteristics of demand, the highway agency's operating costs for the present road, and the costs of constructing and operating the new-scale facility; however, it does not require having a quantitative measure of capacity. The appearance of costs that are related to capacity constraints—congestion delays, rising maintenance costs, deteriorating service—is an indicator that expansion might be worthwhile, because avoiding these costs would be the payoff of expansion. Therefore, analysis to support government decisions on transportation system investment, operation, and regulation should emphasize determination of trends in costs and the nature of any constraints that are forcing costs to rise.

IMMEDIATE POLICY ISSUES AFFECTING FREIGHT CAPACITY

Freight transportation is an ongoing joint venture of government and the private sector. The performance of the system and the adequacy of freight capacity in the next decades will reflect the outcomes of government decisions on numerous spending, regulatory, and operational issues that arise in the course of administering established programs. Decisions on these issues often seem to address narrow concerns and often are guided by short-run considerations. Decision-making authority is dispersed. Decisions are state as well as federal responsibilities. At the federal level, they involve programs administered by several agencies and governed by various legislative acts. If there is to be a coherent government effort at the national level to improve freight efficiency and provide adequate capacity, it must entail recognition of the cumulative long-run consequences of these decisions and provide a framework and principles to direct them. Otherwise, the various responsible government bodies are liable to be working at cross-purposes.

Box 2-1 lists examples of pending decisions that will affect long-run capacity. The purpose of the list is to illustrate the diversity of decisions that would require coordination as part of a comprehensive freight program. It is not comprehensive, and other program decisions affect freight capacity as well. The examples are grouped into areas corresponding to categories of government decisions: decisions on operation and regulation of transportation facilities, selection of funding sources, selection of investment projects, and definition of the division between public- and private-sector responsibilities.

The four categories of government activities are interconnected, and most of the issues listed could be classified under more than one category. For example, financing sources determine the scale of construction and influence where funds are spent, user fee collection can be a mechanism for managing use of facilities and for guiding investment, and regulations are integral to the management of public facilities.

In the following sections, each of these issues is defined, and its implications for long-run freight capacity are outlined.

Management, Operation, and Regulation

Decisions in this area relate to the rules that government applies to the users of freight transportation facilities, for example, traffic controls, economic regulation, and environmental regulation. Pricing (the fees charged to users of public facilities) is an important kind of operating rule. The section following this one, on funding, gives examples of pricing decisions.

Truck Performance Regulations

Federal and state regulations dictate many features of truck design and operation. Regulations limit the weight and dimensions of trucks, limit pollutant emissions, and require vehicle design features and operating practices to reduce accident risk. Congress and the state legislatures have adjusted the weight and dimensional limits on many occasions, although no major federal changes have been enacted since 1983. Liberalization generally has been supported by shippers and carriers. It has been opposed by railroads, sometimes by drivers, by some smaller trucking companies, and by motorist and safety advocacy groups. DOT recently completed an analysis of the consequences of changing limits (DOT 2000), and a TRB committee, responding to a congressional request, has recommended changes in federal regulations. Opponents of liberalization have argued that increasing limits is undesirable because accidents and costs of highway construction and maintenance would increase, railroads would be weakened, and the comfort and convenience of motorists would be reduced. Past TRB and DOT studies concluded that liberalization would yield net benefits.

Truck size and weight regulations directly affect the freight capacity of the highway system. Raising the limits would allow a given quantity of ton-miles (or cubic-foot-miles) to be produced with fewer truck-miles. In addition, differences in truck standards among the United States and its trading partners hinder international commerce. The differences impede cross-border truck operation in North America, and because most countries have higher weight limits than the United States, loaded containers entering the United States by sea often cannot legally be carried on U.S. roads.

However, if U.S. limits were liberalized, an efficiency gain would be assured only if each truck's user fees covered the cost of the truck's use of the roads; otherwise, increasing limits could give rise to uneconomic demands on the road system and render highway agencies less able to afford maintenance and construction. As will be described in the section on funding sources, federal estimates indicate that combination trucks, on average, pay user fees nearly equal to the expenditures highway agencies incur to serve them, although the heaviest combinations tend to pay a smaller share of their costs and fees are not tied closely to the costs of individual movements.

Economic Regulation of Railroads

Since the Staggers Rail Act of 1980, economic regulation of railroads is greatly diminished, but the government retains oversight of rail rates, in part to prevent railroads from exercising monopoly pricing power in markets where competition is weak. Railroad mergers are also subject to Surface Transportation Board review. Since the act's passage, disputes have arisen between the railroads and their customers over the degree of need for protection of shippers from rail market power. Recent rail mergers and ensuing service problems have increased the visibility of this issue. Legislation has been proposed that would require a railroad to offer a rate for service to any point of interchange with another carrier (to neutralize so-called bottleneck monopolies), make access over a railroad's tracks by a second railroad easier to obtain at a shipper's request, and add protections for small shippers (CURE 1999; Wilner 1999a). In addition, some shippers and competitors successfully opposed the most recent major rail merger proposal (*Traffic World* 2001).

Supporters of stronger government intervention on rail rates and competition have included certain shippers, notably producers of bulk commodities like coal and grain, some consumers of these products like power plants, and shortline railroads. The major railroads oppose tighter regulation and have received some shipper support in their positions (AAR 1998).

Federal regulatory policy has had great consequences for rail freight capacity. The revival of the railroads since 1980 is the result of increased freedom to set rates, enter into contracts with shippers, control labor costs, and eliminate unprofitable services. The changes have benefited shippers (GAO 1999). As described in Chapter 3, railroad capital expenditures, which had declined for decades, have increased since 1980; productivity has been growing; and operating income has increased even though rates have continued to decline. Rail traffic is growing and railroads are competing successfully for some lines of business that they had previously ceded to truck.

A return to regulation that was too restrictive—preventing railroads from responding to changing market requirements and from setting prices sufficient to earn market returns—would be expected to once again lead to slowing of capital investment and loss of service to some customers who would have been willing to pay the rates necessary to make service profitable. On the other hand, if railroads are using monopoly power to set freight rates above competitive levels, they are excluding some freight that ought to be on the railroads; so utilization and eventually the capacity of the system will be less than optimal.

International Aviation Regulation

International air cargo probably is the most regulated major freight market. International competition is governed by the system of bilateral treaties that also regulates passenger traffic. The treaties restrict landing rights, nationality of ownership, cabotage, and other aspects of operations. An alternative would be to govern international air cargo, as is trade in other international services such as telecommunications and banking, by a multilateral free trade agreement. International agreements to reduce barriers to ownership, market entry, and cabotage

would enhance competition. A proposal for such agreements has been made by the International Chamber of Commerce and other international business groups (ICC 2000; Parker 1999). In this proposal, international air cargo could be liberalized without changing the present rules governing passenger transport. The issue is timely because a new round of negotiations within the World Trade Organization structure is beginning. The past two administrations have declared liberalization of international cargo and passenger aviation markets to be a priority (FAA 2000; Mineta 2001).

Increased competition and increased carrier flexibility would be expected to yield the same improvements in efficiency in the international air cargo system as they have in other transportation sectors. Increased efficiency means that better use is made of existing capacity. Lower costs would lead to more air cargo, but the system would be better able to respond to growing demand.

North American Free Trade Agreement Freight Transportation Issues

The 1994 North American Free Trade Agreement requires the United States, Canada, and Mexico to seek harmonization of regulatory standards in order to allow free operation by transportation companies across the borders. To date progress has been slow. Truck size and weight, emissions, safety, insurance, and liability rules differ widely among the three countries (FHWA 1997, 1–4, 33–35; Adams 2001). Immigration restrictions, the problem of drug trafficking, and concerns of organized labor are further constraints.

The growth of freight traffic among the United States, Canada, and Mexico has led to serious congestion at border crossings. Facilitating freight flows at the borders will require administrative changes in numerous agencies and jurisdictions, including customs and immigration authorities and state regulatory agencies, as well as public and private infrastructure improvements. TEA-21 created a grant program, the Coordinated Border Infrastructure Program, to fund infrastructure and operational improvements at border crossings and international planning activities aimed at this problem.

The borders are among the most prominent bottlenecks in the freight system. Greater resources for border facilities and operations would directly address congestion; opening borders might reduce congestion if it was accompanied by transference of some of the clearances that now take place at borders to origin and destination points. More important, open borders would offer shippers more choices of routes, carriers, and ports than they now have. A single continental network would have greater effective capacity than the sum of its three parts.

Environmental Streamlining

Legally required environmental reviews and approvals of public and private infrastructure projects serve an essential function. The reviews contribute to the efficiency of the freight transportation system if, by reducing environmental costs, they reduce the total costs of providing transportation services. However, the costs of the reviews themselves, in dollars, time

to complete, and uncertainty, are substantial. The agencies controlling the reviews may be insensitive to these impacts, which do not directly affect their own budgets and mission. The states in particular are concerned with the costs of environmental reviews and are seeking streamlined federal review of highway projects (AASHTO 2000). Section 1309 of TEA-21 required DOT to work with the federal environmental regulatory agencies to develop procedures to facilitate reviews of highway and transit projects to reduce delay and costs. Streamlining environmental review is recognized to require negotiated interagency agreements, communication, and careful planning. Individual states and groups of states are successfully implementing such procedures, but nationwide procedures are not yet operating.

The outcome of environmental review ought to be better infrastructure projects, that is, projects with lower environmental and total costs than if the review were not conducted. Poorly managed reviews greatly complicate the problem of timely response to changes in demand by public- and private-sector providers of infrastructure. Project risk is increased and some worthwhile projects fail. The ability to respond to the market in a timely manner is critical to provision of adequate capacity.

Social Costs of Freight Transportation

Comparisons of the external costs of the various freight modes have taken on increasing prominence in discussions of government freight policy. External costs of freight transportation are costs that shippers and carriers do not primarily bear, but that are borne instead by others. External costs of a freight shipment include the costs of the pollution, congestion, and accidents caused by the shipment, beyond the portions of these costs borne by the shipper and carrier.

External costs are relevant to the freight capacity problem in several ways. If these costs were better managed—through more cost-effective regulation, internalizing external costs through pricing, or technological breakthroughs—not only would freight transportation become more efficient, but the pattern of future development and expansion of the system would be altered. For example, better management of environmental and safety costs could result in changes in location decisions; changes in relative rates of regional growth; and changes in the relative growth of water, rail, and trucking. Second, government intervention in freight markets has sometimes been proposed as a policy tool for reducing environmental costs. The U.K. white paper *A New Deal for Transport*, summarized in Appendix A, contains such proposals.

Another study referred to in Appendix A, the 1996 TRB committee report *Paying Our Way: Estimating Marginal Social Costs of Freight Transportation*, compared market prices with social costs (i.e., the sum of all external and private costs) for freight services for case studies involving actual individual freight movements. The quantitative results suggest that the differences in social costs among the freight modes and among types of freight movements are more complex than they are sometimes characterized (TRB 1996, 6–7).

The study's recommendations emphasized significant practical obstacles to adopting a policy of internalizing all external costs of transportation through government imposition of charges on users (TRB 1996, 14–15). One significant problem identified is that charges imposed

on the basis of poor information, or with insufficient care to developing effective and practical fee structures, would risk detracting from welfare rather than enhancing it. The committee recommended, as first steps, research to understand the magnitudes of costs and their determinants and to develop methods for evaluating the effects of alternative fee structures on shippers and carriers.

Selection of Funding Sources

Finance and pricing decisions are elements of the public sector's management of its transportation infrastructure. The mechanisms chosen to finance projects and to collect revenues from users and others will profoundly affect freight transportation system performance. The structure of user fees determines whether the best use is derived from existing facilities, and finance practices influence the quality of investment decisions. The four examples below are cases where immediate decisions on funding government transportation programs are called for.

Port Rate Competition

Although most of the largest U.S. ports experience congestion, many U.S. ports have slack capacity except perhaps at peak times for certain categories of cargo. Also, many U.S. ports are not wholly dependent on revenues from fees and rents, but receive aid from various government sources (MARAD 1998, 38–44; MARAD 2001, 3). These circumstances have led ports to charge fees to users that are below their costs and to be reluctant to raise fees for fear of losing traffic to competing ports, even as cargo volumes were growing rapidly during the 1990s (Burke 1996; Mathews 1997). State and local governments justify port subsidies on the grounds that the port is a source of economic growth, essential to the stature of its region as a commercial center.

Two recent proposals would curtail ports' price competition to allow them to increase fee revenue. The Maritime Administration has suggested consideration of regional pricing compacts among ports (MARAD 1996, 44; MARAD 1998, 47–48). TRB's 1993 port landside access study proposed creation of a federal port access trust fund, with revenues collected from port users devoted to port improvements (TRB 1993, 15). Such a fund would be analogous to the existing highway, airway, and inland waterways trust funds. The present administration recently has encouraged discussion of proposals for such a fund, to be called SEA-21 by analogy with the TEA-21 legislation governing the highway trust fund (Parker 2001).

The existing trust funds reduce the responsibilities of individual facilities to support themselves by redistributing revenue from heavily used to lightly used facilities and from one transportation mode to another. An alternative policy, which would reflect a fundamentally different perspective on the public interest in providing freight capacity, would be to reduce the availability of external funds to ports, forcing them to be more self-sustaining.

Increasing user fees could provide additional funding for justifiable port improvements. It would also to some extent diminish the volume of cargo handled at U.S. ports, through diversion to foreign ports and a decrease in trade as a result of higher prices. The persistence of

subsidies at some ports indicates that excess capacity exists, at least for the present, in the U.S. port system and that some rationalization of capacity could improve efficiency. The form of any new or increased user fees and the use of the revenues generated would strongly affect the direction of rationalization. In particular, if each port were required to be self-sufficient, it is likely that the number of ports would decline. The debate over harbor maintenance fees described below raises the same issues.

Harbor Dredging Funding

The federal government funds most maintenance dredging of harbor channels. Appropriations for maintenance of navigation channels are made annually from the federal Harbor Maintenance Trust Fund. The fund receives receipts from the Harbor Maintenance Tax, which was enacted as an ad valorem tax applied to the value of cargoes loaded or unloaded at ports served by federally maintained channels. This funding mechanism was created by the Water Resources Development Act of 1986. In 1997, expenditures from the fund for dredging by the Corps of Engineers were \$546 million (MARAD 1998, 64). In 1998, the federal courts ruled that the portion of the Harbor Maintenance Tax that applied to exports violates the constitutional prohibition on export taxes, and that fee ceased to be collected. The remaining fee on imports is vulnerable to charges of being in violation of international trade agreements (Subcommittee on Water Resources and Environment 1999; Godwin 1998; Taxpayers for Common Sense 2000). Therefore, a new revenue source for maintenance dredging is needed.

Congress has considered competing proposals to restructure the fee and to extend user fee finance to capital improvements as well as maintenance, or alternatively to abolish fees and fund dredging from other sources (CBO 2001, Section 300-12; Wilner 1999b). The American Association of Port Authorities (AAPA), shipper groups, and ocean carriers oppose a replacement user fee. AAPA has proposed that all federal funding of dredging come from general revenues. It argues that port user fees reduce the volume of trade and divert cargo to Canadian ports and that, because the benefits of ports are broadly distributed nationwide, channel maintenance is appropriately funded from federal general revenues (Godwin 1998; AAPA n.d.). Proposals to create a new federal trust fund, with revenues from import duties, to finance both harbor maintenance and capital improvements are described in the section above on port competition.

The resolution of the dredging funding issue may have broad implications for the federal role in freight and for transportation infrastructure finance principles. The user fee/trust fund mechanism has been used in the United States for highways, inland waterways, ports, and aviation. It has been seen as a means of providing a stable source of funding that is perceived to be fair by the payers and the public. User fees act, although imperfectly, as prices in regulating use of public facilities and signaling when and where expansions are justified. A stable funding source could similarly promote rational long-range development of U.S. port facilities. In addition, depending on how revenues from a fee were allocated, this funding arrangement could affect the future prospects of the less-utilized ports. To promote efficiency, fees must be structured so that the fee each user pays is as closely related as is practical to the cost of serving that user, and expenditures must be allocated to the projects that yield the greatest benefits. The

federal highway program is an example of the effectiveness of the user fee/trust fund mechanism in providing a financial basis for continual development and long-range planning.

However, the trust fund mechanism may be less suitable for funding seaports than for funding highways. The highway trust fund has always functioned to redistribute funds from the high-traffic components of the highway system, which generate high revenue, to spending on components that generate relatively low revenue. Economic arguments, citing various possible kinds of external benefits or scale economies in the highway system (e.g., network externalities or indivisibilities), have been offered to justify this redistribution. However, historically, the motivation for redistribution through the trust fund mechanism can be seen as arising simply as a result of the impracticality of collecting revenues and assigning costs to individual system components. Although it would be technically feasible today to assess highway user fees from individual users as a function of route and time of travel, such systems were not available in the past, and their introduction now would be politically difficult. In addition, given the established institutional structure, a significant portion of highway spending serves systemwide functions (e.g., many aspects of planning, administration, engineering services, and law enforcement) and can only arbitrarily be allocated to highway segments.

None of the arguments that might be cited in support of the redistribution of funds among elements of the system through the highway trust fund applies in the case of seaports. Port user fees would all be collected at individual ports, and for particular services or facilities used at individual ports, and most ports are administratively autonomous. Arguments for cross-subsidies based on scale economies, whatever their validity for highways, do not apply to ports. U.S. seaports do not constitute a network that is analogous to the highway system, since the value of a port does not depend on the existence of other ports in the same way that the value of a road increases if its connectivity to other roads increases. Therefore, the highway program cannot be used as a model for justifying the use of revenues generated at high-volume ports to subsidize maintenance and improvements at low-volume ports.

Toll Funding of Highways

Highway tolling has generated renewed interest both as a source of new funds for roads (either public roads or various forms of public-private joint developments) and, in the form of congestion pricing, as a means to manage use of highway capacity more efficiently. Information technology has made toll collection more practical, but toll roads still face implementation difficulties. TEA-21 included two provisions, the Value Pricing Pilot Program and the Interstate Toll Pilot, to provide incentives for states to experiment with tolls for construction finance and demand management (FHWA 2001a; FHWA 2001c). States also may use federal-aid funds to construct or reconstruct toll roads or to loan funds for these purposes to private toll operators. Although the federal-aid pilot programs apparently have not been popular, several new toll operations have opened in recent years (FHWA 2001b).

No method holds greater promise for reducing the harm caused by congestion than does pricing. Greater reliance on tolls allows capacity to be more self-adjusting, as it is in the private sector: fees ration use in the short run, provide funds for expansion, and indicate where

expansion should occur in the long run. Nonetheless, the institutional and political obstacles to road pricing are recognized as formidable (TRB 1994).

Future of User Fee Finance in State Transportation Programs

States have begun to question whether traditional sources of transportation funding, in particular fuel taxes, will continue to be adequate for perceived needs. In the future, increasing use may be made of general revenue funds, special sales taxes, and other sources, while increases in gasoline taxes will be more difficult to enact if the price of petroleum remains high.

Nationwide, the share of highway spending funded by sources other than user fees (i.e., fuel taxes, vehicle taxes, and tolls) has remained fairly constant in the range of 20 to 25 percent for the past 30 years (FHWA 1973–2000). However, some jurisdictions [e.g., California (Adams et al. 2001, i, 33)] are today experiencing an evolution away from reliance on charging users in favor of greater reliance on sales taxes.

Some trends in user fee finance have positive implications. In the most recent federal highway cost allocation study, which compares the user fee payments of various classes of highway users with the highway agency expenditures that may be attributed to each class, user fees paid by operators of combination trucks (the principal freight-carrying vehicles) are estimated to equal 80 percent of the highway agency expenditures attributed to this class of vehicle. This equals the ratio of fees to costs for all vehicles. When just federal user fee revenues are compared with the uses of federal-aid highway funds, combination trucks are estimated to pay 90 percent of the attributed expenditures, the same as the average ratio for all vehicles (DOT 1997, Table 13). The previous federal cost allocation study estimated that, in 1977, federal user fees paid by operators of combination trucks equaled 60 percent of federal-aid fund expenditures attributed to combination trucks (DOT 1982, Table I.7). In both years, heavier combinations were estimated to pay somewhat smaller shares of their costs than lighter combinations.

To the extent that the traditional user fee system has served as a relatively efficient and reliable means of managing state transportation finance, states would be taking a risk in de-emphasizing its role. If expanded revenue sources allow support of sound investments, there may be gains for freight transportation performance. However, user fee finance, with fees related to costs attributable to users, provides incentive for shippers and carriers to make logistics and operating decisions that reduce freight transportation costs. User fee finance also is a safeguard against wasteful investment.

Public Investment Choices

Government decisions about which transportation infrastructure projects to invest in are more difficult than in the private sector. Private-sector decisions are market driven: the investments selected are those expected to yield the highest returns, and investments are triggered by circumstances (i.e., rising prices and profits) that signal an opportunity for profit in a particular

segment of the transportation firm's market or the threat of loss of profitability to competitors. In the public sector, in contrast, users of facilities often do not pay market prices, so market signals are weak, and a variety of equity considerations influence decisions along with expectations of overall economic return. The three examples below illustrate how these factors affect public investment choices.

Future of the Inland Waterways System

Characteristics of the inland waterways system include aging infrastructure, great disparities in the ratios of operating and capital costs to traffic volume among the various waterways that make up the system, erratic federal funding for capital expenditures in recent decades, and growing traffic with occasional heavy congestion on certain segments. Although a towboat fuel tax contributes, historically federal general revenues have paid the majority of capital and operating costs (USACE 1997, ES-7–ES-23, 4-1–4-10, F-2–F-9). The Corps of Engineers is completing an economic and environmental analysis of proposed investments to replace old locks and expand lock capacity on the upper Mississippi River, a heavily used portion of the waterways system with numerous locks. The study has been controversial because of questions about whether user benefits justify the cost of proposed improvements and about the magnitude of environmental costs (NRC 2001).

The choices are whether to continue present subsidies or increase reliance on user fees, and whether to replace facilities as they wear out over time on each of the segments of the system. If subsidies lack economic justification, their effect is to support an inefficient portion of the freight transportation system at the cost of retarding development of capacity on more efficient alternatives (NRC 2001, 15–18). However, fee increases or a decision not to continue to support the inland waterways over the long run would cause shifts in traffic to other modes, which might strain capacity for some period.

Public-Sector Technology Development

Spending for research and development is a form of capital investment. In all the modes, productivity and capacity have been affected by applications of information technology, equipment improvements, improvements in construction materials, and advances in the design of facilities. For many decades, government has been a leader in supporting and planning transportation research and in implementing new technology in the United States. The federal government's Intelligent Transportation Systems initiative (FHWA 2000) is a high-profile activity, but basic civil engineering research remains vital also (TRB 2001, 3–8). So far, the federal government has not established its ability to foster development and implementation of basic new transportation systems and technologies. Effective forms of government leadership and involvement with the private sector for this purpose have not yet evolved (TRB 1998b, 11–13, 57–59; TRB 2001, 135–144).

The possibility exists of eventually obtaining large increases in the effective capacity of transportation systems through information technology applications and new vehicle designs that

allow vehicles to operate at higher speeds and shorter headways. This concept is applicable to highway and rail right-of-way and to the air traffic control system. In the short run, information technology can improve the effectiveness of conventional traffic control systems (e.g., highway traffic signals) and improve safety. Reducing road accidents incidentally increases capacity, since accidents are a major source of congestion and delay. Developments in construction and materials technology can reduce the cost of expanding and maintaining infrastructure. Extending the life of structures would reduce the significant capacity losses that occur during construction and maintenance. Government decisions about research spending, management of research and development, public-private cooperation, standards setting, regulation, and technology transfer will influence the rate at which such developments are perfected and adopted.

Structure of Federal Highway Aid Programs

Congress has begun to debate successor legislation to the TEA-21 federal surface transportation program, which expires in 2003. The issues may include whether to continue the established federal role in transportation finance, project eligibility requirements for federal aid, the structure of user fees, and the role of local government in project selection. Proposals will be made for provisions to target more spending, specifically on projects important for freight transportation.

The level of funding of the federal surface transportation program and the structure of the program (i.e., the definitions of projects eligible for funding, the rules for allocating federal funds, and the sources of federal funds) are among the major instruments available to the federal government to impart national direction on transportation system development. Program rules will influence the priorities given to freight-related projects, the success with which funding is directed to projects with the highest payoff, whether activities other than highway and transit projects may be funded, and opportunities for input from the freight sector in the project selection process.

Of the \$218 billion in transportation spending authorized in TEA-21, all but a few percent was dedicated exclusively to highways and mass transit (DOT 2001). It is likely that in the successor program as well, by far the most significant element for freight transportation will be the highway program. Highways are the largest U.S. freight transportation mode in terms of shipper expenditures. Therefore, the highway funding level and the degree to which program rules promote sound overall highway investment decisions will have greater effect on freight transportation system performance than narrowly conceived provisions intended to promote freight projects specifically or to allow funding of nonhighway freight projects. The structure of federal user fees will also be important for freight system performance because it will influence shipper and carrier decisions as well as funding availability.

Redefining Government Responsibilities

Public-sector investment choices include decisions within established government activities (for example, deciding whether to increase the capacity of a state highway) and decisions on expanding or contracting the sphere of government involvement. In all the transportation modes,

changing conditions have led to reexamination of government roles. Two examples of this process are described below.

Air Traffic Control Reform

A TRB committee that reviewed the performance of the air transport industry in the first decade after deregulation concluded in 1991 that there were grounds for concern “about the ability of the FAA [Federal Aviation Administration] in its current form to meet future challenges posed by continued air traffic growth. This concern extends beyond the efficient provision of airspace capacity; the committee is not assured that the FAA in its current form, despite the best intentions of its managers and staff, will be able to continue to maintain the high level of safety in the aviation system that the American public enjoys and has come to expect” (TRB 1991, 16). The committee recommended that consideration be given to limited privatization of FAA. Privatization has since been proposed by others as a means of accelerating adoption of new technology and allowing pricing of air traffic control services. The president’s 2002 budget proposal stated that the administration planned to examine the experience of other countries, including Canada, with private-sector air traffic control operations (OMB 2001, 139).

Information technology applications can increase airspace capacity to accommodate expected growth of passenger and freight traffic. The number of passenger-miles flown on U.S. carriers is expected to grow at a rate 40 percent higher than the rate of growth of the overall economy in the next decade, and the number of U.S. carrier air freight ton-miles is expected to grow at nearly twice the rate of the economy (Rodgers 2002; FAA 2001). FAA historically has been slow in keeping up with technological opportunities. If a privatized air traffic control organization could improve on past performance, capacity constraints would be lessened. In addition, rational pricing of air traffic control would improve utilization of capacity and provide direction to investment decisions.

Government Grants to Freight Railroads

Freight railroads have received government grants through various programs, usually on a small scale in recent decades, including state rail assistance programs with and without federal support and ad hoc arrangements for single projects. TEA-21 (Section 7203) contained a program for federal rail assistance, the Railroad Rehabilitation and Improvement Financing program (RRIF), which was to provide loans and loan guarantees to public or private sponsors for development or improvement of rail or intermodal facilities or equipment. The act limited the total amount of loans provided or guaranteed to \$3.5 billion, with at least \$1 billion of this available to shortline railroads. This program and another provision of TEA-21, the Transportation Infrastructure Finance and Innovation Act (for which exclusively rail projects are not eligible), were seen as institutionalizing the kind of federal freight project credit assistance that Congress has previously provided specially to the Alameda Corridor port access project in Los Angeles (DOT 1998, 1-3).

Funding for the federal budgetary cost of the loan program was not provided, although TEA-21 authorized the government to accept payments from loan applicants for this purpose and

left open the possibility of future appropriations. Proponents of the program criticized implementing regulations regarding loan eligibility and creditworthiness requirements, published in 2000, as excessively stringent. Because of the lack of appropriations and the stringent criteria, as of 2001 no loans under the program had been finalized (Committee on Transportation and Infrastructure 2001). Proposals have since been made for more liberal rail assistance on a larger scale. For example, the Railroad Infrastructure Development and Expansion Act for the 21st Century (RIDE-21), a bill introduced in the House of Representatives in 2001, called for expanding RRIF to \$35 billion, including \$7 billion for shortlines, and relaxing aid criteria (Subcommittee on Railroads 2001). The bill was supported by the Association of American Railroads (Hamberger 2001). Executives of major railroads recently have endorsed the principle of federal aid to freight railroads (Mottley 2001; Krebs 2001).

The justifications offered in support of proposals for rail freight grants are that it can be cheaper in some circumstances from the standpoint of the government to aid the railroads than to provide the same freight capacity by expanding highways, or that rail aid is needed to offset the effect of subsidies truck operators receive if they do not pay the full cost of providing highway service to them. An alternative policy to rail grants would be to adjust truck taxes to ensure that trucks covered their costs. Shippers would then select the best transportation options on the basis of true costs. The case study presented in Chapter 3 on the Virginia I-81 corridor examines the issue of government aid to freight railroads.

Summary

The performance of the freight transportation system is affected by diverse government programs housed in several federal agencies and in state governments. Imminent decisions on management, structure, and funding levels in these programs will have important consequences for the development of freight capacity. The issues range from technical program details to the basic question of the proper role of government in the freight sector. The relevant decisions are not confined to infrastructure spending; critical issues also involve operating practices, fee structures, and regulation. U.S. policy on international trade also affects freight capacity, since foreign carriers and infrastructure supplement and compete with U.S. capabilities. The international dimension will be of increasing importance as the volume of trade grows.

RECENT POLICY STATEMENTS

The committee took advantage of several recent statements from prominent sources that analyzed public policy problems related to provision of freight capacity and recommended changes in government policy. Noted were specific policy proposals of these groups as well as the evaluation criteria and principles concerning responsibilities of government in freight transportation that guided conclusions. Taken together, the recommendations and policy statements from these sources indicate the range of options that are open.

The statements reviewed by the committee here include reports of three past TRB committees that considered freight policy issues in studies sponsored in part by DOT and the

states. Their reports were *Landside Access to U.S. Ports* (TRB 1993), *Paying Our Way: Estimating Marginal Social Costs of Freight Transportation* (TRB 1996), and *Policy Options for Intermodal Freight Transportation* (TRB 1998a). The committees examined aspects of government freight transportation policy related to capacity, including port access, social costs of freight transportation, and intermodal policy. Their work provided a starting point for the present study.

The committee also reviewed the report of the National Commission on Intermodal Transportation, which was created by Congress and charged with recommending ways to improve the efficiency of the U.S. transportation system (NCIT 1994). To provide an international perspective, the 1998 white paper of the U.K. government declaring its transportation policies, *A New Deal For Transport*, was examined (Department for Transport, Local Government, and the Regions 1998). The committee also reviewed proposals published by two independent private sources, the Brookings Foundation (Winston 1999) and the Reason Foundation (Samuel and Poole 1999). This does not approach a comprehensive list of recent relevant studies and policy proposals. Many more detailed proposals have been made for mitigating specific capacity-related problems or problems of specific freight industry segments. However, these sources do provide a representative sample of current ideas on the basic policy issues. Each of the statements is summarized in Appendix A.

All the statements reviewed agree that the social benefit derived from freight transportation could be increased through changes in government transportation programs. They tend to agree that government needs to improve the effectiveness of its transportation infrastructure investment decisions—that is, to make high-payoff investments that are now being missed and to avoid projects with low return—and that government needs to get more out of existing facilities through better management. The statements account for poor investment and management as results of certain institutional obstacles to improved performance. The obstacles cited relate to organizational complexity, opposition of parties who expect that their interests will be harmed by new developments, and the finance of infrastructure projects.

Although diagnoses are similar, the nature of policy recommendations varies greatly among the statements, reflecting some sharp differences of perspective. At the risk of caricaturing the views of the authors, the philosophies underlying their recommendations may be grouped into three categories:

- **Incrementalist:** These proposals include more resources for existing programs, refinements in program structure or initiatives within the precedents of established policy, and more coordination and cooperation among the interested parties. Examples are programs to promote state and local freight planning and communication between government transportation officials and freight carriers and shippers, finance arrangements to improve investment decisions by favoring projects with lower subsidy requirements and private-sector acceptance of a share of risk, and reduction of environmental regulatory burdens by administrative streamlining.
- **Activist government:** These proposals involve new government programs departing from established structures, expanded responsibilities for government, partnerships with the private sector, private-sector grants, increased regulatory oversight, and government promotion

or advocacy of particular business practices or institutional structures. Examples are proposals for redesign of federal programs to allow financial aid for types of facilities and projects not eligible under present programs, including railroads, terminals, and landside port facilities; addition of federal restrictions or incentives affecting local programming of federal-aid funds to increase the share going to projects important to freight; and advocacy of national freight planning.

- **Limited government:** These proposals call for deregulation, privatization, pricing, and devolution of government responsibilities to the local level. Examples are recommendations for supplementing or replacing federal grants with cost-based user fees that incorporate peak pricing, privatizing air traffic control and ports, reducing the environmental regulatory burden by using pollution taxes and tradable emissions quotas, and promoting competition by removing barriers to foreign carriers and facilities.

Incrementalists and activists argue that laissez-faire provision of freight infrastructure is impractical because government is already responsible for major infrastructure components and this institutional arrangement is not going to change soon. Activists can note that government has in the past intervened, often successfully, with unprecedented actions guided by long-range planning. Examples in the 20th century are the Interstate highway system and the federal-aid highway program, the air traffic control system, and new industry regulatory regimes (the Civil Aeronautics Board and motor carrier regulation). In the 19th century, canal development, railroad land grants, and creation of the Interstate Commerce Commission are examples. Proponents of limited government would argue that institutional obstacles, which all agree lie behind performance shortcomings, can be overcome only by changing the incentives of service providers, and that the correct incentives can best be provided via markets.

The divergence of prescriptions must be the result not only of philosophical differences, but also lack of empirical information, the consequence of the failure of government transportation agencies to conduct adequate evaluations of many of their projects. Systematic evaluation and policy experimentation would provide a better factual basis for judging the alternatives.

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Abbreviations

| | |
|--------|--|
| AAPA | American Association of Port Authorities |
| AAR | Association of American Railroads |
| AASHTO | American Association of State Highway and Transportation Officials |
| CBO | Congressional Budget Office |
| CURE | Consumers United for Rail Equity |
| DOT | U.S. Department of Transportation |
| FAA | Federal Aviation Administration |
| FHWA | Federal Highway Administration |
| GAO | U.S. General Accounting Office |

| | |
|-------|--|
| ICC | International Chamber of Commerce |
| MARAD | Maritime Administration |
| NCIT | National Commission on Intermodal Transportation |
| NRC | National Research Council |
| OMB | Office of Management and Budget |
| TRB | Transportation Research Board |
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BOX 2-1 Pending Government Decisions Affecting Freight Capacity

Government management, operation, and regulation of transportation:

- Truck performance regulation (size, weight, safety, pollution)
- Railroad economic regulation
- International aviation regulation
- North American Free Trade Agreement freight transportation issues

Selection of funding sources for capital expenditures and operation of public facilities:

- Harbor dredging funding
- Toll funding of highways
- Future of user fee finance in state highway programs
- Port rate competition

Public investment choices:

- Structure of federal-aid programs
- Evaluating freight benefits in setting investment priorities
- Public-sector technology development programs
- Future development of the inland waterways system
- Application of environmental regulations to infrastructure projects

Redefining government responsibilities:

- Air traffic control reform
- Government grants to freight railroads

Chapter 3

Data on System Performance: Trends and Case Studies

As explained in Chapter 1, the committee relied on four kinds of information to support its conclusions: aggregate trends and projections regarding traffic volumes, infrastructure development, and system performance; case studies of freight projects and planning efforts; interviews with participants in the freight transportation industries; and a review of the conclusions of past studies of related transportation policy questions. Findings from the first three of these sources are summarized in this chapter; conclusions from the review of past studies were presented in Chapter 2.

TRENDS IN TRAFFIC, INFRASTRUCTURE, AND PERFORMANCE

Historical data on freight traffic, infrastructure development, and freight transportation system performance are summarized in the sections below. The presentation is organized in seven topical areas: highway trends; railroad industry trends; problems related to congestion at freight terminals and border crossings; the long lead times and rising costs of infrastructure projects; trends in congestion in urban areas, especially on facilities shared by passengers and freight; trends in other freight modes; and underlying trends in productivity, finance, and technology. The first five of these topics parallel the perceived developments identified in Chapter 1 as having been instrumental in shaping industry and public views on freight capacity problems. Whether the aggregate trend data are consistent with perceptions and the extent to which the data support judgments about the nature and severity of freight capacity problems are examined in this section.

The public policy questions regarding freight capacity are whether public investment in additional capacity is justified, public infrastructure is efficiently managed, and government policies are hindering private-sector investment and management. The answers to these questions depend on whether total costs would be lower at a different scale of the physical plant or with different management practices. Therefore, performance measures are required that indicate the costs of capacity constraints and hence the benefits of expansion (which may include reduced congestion, lower freight rates, or lower accident or environmental costs). Performance measures that could be useful for this purpose include carrier costs and prices and shipper delays. Some performance data are presented below, but readily available information is limited.

Trend data on traffic and investment are, by themselves, insufficient as guides to policy. For example, a declining ratio of capital stock in an industry to the output of the industry does not necessarily indicate that the rate of investment is too low, but may rather reflect productivity growth.

A further inadequacy of the aggregate data is that capacity constraints in transportation systems typically are local. The average link at an average time period may be operating well

below capacity even if the performance of the system as a whole is hampered by problems at local bottlenecks during peak periods. Local problems can have a severe impact on a network transportation system such as an airline or a railroad. Problems at a hub airport or rail center can quickly spread hundreds or thousands of miles from the source. (Trucking is less vulnerable to such cascading impacts.) Another consequence of the local character of capacity problems is that severe congestion in a few of the culturally and politically most important urban areas (New York, Los Angeles, and Washington, D.C.) may bias the views of opinion makers and the public regarding the scope of problems. The case studies presented later in this chapter illustrate some of these local circumstances.

Highway Spending and Traffic Growth

Perhaps more than any other development, the perception that highway traffic growth has outstripped the ability to provide roads has given rise to concern among transportation professionals and the public that current trends in transportation capacity are unsustainable. Roads are shared by trucks and cars, so it is impossible to separate highway freight capacity from the question of overall system capacity for serving all vehicles.

Trucking is the major freight mode in terms of expenditures in the United States. According to estimates by the Eno Foundation, 81 percent of domestic intercity freight transportation expenditures in 1999 were for trucking, and trucks carried 27 percent of intercity ton-miles (Wilson 2001, 7, 12). In 1999, combination trucks accounted for 5 percent of vehicle-miles traveled (VMT) on all roads and 17 percent on rural Interstates (Figure 3-1) (FHWA 2000a, Table VM1). Highway engineers estimate that a large truck has approximately the same effect on traffic operations as two cars, so large trucks account for about 30 percent of all passenger-car equivalents on rural Interstates.

Capital Expenditures, Capital Stock, and Traffic

From the late 1940s to the 1960s, real capital expenditures for highways grew at least as fast as did highway travel; but since that time, while VMT has steadily grown, the long-run trend in real capital expenditures appears nearly flat (Figure 3-2). Capital expenditures on public roads in 1999 were \$59.5 billion, VMT was 2.7 trillion, and VMT for combination trucks was 132 billion (FHWA 2000a).

A more relevant question for performance is whether the stock of highways, rather than the rate of capital expenditures, is expanding in pace with traffic. A constant rate of capital expenditures can yield growth in capacity if assets are long-lived. Data on road miles or lane miles can serve as approximate physical measures of the capital stock of highways (although roads vary greatly in their traffic-bearing capabilities). These physical measures of highway capacity appear to be flattening in the past decade, after nearly three decades of rapid postwar expansion. For example, mileage of limited-access divided highways grew rapidly during the

peak years of Interstate highway system construction; mileage is still growing but much more slowly compared with the 1960s and 1970s (Figure 3-3).

An economic measure of the capital stock of highways is estimated by the Commerce Department's Bureau of Economic Analysis (BEA). It is defined as the replacement cost of all past capital expenditures less depreciation, in constant dollars. The BEA measure of capital stock, published only for 1985–1995, exhibits more rapid growth than do the data for road miles. BEA estimates that capital expenditures have been considerably exceeding depreciation (Figure 3-4). Much highway capital expenditure today—for example, projects to widen roads, improve roadway geometry, or improve traffic control—increases capacity but is not reflected in gross indicators of physical capacity like road miles. Between 1985 and 1995, average annual growth rates were 3.2 percent for VMT on all roads, 2.1 percent for BEA capital stock, and 0.6 percent for miles of limited-access highways.

Another estimate of highway capital stock, produced by the Federal Highway Administration (FHWA) using a definition somewhat different from that of the BEA estimates, indicates that productive capital stock grew at an annual rate of 1.7 percent from 1985 to 1995, 1.3 percent from 1975 to 1985, and 5.1 percent from 1955 to 1975 (Fraumeni 1999).

Performance

As noted above, a declining ratio of roadway stock to travel does not in itself demonstrate that more rapid expansion of the system is called for. The system may have been larger than necessary in earlier decades, or the declining ratio may represent productivity growth rather than a decline in the level of service. The overall pattern of a declining ratio of capital to output does not seem to be rare in U.S. industry; the trend in the rail industry has been parallel, as shown in the next section, and another network industry, electric utilities, shows a similar trend (Figure 3-5). The electric utility industry, like the railroads, has recently experienced a severe temporary regional supply disruption, which has stimulated debate about the adequacy of capacity and the need for government intervention. In both industries, more productive use of capacity in recent decades has benefited the public, but it may have increased vulnerability to disruptions caused by extraordinary external circumstances.

There is evidence that highways are becoming more productive, in part because of changes in users' behavior. Traffic engineers have discovered that roads today maintain free-flowing traffic conditions while carrying traffic volumes that would have resulted in slow-speed or stop-and-go traffic conditions according to traffic models calibrated in earlier decades. The data suggest that a freeway can today carry perhaps 15 percent greater peak traffic volume before speed slows to 80 percent of free-flow speed, compared with the 1960s (TRB 1996, 64, 142). Apparently drivers, as they become more accustomed to high-speed, high-traffic-density driving, are learning to make more efficient use of the available road space. Changes in the dimensions and performance of vehicles may also be affecting the relationship of speed to traffic density. Improved traffic management has the potential to significantly increase the effective capacity of existing roads, but the most powerful techniques have as yet seen little application.

Data on time trends in performance of the entire highway system are sparse, and forecasting future performance has proven to be difficult. A 1987 study of urban freeway congestion estimated an annual cost of 1.2 billion vehicle-hours of delay, and projected a 5.6 percent annual rate of growth of vehicle-miles of congested travel on urban freeways through 2005, compared with a projected 1.9 percent rate for all vehicle-miles (Lindley 1987). However, a 1997 FHWA analysis found that the fraction of daily peak-hour vehicle-miles of travel on urban Interstates that takes place in congested conditions was fairly constant between 1990 and 1995 (Figure 3-6), while total urban Interstate travel grew at 4.1 percent annually during the period.

Projections

Projections of total and combination truck VMT typically predict lower rates of growth in the next decades than occurred during the 1990s. On the supply side, highway capital expenditures for the next few years may be projected on the basis of the size of the federal-aid program enacted periodically by Congress, if it is assumed that the ratio of state to federal expenditures remains constant (Figure 3-7). The 1998 program provided for moderate spending growth through 2003, and preliminary proposals for the successor legislation also call for increases.

FHWA produces a biennial projection of national highway capital spending requirements based on a benefit–cost analysis, using its HERS (Highway Economic Requirements System) model. The model employs a sample of road segments, reported to FHWA by the states, with information on traffic, geometry, and state of repair of each sample segment; and a set of cost factors to allow projections of infrastructure and user costs for each segment for specified assumptions about future road improvements and traffic growth. Given a forecast of traffic and a budget, the model computes the most cost-effective highway improvements. The DOT model has two major shortcomings. First, it does not support comparisons of highway expansions with congestion pricing or other demand management alternatives. Therefore, the model overlooks attractive policy alternatives in many instances. Second, it does not incorporate a network model. Consequently, the estimate of benefits from expansion of a highway link does not change if a decision is made to simultaneously expand a substitute or complementary link. Necessary revisions to DOT models to make them more useful for planning are identified in Chapter 4.

In the most recent projections using this model (Figure 3-8), which assume VMT growth on the order of 2 percent annually, FHWA estimates that, to maintain the present level of average highway user costs, annual capital expenditures averaging \$46 billion (in 1995 dollars) would be required over the next 20 years, a rate of spending 20 percent above the actual 1995 level. In this scenario, the average benefit–cost ratio of all projects carried out is 5. If all projects with a benefit–cost ratio greater than 1 were carried out, FHWA estimates that annual spending would be \$79 billion, twice the 1995 level, and the average benefit–cost ratio of all projects would be 3 (FHWA 1997a, 7).

Summary

Although the picture that can be formed from aggregate trends is necessarily incomplete, as emphasized earlier, the data suggest a more complicated situation than the simple conclusion that the nation is near to running out of highway capacity. Real highway capital spending slumped severely in the 1970s but recovered afterwards, spurred by larger federal-aid programs. The stock of highway capital is growing, although not as fast as VMT. Although the available data on highway performance are inadequate, they do not demonstrate widespread deterioration. Nonetheless, DOT economic analysis indicates that at current funding levels many opportunities for high-payoff, mobility-improving projects are being missed.

Railroad Infrastructure Downsizing and Service Disruptions

Capital Expenditures and Traffic

In 1999, railroads carried 37 percent of intercity freight ton-miles in the United States and rail revenues accounted for 10 percent of expenditures for domestic intercity freight services (Wilson 2001, 7, 12). The recent history of the development of the railroads differs markedly from that of highways and trucking. Rail freight traffic grew slowly, and the rate of real capital expenditures declined in the post-World War II period through the 1970s. Since the end of most economic regulation of the industry in 1980, traffic growth has accelerated, and spending for roadway and structures has grown more rapidly than traffic (Figure 3-9). In 1999, capital expenditures for roadway and structures by Class I railroads (the largest U.S. railroads, accounting for 91 percent of rail freight revenues) were \$4.4 billion, and the number of ton-miles was 1.4 trillion (AAR 2000).

The mileage of track owned by Class I railroads has contracted throughout this period (Figure 3-10). Some of the decline shown in the figure reflects divestitures of track to small regional and shortline railroads, which operated 29 percent of road-miles in use in 1999. Rail roadway operated by all U.S. railroads declined from 181,000 miles in 1987 to 171,000 miles in 1999 (AAR 2000, 3; AAR 1988, 2). Much of the reduction in mileage since World War II was the result of the decline in passenger service. Technology also has played a role; for example, computerized traffic management has increased effective capacity. Patterns differ by region: in the East and Midwest after World War II, multiple independent railroads operated redundant mainlines and branchlines. The South had fewer carriers and less duplication, and far fewer multiple-track lines, and the West was largely single-tracked. From the 1960s, the South and West were growing and rail traffic was generally on the rise. Growth on a large single-tracked system led to congestion problems in the West in the 1980s at the same time that track was being removed from the East and Midwest. Thus, it would be an oversimplification to ascribe any present capacity problems to rail infrastructure downsizing. Most of the downsizing occurred in the Northeast, where traffic growth has been relatively modest.

According to BEA estimates, the strong rate of capital spending for new roadway and structures has not kept pace with depreciation and retirements, so the real net capital stock of all U.S. railroads has declined (Figure 3-11). Trends in rail roadway and structures spending and net stock are presented here as measures more directly related to long-term capacity than are equipment spending and stocks, and for comparability with the highway capital trends presented above. Short-term capacity problems often are related to equipment availability.

The capital stock and investment trends are consistent with the view that the railroad industry had substantial excess capacity in 1980 and has since been shedding uneconomic capacity while maintaining and upgrading the best-performing components of the network. By some accounts, the period of systemwide downsizing has come to an end within the past few years, and the railroads now face the need for expansion if they are to serve expected demand growth (Machalaba 1998).

Like highways, railroads carry both passengers and freight. Traffic is overwhelmingly freight: annual Amtrak car-miles are 1 percent of freight car-miles (AAR 2000, 34, 77). Nonetheless, requirements for freight traffic to share track with intercity and commuter passenger trains are a significant capacity constraint in some locations.

Performance

Available measures of railroad performance also are consistent with this view. A physical measure of performance, average train speed, showed improvement from 1980 to 1992 and then declined (Figure 3-12). This is suggestive of a capacity problem, although many other factors can influence the performance of this measure. Railroads report that speeds have largely recovered since the postmerger problems of the 1990s were resolved. Average revenue per ton-mile in constant dollars (i.e., average price) has been declining for many decades (Figure 3-13). This price trend presumably reflects the combined effects of productivity growth, excess capacity, and deregulation. Recently the rate of decline may have slowed compared with the preceding decade, although a pronounced price rise, such as might be expected to accompany a capacity crunch, does not appear in the aggregate data.

The railroads' operating income grew throughout the 1990s, a trend not inconsistent with tightening capacity (Figure 3-14). However, according to some analysts, the rate of return is insufficient to attract the capital that would be needed to develop new lines of business to the railroads and serve expected growth of established lines (Machalaba 1998; Ellis 2000). A low rate of return would presage further contraction, rather than capacity expansion.

The trends in railroad output, capital stock, and average revenue suggest strong productivity growth; that is, the railroads are getting more and more service out of existing facilities. Caution is required in interpreting trends in ratios of outputs to inputs for railroads, as for any transportation sector, because ton-miles is a very approximate measure of physical output. Rail costs depend on the mix of traffic among bulk commodities, general merchandise, and intermodal containers, since these lines of business demand different services. One careful

estimate of rail industry productivity indicates that multifactor productivity grew by 4.5 percent annually in the decade after deregulation, twice as fast as during the preceding decade and faster than in other freight sectors or in the economy as a whole during the 1980s (Gordon 1992). However, apparently no available rail productivity measure does a thorough job of taking into account changes in output and input quality (Oum et al. 1999).

Projections

Two recent forecasts predict strong growth in rail traffic in the coming decades, although neither appears to explicitly take into account any capacity constraint (Figure 3-15). A forecast of freight traffic for all modes for the American Trucking Associations, with gross domestic product (GDP) growth of 3.3 percent annually for 2000–2008, predicts rail tonnage will grow at 1.3 percent annually from 1998 through 2008, compared with 1.7 percent for total freight tonnage (ATA 2000); this implies a rail ton-mile growth rate of 1.5 percent annually. A forecast of the Department of Energy's Energy Information Administration, on the basis of assumed GDP growth averaging 3.0 percent annually from 1999 through 2020, predicts rail ton-mile growth of 1.9 percent annually over the period (EIA 2000, 138).

Service Disruptions

No recent event has brought greater public scrutiny of the national freight transportation system than the service disruptions that occurred following the 1996 merger of the Union Pacific (UP) and Southern Pacific (SP) Railroads. For the purposes of this study, these events as well as the service disturbances following the 1999 Conrail breakup are relevant only insofar as they may indicate underlying long-run capacity problems. A General Accounting Office (GAO) report described the Union Pacific episode as follows:

In the summer of 1997, during implementation of the Union Pacific/Southern Pacific merger, rail lines in the Houston/Gulf Coast area became severely congested, and freight shipments in some areas came to a complete halt. As the problem spread, many grain shippers experienced delays in railcar deliveries of 30 days or more, while some grain shippers in Texas did not receive railcars for up to 3 months. Transit times for movements of wheat from Kansas to the Gulf of Mexico in some cases exceeded 30 days—four to five times longer than normal. In late 1997, the [Surface Transportation] Board determined that the service breakdown, which had a broad impact throughout the western United States, constituted an emergency and among other things, ordered Union Pacific to temporarily release its Houston area shippers from their service contracts so that they could use other railroads serving Houston, and to cooperate with other carriers in the region that could accept Union Pacific traffic for movement, to help ease the gridlock. (GAO 1999, 67)

By December 1998, UP announced that its operations had returned to normal (GAO 1999, 84). The Surface Transportation Board and industry officials reported to GAO that they regarded the

service breakdown as an aberration, related more to prior deficiencies at SP, including substantial deferred maintenance, than to the merger itself (GAO 1999, 67, 72). Nonetheless, when Conrail was split up between the CSX and Norfolk Southern (NS) railroads in 1999, disruptions again occurred, although not on the scale of events following the UP/SP merger. Shippers reported delays of shipments and unavailability of service (Larson and Spraggins 2000). Major intermodal customers, including United Parcel Service, suspended some use of the railroads (Lang 2000). The service failures were attributed mainly to problems of integrating separate operations, and especially to information system failures.

Most observers concluded that the postmerger rail service disruptions were exceptional events rather than indicators of long-run capacity problems, and the railroads report that they have largely put merger-related service problems behind them. However, it is plausible that availability of capacity will reduce risks of disruptions and that tight capacity may aggravate disruptions once they occur. Rail mainlines today typically operate at high utilization levels compared with past practices. The eastern railroads reportedly relied on the region's older facilities, now in the hands of shortline railroads, to alleviate operating problems after the Conrail breakup, and had made important capacity enhancements leading up to the breakup that probably averted more severe difficulties (Phillips 1999).

Summary

Do the data support the view that traffic on the nation's mainline railroads is nearing maximum capacity? As noted previously, capacity constraints are localized in time and space, so aggregate trends cannot be definitive tests. However, most trends are consistent with a condition of tightening capacity: long-run contraction of the extent of the network, the declining net capital stock measure in spite of historically high rates of industry capital expenditures, rising profits, slowing train speed, and sporadic service failures. In spite of these trends, freight rates, driven mainly by productivity gains, continue to fall, and rates of return remain modest. These last two trends suggest the possibility that the industry may contract further before it reaches a sustainable scale.

Growing Congestion at Terminals and Border Crossings

The scope of terminal capacity issues is broad: it can be defined to encompass the internal adequacy of the terminal facilities themselves (e.g., the capacity of ports to load and unload ships and of rail terminals to handle rail cars) as well as the capacity of intermodal connections to the terminals (e.g., access by rail and truck to ports, and truck access to rail yards). Data indicating the performance of all these components are fragmentary. The issue of terminal capacity received attention in the 1990s because of the growth of international trade and intermodal freight traffic, and because of intent to facilitate development of intermodal transportation that Congress expressed in the 1991 surface transportation act (ISTEA).

The professed federal commitment to an intermodal approach to freight transportation policy has been put into practice largely through a focus on congestion at terminals and other local bottlenecks, such as border crossings. When in 1995 DOT undertook to develop ties to the private sector to jointly address freight problems through its National Freight Partnership, the group's initial priorities were two terminal areas (the Southern California ports and Alameda Corridor project, and rail interchange in Chicago) and two border crossings (El Paso and Laredo, Texas) (FHWA 1997b). The most recent federal surface transportation act (TEA-21 of 1998) created two aid programs aimed at these bottlenecks: the Corridors and Borders program and Transportation Infrastructure Finance and Innovation Act (FHWA 1998). Following congressional directives in ISTEA and subsequent legislation, DOT and the states have been engaged in an effort to identify important road connections between terminals and major through highways, to make them eligible for federal-aid funding, and to assess their condition and investment needs. A Federal Highway Administrator explained the philosophy behind this program emphasis as follows: "Freight flows rapidly across our system but then comes to a virtual stop as vehicles come off exit ramps out to congested, narrow streets with multiple stoplights leading to our seaports, airports, rail terminals and stations, and major manufacturing facilities. If we focus on less than 2 percent of the system, we can significantly increase productivity" (Smallen 1998).

As part of its intermodal connectors program, in 2000 DOT completed an inventory of roads serving as intermodal freight connectors. These were defined as the most important secondary roads carrying truck traffic between freight terminals and major highways. By DOT's definitions, 1,200 miles of such connectors were identified, connecting 250 ports, 200 rail terminals, 100 airports, and 60 pipeline heads to the National Highway System. DOT found that \$1.5 billion of improvements were carried out or planned for 1996–2000 on these roads, \$250,000 per mile per year, although much of the spending was concentrated on a few projects (DOT 2000).

The DOT study acknowledged that data are insufficient to judge the adequacy of these roads or the funding levels devoted to their improvement (DOT 2000, 4). This finding is significant, since it means that the case for devoting more funding to the connectors has not yet been made. At issue is whether earmarking a portion of transportation funds, at the federal or state level, for improvements to the connectors would yield greater public benefits than allowing the states to choose transportation uses for the funds.

To illustrate the demands on port waterside facilities, Figure 3-16 shows the trends in tonnage of U.S. waterborne commerce (excluding inland waterway traffic but including domestic Great Lakes and coastwise tonnage), as well as historical and projected capital expenditures by public port authorities. The aggregate data are not very illuminating because tonnage is dominated by a few bulk commodities, especially petroleum. Port authority capital spending has been accelerating, although to gain a complete picture, the capital expenditures of private-sector terminal operators, shipping companies, railroads, state governments, and others would have to be included.

Examination of trends by port or by region, or, to the extent that expenditures can be allocated, by type of commodity (e.g., bulk versus container), would be necessary to give a clear indication of the relationship between capital expenditures and traffic. Figure 3-17 shows historical and projected volumes for one category of cargo in one region: loaded containers in international trade handled in the Ports of Los Angeles and Long Beach. Growth in this traffic at these ports was nearly 10 percent annually in the 1990s and is expected to continue at a more moderate rate, providing port and landside facilities continue to expand (SCAG 2000, 78). These ports handle 30 percent of U.S. ocean container traffic.

While growth of some categories of freight at certain ports has been remarkable, there is some evidence that the waterside facilities of the U.S. port system as a whole are at present not capacity-constrained. Ocean cargo has a choice of ports on all U.S. coasts, and cargoes can bypass landside congestion out of busy west coast ports by sailing directly to the east coast (Phillips 2000; Gillis and Damas 1998). One indication of capacity conditions is port pricing practices. Competition among ports and the leverage that ocean carriers can exert in negotiating port leases and service fees have depressed the rates charged at many U.S. ports to a level below costs (MARAD 1998, 47–48). Although port operating revenues have increased in the past decade and more ports are becoming self-sufficient, many ports still rely on various forms of public aid to break even. The depressed pricing and reliance on subsidies both are suggestive of overcapacity. Some apparent port waterside excess capacity probably reflects landside capacity constraints. Poor landside access may be discouraging use of some ports that have low utilization of waterside capacity.

Border crossings, although they are not terminals, are analogous physical choke points in the freight system. Growth in international trade has put strains on border crossing facilities. As one illustration, truck border crossings between Mexico and Texas increased 220 percent from 1990 to 2000 (Texas Center for Border Economic and Enterprise Development 2001). Congestion and delays for truck and rail traffic at U.S. land border crossings have been frequent. Delays are the consequence of physical infrastructure limitations as well as of the complexities of customs and immigration proceedings at borders.

Long Lead Times and Rising Costs of Infrastructure Projects

Public-sector construction projects for highways or other transportation infrastructure typically require 5 to 15 years to plan and complete. In U.S. urban areas, examples of billion-dollar infrastructure projects with 20-year delivery times can be cited, and projects costing in the hundreds of millions of dollars are no longer rare (GAO 1997; GAO 1998). Among the factors that have added to the uncertainties and costs of infrastructure development are the following:

- Increasing population density and urbanization. The population of U.S. urban areas has grown by 75 million since 1960, when Interstate highway construction was first reaching full speed. Urban land is valuable, and the spillover effects of infrastructure are more objectionable in cities.

- Stronger environmental regulations, which primarily reflect greater value placed on environmental quality by the public.
- Greater emphasis on safety, which has necessitated upgrading of design standards.
- More intensive use. Traffic volumes and truck loads on a typical road are much greater today than in earlier decades.

Systematic data on trends in project delivery times and costs are not available. Construction cost indexes reflect unit costs but not the effects of changes in preconstruction project development costs or design standards. The following anecdotal data indicate the nature of the problem:

- In a recent survey, state transportation officials reported that projects in which delays caused by federally required environmental reviews retard completion by 1 to 2 years occur with regularity [TransTech Management (forthcoming)].
- DOT data reported to Congress on the environmental review process for highway and transit projects show that the average time required to process environmental documents for major federal-aid highway projects was 2 years in the 1970s, 4 years in the 1980s, and peaked at 5 years 10 months in 1999. DOT reported that its efforts to streamline reviews according to legislative directives had reduced the average to 5 years 2 months by 2001 (DOT 2002).
- A review of large transportation infrastructure projects worldwide found that among 41 U.S. and European projects with costs mostly in the range of \$100 million to several billion dollars, the median cost overrun of completed projects was 50 percent compared with preconstruction estimates, in constant prices (Skamris and Flyvbjerg 1996).
- A GAO review of eight U.S. public-sector transportation projects, costing from \$300 million to \$11 billion each and including highway, freight rail, and transit projects, found that most, but not all, were experiencing significant cost or schedule overruns (GAO 1998).
- Another GAO study, of environmental reviews of airport expansion projects, found that most major U.S. airports are operating at or near capacity and that balancing airport operation with environmental protection has become much more difficult in the past decade, which increases the time and cost of airport development. GAO concluded that poor coordination and communication among federal agencies and between the federal government and airports make compliance with requirements for environmental review of expansion projects more difficult. According to an operator survey, environmental issues were the most common cause of project delays in the preceding 5 years. One-fourth of major airports reported canceling or indefinitely postponing expansion projects in the past 10 years because of environmental issues (GAO 2000).

A comparison of the development of two toll roads in California, SR-91 in Orange County and SR-125 in San Diego County, concluded that environmental reviews added 6 years to the schedule for SR-125 compared with SR-91, which did not require an environmental impact

statement because the new lanes were being added to the median of an existing freeway. Project development and engineering for the 12-mile SR-125 toll road required 9 years (Lockwood et al. 2000).

Of course, processing delays may be the price of achieving desired environmental outcomes. Still, state officials see curtailing the growth of project delivery times as essential to their ability to control the costs of future infrastructure expansion. The attention of the states and the federal government has recently been focused on the issue of environmental streamlining, that is, efforts to reduce the time and cost of environmental regulatory reviews of transportation projects (DOT 2002).

The consequences of lengthening project delivery times and rising costs are that the adjustment of infrastructure to changing markets will be slow, development decisions must be based on highly uncertain long-term forecasts, and investments become more risky. Changes in practices and policies that reduced delivery time, cost, and risk would greatly reduce the difficulty of efficiently matching capacity to traffic demand. The Interstate 81 and Upper Mississippi navigation case studies in this chapter illustrate these issues.

Urban Congestion and Passenger–Freight Conflicts

Most major freight nodes (ports, airports, and railheads) and the origins and destinations of most shipments are in cities. Freight must compete with passenger traffic for use of transport facilities and with all other land uses for space for expansion. Once again, data that isolate trends in the freight impacts of urban congestion are not available, so the problem must be demonstrated anecdotally.

The Freight Action Strategy (FAST) Corridor project in Seattle, described in one of the case studies below, is representative of urban competition between freight traffic and other activities. Conflicts between freight traffic at the Seattle region's ports and other road traffic, as well as other community impacts of port traffic in a major city, impose strong constraints on port development. The Alameda Corridor port access project in Los Angeles has its origins, in part, in the same set of issues; that is, the new rail link to the ports was considered necessary not only to increase physical capacity but also to reduce the impacts of port traffic on residents, automobile travelers, and other businesses (Shaw 1992, 26–54; GAO 1998, 33–34).

The GAO survey of airport operators described in the preceding section shows that airports face an analogous challenge: operators reported that noise pollution is the most important environmental problem they face and constitutes one of the principle constraints on expansion. The growing importance of environmental constraints is driven by growing populations near airports.

The Alameda Corridor project, which involves eliminating some surface rail lines, illustrates how pressure grows to displace freight traffic when urban freight–passenger conflicts worsen. Other examples of this process are proposals for various forms of urban truck bans or

restrictions (Shaw 1992, 49–50). In aviation, an official of the authority operating Boston's Logan Airport proposed in 2001 that consideration be given to adopting a Northeast airports regional plan that would allocate traffic among the airports, reserving Logan for long-distance passenger traffic and moving short-range and cargo operations to other regional airports (Krause 2001). Similarly, freight railroads often have been obliged to cede access to local commuter trains. The American Public Transportation Association in 2001 supported a legislative proposal that would allow local governments to petition the federal Surface Transportation Board to gain access to track when they failed to reach agreement with the railroad (AASHTO 2001).

Chicago is the setting for some of the most challenging problems involving urban freight–passenger conflicts. All the major North American railroads interchange traffic in the urban area. As a component of these interline exchanges, 1.2 million containers annually are hauled by trucks over city streets and expressways (Prince 2001). These highway interchanges are significant for the performance of the nationwide intermodal container transportation system and the costs of intermodal to shippers and the community.

The growth of intermodal will aggravate the problem concentration of truck traffic near terminals. The most important constraint on intermodal growth in the future may be the difficulty of expanding terminal capacity in urban areas (Prince 2001, 68). As one additional illustration of this problem, NS reportedly required 10 years to negotiate arrangements with local government to construct an intermodal terminal at Austell, Georgia, to serve as its Atlanta hub. The main point of contention was local residents' concern about truck traffic (Gallagher 2001).

Trends in Other Modes

The trends described above have been emphasized because of their visibility and because they affect the largest freight modes. However, two other infrastructure systems utilized for freight, inland waterways and aviation facilities, have experienced performance problems related to tight capacity.

Inland Waterways and Ports

Inland waterways (rivers, canals, and the Intracoastal Waterway, but excluding the Great Lakes and oceangoing coastwise shipping) carry 11 percent of domestic intercity ton-miles but account for only 1 percent of freight expenditures (Wilson 2001, 7, 12), making the system the cheapest freight mode in terms of average transportation cost per ton-mile. Farm products, coal, and petroleum products make up two-thirds of ton-miles. Traffic (in ton-miles) has grown steadily at close to 3 percent annually in recent decades (Figure 3-18), while tons have grown at about 1 percent annually. Annual federal capital expenditures have been variable, as Congress has enacted authorizations at irregular intervals (Figure 3-18). The U.S. Army Corps of Engineers estimates that federal expenditures account for at most half of all capital expenditures related to the waterways, since terminals and equipment are privately owned (USACE 1997, ES-4). The Corps periodically produces forecasts of expected traffic growth by commodity and by segment

of the waterways, which depend on assumed growth rates of the economy as a whole and individual sectors as well as export forecasts. The projections call for overall growth of 0.8 to 1.6 percent annually to 2010 (USACE 1997, ES-13).

Potential capacity-related problems on the inland waterways include the aging of facilities and peak-period congestion at certain locks. The median age of all lock chambers is 35 years (USACE 1997, 2-4). The Corps maintains detailed data on lock performance. Average delays have been rising slightly in spite of recent elimination of some bottlenecks. Average delay is 6 hours at the most congested locks and much longer during peaks (USACE 1997, 2-18). The case study on Upper Mississippi planning below illustrates waterway capacity issues.

Air Freight

The U.S. aviation system experiences recurring congestion in airport flight operations, airport landside connections, and the air traffic control system. All three kinds of congestion represent constraints on the development of air freight. Freight and passenger air traffic grew much faster than overall economic activity throughout most of the 1990s. Annual growth rates from 1993 to 2000 were 4.3 percent for revenue passenger-miles on U.S. carriers, 5.1 percent for U.S. air carrier domestic freight revenue ton-miles, and 10.1 percent for U.S. air carrier international freight revenue ton-miles (FAA 2001a, I-2). As a consequence, by the end of the decade delays had worsened at most major airports (FAA 2001a, I-4). The Federal Aviation Administration (FAA) monitors the frequency of flight operation delays that are caused by air traffic control congestion. In 2000, at the 31 busiest U.S. airports, the median fraction of flight operations (takeoffs and landings) delayed more than 15 minutes by air traffic control was under 2 percent. The most frequent delays were at La Guardia (16 percent of operations) and Newark (8 percent) (FAA 2001b). These delays may not directly affect air freight flight operations, which can be scheduled in off-peak periods; however, as the section above on urban freight-passenger conflicts describes, a consequence of growing congestion at shared facilities tends to be the crowding out of freight.

U.S. carriers in 1999 produced 14 billion revenue ton-miles of domestic air freight services. International traffic of U.S. carriers was also 14 billion ton-miles (FAA 2001a, Table I-2R). Air freight is less than 0.5 percent of all U.S. domestic freight ton-miles and accounts for 5 percent of expenditures for domestic intercity freight (Wilson 2001, 7, 12). FAA forecasts that freight ton-miles on U.S. carriers will double between 2000 and 2012, an average annual growth rate of 5.8 percent. The forecast shows U.S. carrier passenger-miles growing at 4.7 percent annually over the period (FAA 2001a, Table I-2R). The challenges that airport authorities face in expanding runway capacity to respond to traffic growth are described in the sections above on lead times for infrastructure projects and urban conflicts. Proposals that have been made for reform of FAA's air traffic control function to allow more efficient traffic management are described in Chapter 2.

Trends in Underlying Forces

The prominent trends that were described above represent the most visible concerns of the past decade. To put them in context, the committee examined certain more fundamental developments. These include freight transportation industry productivity and output, which are measures of overall industry performance; public infrastructure finance, which is one of the key determinants of the performance of public-sector transportation activities; and technological and social developments, which are the drivers of long-run change.

Productivity and Output

In recent decades, freight outperformed the economy as a whole. Output per hour, adjusted for quality change, grew by 4.3 percent/year between 1980 and 1995 in railroads and by 1.9 percent/year in trucking, compared with 0.7 percent/year in all of business. But by the mid-1990s, productivity growth was slowing in freight transportation and accelerating in the economy as a whole: growth between 1995 and 1998 was 3.6 percent/year in rail, 1.3 percent/year in trucking, and 2.2 percent/year in all business (BLS 2002). Freight productivity growth in the 1980s may be attributed primarily to deregulation and new infrastructure; the slowing in the 1990s may reflect the impact of the five trends identified above.

It would be a misconception to view freight as an “old economy” industry of diminishing importance. Rail and truck ton-miles per real dollar of gross domestic product, after declining by nearly half from 1950 to 1987, rose 12 percent by 1998. One possible interpretation of this trend is that the decline in the postwar years reflected the decline in relative importance of the extractive industries and heavy manufacturing, while the growth since the 1980s may reflect, at least in part, the growing importance of trade in the economy.

Finance

In spite of endorsements of the principle of user fee finance by successive administrations and congresses and by state transportation agencies, there has been no pronounced trend in favor of user fees to finance public-sector construction and operation or in favor of reliance on the market mechanism for managing public-sector transportation facilities. A modest fuel tax on inland waterway users was introduced in 1986, but harbor maintenance lost user fee finance in 1997. Federal rules have blocked airport efforts to rationalize pricing. By FHWA definitions, the ratio of highway user fee collections to spending declined from 78 percent in 1970 to 68 percent in 1998. When decisions are not market driven and subsidies are available, expansion of public infrastructure capacity beyond the economically justified level is a threat to efficiency. As one example, U.S. port authorities' current and projected capital spending is at the rate of \$1.6 billion/year, twice the rate of the 1990–1995 period. Excluding the Southern California ports, most of the planned spending is to be financed from sources other than port revenues; yet most ports would have difficulty increasing revenues because of intense competition, a circumstance indicating overcapacity. Conversely, on some heavily used components of public-sector

infrastructure, imposition or increase of user fees could readily finance high-return capacity investments.

Technological and Social Developments

Improvements in equipment and infrastructure design and successful applications of information technology to operations and management have been continuous processes throughout recent decades. Advances in the management of transportation and logistics are a form of technological progress. Economic deregulation after 1980 was a stimulus to these innovations. Better logistics management lowers costs by reducing inventory and allowing suppliers to respond quickly and precisely to changes in the market.

One prominent aspect of these organizational developments has been the growth of rail intermodal, the carriage of road trailers and containers on railcars. The new service options and competition created by intermodal service stimulate efficiency and reduce costs. The railroads carried more than 9 million containers and trailers in 1999, and rail intermodal loadings grew 4.4 percent annually during the 1990s. Rail intermodal is seen as an opportunity to relieve pressure on overburdened highways and reduce external costs of freight transportation. However, growth will be inhibited in the future by capacity constraints on the rail system, and the potential to displace trucking is limited: rail intermodal traffic is today roughly equivalent to 8 percent of the volume of combination truck traffic; if it doubles in the next decade (nearly twice its growth rate in the 1990s), it will still amount to only about 10 percent of combination truck traffic.

Freight transportation companies are not responsible for certain costs of their activities and therefore do not have incentive to control them. These include costs of congestion on public rights-of-way, air and noise pollution, accident losses for which carriers are not liable, and environmental costs of infrastructure construction. Recent decades have seen substantial reductions in pollutant emission rates and accident rates per unit of freight services, but freight traffic volume and the population exposed to pollution have increased, so total costs probably are increasing. Also, possibly as the result of increased wealth and urbanization, the public may value environmental quality more highly today than at earlier times.

Interpreting the Trends

Historical trends are interesting only if they provide some insight into the future. For now, insights must rely more on judgment than on quantitative forecasts. Structural models with the network detail and reliability that would be required to reduce the risks of long-run public-sector investment decisions are not available, and their development would require substantial effort. For example, congestion is probably an important determinant of regional or metropolitan population dispersion, but existing forecasts will not reflect this feedback. The state of the art of forecasting suggests that public policy should seek to increase the flexibility of the transportation system to respond to developments that cannot be reliably foreseen.

Nonetheless, the trends described above support some conclusions about the likely future evolution of the freight system. An assessment and qualitative predictions about developments over the next few decades is presented in Chapter 4 in the section Prospects for Freight Capacity.

CASE STUDIES

Because aggregate trend data are insufficient as indicators of the adequacy of capacity, the committee also examined individual system components as case studies to provide a more concrete understanding of freight supply problems and insight into the institutional setting of project-level decision making. The cases were Virginia's 20-year plan for expanding capacity on I-81, a major truck corridor; plans of the U.S. Army Corps of Engineers to expand lock capacity on the Upper Mississippi River; the FAST Corridor port access project in Washington State; the Florida Freight Stakeholders Task Force, a body charged with advising the Florida Department of Transportation on freight issues, including capital expenditure decisions; and PrePass, a public-private system to automate certain trucking regulatory enforcement functions. The Virginia and Upper Mississippi River cases each involve efforts of a government agency to expand capacity on a mainline route that it owns and operates. The Florida and Washington cases are efforts to foster public-private cooperation in identifying and resolving terminal access problems in local areas. PrePass illustrates the potential of information technology to increase the effective capacity of transportation systems.

The case studies alone are too few in number to support definite conclusions about the sources of obstacles to efficient provision of freight capacity. However, they point to hypotheses about this question deserving closer examination.

Virginia Interstate 81 Widening Project

I-81, an Interstate highway running from southwest to northeast through Virginia, is a major truck route. The state has a plan for several billion dollars in improvements to the highway in the next 20 years to accommodate expected traffic growth. The state studied construction of exclusive truck lanes as part of the project, but rejected that option. The NS has a parallel route on which it believes there is potential for growth of container and general merchandise traffic. During the Conrail breakup proceedings, the railroad stated that it could divert some I-81 traffic from truck to rail. There may be a connection between the level of state investment in upgrading I-81 and the railroad's willingness to invest in building up rail service. The railroad has proposed to the state that it consider providing public funding for improvements on the rail route as a lower-cost alternative to accommodating more freight traffic on the highway.

This case illustrates several of the public policy issues related to freight capacity that were identified in Chapter 2. I-81 is a major intercity highway freight artery facing capacity constraints in the future if no action is taken. At issue is whether resources will be available for increasing capacity on such routes, how environmental impacts or local community objections

may affect the feasibility of expansion, and what alternatives have been recognized for responding to traffic growth. The case constitutes a test of the prospects for multimodal corridor planning because of the consideration given to the possibility of publicly financed expansion of rail capacity as a supplement or alternative to highway capacity expansion.

Highway Facility

I-81 extends 325 miles in Virginia, running northeast to southwest along the Appalachians. The route continues to Harrisburg and Syracuse to the north and terminates at its junction with I-40 near Knoxville, with direct Interstate connections throughout the Southeast. The Virginia portion, completed in 1969, is four lanes except for one short six-lane section. The route in Virginia is not heavily urban; the largest city traversed is Roanoke (population 120,000).

Annual average daily travel (AADT) over most sections of I-81 in Virginia in 1997 ranged from 30,000 to 60,000 vehicles per day (counting both directions), with an average over all sections of about 40,000. Tractor-semitrailers accounted for 25 percent of vehicles on average (VDOT 1999a), or more than 10,000 vehicles per day. Traffic studies show that, in estimating the capacity of a highway, a tractor-semitrailer is equivalent to approximately two passenger cars; therefore tractor-semitrailers are consuming about 40 percent of the utilized capacity. For comparison, AADT averaged over all Interstates in the United States in 1997 was 20,000 vehicles per day and average volume of combination vehicles (predominantly tractor-semitrailers) was 3,500 vehicles per day, 17 percent of the total.

The greatest one-way peak-hour volume among 18 locations for which the state provided traffic data is 2,720 vehicles per hour (1,360 per lane); typical peak-hour volume on the route is 1,600 vehicles per hour in each direction, or 800 vehicles per hour per lane. Traffic slows appreciably at about 1,800 vehicles per hour per lane on Interstates. With these peak volumes, and in the absence of large cities, serious recurrent congestion on the route should be uncommon.

The state conducted a survey of truck drivers at I-81 truck stops in 1997 (VDOT 1997). It found that tractor-semitrailer traffic is predominantly Interstate: half of all trips have an origin or destination within Virginia, Tennessee, North Carolina, or Pennsylvania, and half have an origin or destination outside these four states. (The survey might have undercounted intrastate trucks if local operators make less use of truck stops on the Interstate.) Commodities are diverse: according to the drivers' responses, general freight and household goods are 34 percent of loads, food and agricultural commodities 18 percent, and construction materials 13 percent.

In 1971, 2 years after the route was fully open in Virginia, AADT (averaging three sites for which data are available) was 11,300 and tractor-semitrailer volume was 1,700 vehicles per day (15 percent of the total). From 1971 to 1997, AADT grew at an average annual rate of 4.8 percent and tractor-semitrailer volume at 6.4 percent.

Traffic Forecasts

The Virginia Department of Transportation (VDOT) traffic forecast used in its study of highway expansion requirements predicted that AADT would increase by 100 percent from 1997 to 2020, equivalent to a 3 percent annual growth rate. The tractor-semitrailer share of total traffic is forecast to remain constant. Peak-hour volume on the busiest segment in the forecast is 5,150 vehicles per hour in one direction, exceeding the capacity of the present highway. Tractor-semitrailer volume would exceed 1,000 vehicles per hour in one direction during the peak hour on the busiest section.

One of the important considerations for the purposes of this case study is the degree to which the state's highway expansion plans are driven by the growth of truck traffic. As noted above, tractor-semitrailers account for 40 percent of the utilized capacity on the route, today and in the forecast for 2020. If there were no growth in tractor-semitrailer traffic between 1997 and 2020 and automobile traffic grew according to the state's forecast, peak-hour passenger-car-equivalent volume in 2020 would be about 85 percent of the volume in the state's present forecast and projected peak traffic on the most heavily traveled segments would exceed capacity. (Trucks constitute a smaller fraction of traffic at peak hours than throughout the day.) Therefore, eliminating growth in truck traffic might not greatly change the state's assessment of the need for highway expansion.

While some aspects of the state's forecast might be debatable, it is noteworthy that the forecast does not play as critical a role in decision making in this case as in the Upper Mississippi case. Construction of highway improvements will be staged over many relatively small projects over a period of years. For example, the \$2.6 billion FY 2000 Virginia state highway program budget included \$28 million of engineering studies for improvements on four short sections and two interchanges on the highway (VDOT 1999b), and two construction projects are under way.

The State's Plan

In 1997 VDOT was directed by the Commonwealth Transportation Board to develop a plan for improvements on I-81 in the state to accommodate expected traffic growth. VDOT reported its recommendation in December 1998, which called for widening the route to at least six lanes, with eight lanes near four cities, and interchange improvements. It concluded that the widening would be essential to accommodate forecast traffic in 2020. The estimated cost for all recommended improvements was \$3.4 billion (VDOT 1999c). VDOT also recommended construction priorities. The project would be staged over 20 years. As noted, the Board has approved the next stage of engineering studies for several segments and the start of construction.

At the direction of the state legislature, VDOT also studied the option of constructing a separate exclusive truck facility along the I-81 right-of-way. The analysis questioned whether a separate facility would be justifiable. The design considered was two truck-only lanes in each direction (because provision for passing would be essential) plus separate truck lanes on some interchanges. The estimated cost of the separate truck facility was \$2.5 billion. The facility

would require substantial right-of-way acquisition (apparently more than the recommended widening, which involves adding only one lane in each direction), increasing the potential for environmental damage and local community disruption. Most important, if a separate truck facility were constructed and automobiles were left with four lanes, automobile travelers would still experience significantly degraded levels of service by 2020. That is, the truck-only lanes would not solve the underlying problem. Finally, the study concluded that the recommended design would be safer than the separate truck facility option. The analysis apparently did not estimate cost savings from not having to accommodate large trucks in the automobile-only lanes or any perceived service improvements to motorists from the absence of trucks (other than reduced congestion delay).

In early 2002, a consortium of construction companies made a proposal to the state, following procedures in Virginia's 1995 Public-Private Transportation Act, to widen the highway and add dedicated truck lanes to be financed by truck tolls. The proposal was taken under consideration by the state (Truckinginfo.com 2002; Laurio 2002).

NS's Shenandoah Corridor Route

A secondary mainline route of the NS lies parallel to I-81 and its connecting Interstates, from Harrisburg through Roanoke and Knoxville to Birmingham and New Orleans. It carries virtually no intermodal traffic and only a very limited volume of merchandise traffic.

Historically, the route was little used for through rail traffic. Ownership was divided between three companies: the Pennsylvania Railroad operated between the Northeast and Hagerstown, Maryland; the Norfolk and Western between Hagerstown and Bristol, Virginia/Tennessee; and the Southern between Bristol and points in the Southeast and gateways to the Southwest. While these railroads did cooperate on some passenger and bulk commodity services, both the Pennsylvania and the Southern preferred to route most of the merchandise traffic on alternate routes that provided longer hauls and more revenue for them. The 1982 merger of Norfolk and Western and the Southern and the 1999 purchase of Conrail lines by NS finally created a route under single control between the Northeast and the Southeast.

Largely on account of this historic balkanization, there has been only limited investment in the route. Reflecting the difficult terrain involved and the poverty of the South when the railroad was built, the line has many curves and gradients. Always a minor rail route, it did receive minor improvements over the decades, mainly in the form of signaling and a track structure capable of carrying heavy loads. (It is important as a coal route.)

With the Conrail acquisition complete, NS has increased traffic over the route. Both coal and carload merchandise traffic have increased. NS operates a Memphis-Harrisburg service on this line. However, the running times are slow, and the railroad reports that it will utilize alternate, faster north-south routes for the majority of its intermodal volume. Substantial infrastructure improvements would be required to provide the trip times needed to divert traffic from the highway. Curve straightening and other changes are very costly in the region's

mountainous terrain. NS also reports that such investments are unlikely to occur just to support the diversion of additional traffic from the highway. The margins on such traffic make it attractive only if the lengths of haul are long (more than 1,000 miles) or where surplus capacity exists. Neither of these conditions holds for this market.

During the proceedings leading to the Conrail breakup, NS designated this new single-line route the Shenandoah Route and cited it as one of the routes that would spur improved rail service between the Northeast and Southeast. NS stated that it expected to draw significant general merchandise and intermodal freight from trucks to rail service on the route and that it planned \$33 million in investment for sidings and for doublestack clearances between Front Royal, Virginia, and Roanoke (Norfolk Southern n.d.).

The Railroad's Proposal to the State

In August 2000, NS proposed to the state of Virginia that it consider public investment in improvements to the Shenandoah line as an alternative solution to I-81 congestion problems. State officials from Maryland, North Carolina, Pennsylvania, Tennessee, and West Virginia also participated in discussions with the railroad. As a consequence, the Virginia legislature instructed VDOT to conduct a study, to be completed in 2001, of the feasibility of shifting traffic in the I-81 corridor from highway to rail.

The NS proposal included double-tracking much of the line, upgrading signals, reengineering curves, improving existing yard facilities, and developing intermodal terminals. The improvements would increase capacity and allow higher train speeds, which are requirements for attracting intermodal traffic to the line. The railroad estimated that at least 1,000 heavy trucks per day, and possibly as many as 3,000 per day, could be removed from the Interstate between Harrisburg and Chattanooga, that is, 10 to 30 percent of present heavy truck traffic. The railroad argued that it would be much cheaper to add needed capacity on the rail line than to the highway, especially considering benefits from improved safety and reduced environmental impact (Norfolk Southern 2000a; Norfolk Southern 2000b).

It may be something of an oversimplification of the functioning of the freight system to relate traffic growth on a specific highway to improvements on a specific rail line. A more realistic approach from the state's point of view might be to consider whether improvements on rail lines throughout a corridor or region could reduce truck traffic on the main roads throughout the region. If rail improvements were successful in developing intermodal freight, then such traffic reductions would be achieved, although the effect of the rail line improvements might be to increase truck traffic in certain locations on roads leading to intermodal terminals.

Policy Issues

Feasibility of Intercity Highway Capacity Expansion

The VDOT plan for improvements to I-81 gives some grounds for optimism about the capability of the states to continue to expand highway capacity in response to traffic growth on major intercity truck routes. Although the highway is an older Interstate connecting some of the most densely populated parts of the nation, the state's initial study indicates that right-of-way for widening will be available and does not identify any insurmountable environmental obstacles. The cost seems not unreasonable: it amounts to about \$0.02 per vehicle-mile of travel that will occur on the road during the project's 20-year schedule, according to the VDOT projections, and the improvements will have a lifetime beyond that 20-year period. The project has low risk in the sense that it can be done in stages, widening those segments earliest on which the immediate benefits would be greatest, and the schedule can be accelerated or retarded in accordance with the growth of traffic.

On the other hand, limitations on the state's planning approach might raise concern over whether all potentially attractive options have been fully explored. VDOT's recommendations to the Transportation Board seem to have been based primarily on projections of the date at which congestion on the route will start to become severe. They do not include quantitative estimates of benefits of the proposed improvements or analysis of sensitivity of benefits to uncertainties in traffic projections. The state agency did not explore the possible benefits of coordinated planning with adjoining states along the route of I-81. It was prompted to consider the alternatives of exclusive truck facilities and state-funded rail developments, but did not publish the results of its exclusive truck lanes analysis and did not consider any options involving alternative management and funding approaches to developing the highway. Planning for developing the route is still in preliminary stages, so there will be opportunity for VDOT to conduct more detailed analyses in the future.

Although the state apparently did not consider such alternatives relevant in this project, in some states facility management alternatives to highway expansion are regularly evaluated during project planning. An example is Minnesota, where ramp metering on urban freeways was installed after evaluation indicated that this technique would be preferable to physical expansion.

Public Funding of Rail Capacity as an Alternative to Highway Expansion

As described in Chapter 2, government grants to private freight railroads have occurred, usually on a small scale, for many years in the United States. They have included state rail assistance programs with and without federal support and ad hoc arrangements for single projects. TEA-21 contained a new program for federal rail assistance, the Railroad Rehabilitation and Improvement Financing program, which is to provide loans and loan guarantees to public or private sponsors for development or improvement of rail or intermodal facilities or equipment. The total amount of loans provided or guaranteed is \$3.5 billion. This program would institutionalize the kind of federal credit assistance given to the Alameda Corridor port access project in Los Angeles.

Several arguments have been made in support of proposals for rail freight grants. First, it might be cheaper in some circumstances from the standpoint of the government to aid the railroad than to provide the same freight capacity by expanding highways. Such cost savings might be most significant in a densely developed location where right-of-way was more readily available for rail upgrading than for highway expansion.

Second, rail aid might be justified as a means to improve freight market efficiency by offsetting subsidies truck operators receive because they do not pay the full cost of the highway service provided to them. As also described in Chapter 2 in the section on the future of user fee finance in state highway programs, the most recent DOT highway cost allocation study estimates that fuel taxes, registration fees, and other user fees paid by truck operators amount to 80 percent of the highway expenditures of all levels of government attributable to trucks, the same as the ratio of fees to costs for all vehicles. The DOT study does not compare fee revenues to costs by class of road. However, one analysis made plausible allocations of fees and costs between urban and rural roads and concluded that in 1975, payments by urban highway users exceeded urban highway expenditures by 13 percent, while on rural roads payments were 30 percent below costs (Meyer and Gómez-Ibáñez 1981, 198–203). Thus, according to these estimates, urban road users subsidize rural users.

Intercity roads include the truck routes that directly compete with railroads. Therefore, a subsidy to rural truck traffic paid by urban highway users would distort modal competition and degrade freight transportation efficiency. The significance of any urban/rural cross subsidy in highway user fees today is unknown. The study cited above is old and compared payments with costs for all vehicles, rather than for trucks alone. The study *Paying Our Way* (TRB 1996) estimated external costs and subsidies for case studies of individual truck trips. It found that the difference between estimated costs and fees paid varies widely and depends on the characteristics of the truck trip, but no consistent urban/rural bias is apparent in the small number of cases considered.

Because a railroad builds and owns its own track, it bears all the financial risk of misjudging the appropriate scale of infrastructure. Because highways are publicly owned and operated, a trucking company bears relatively little of the analogous risk of over- or under-building of highway infrastructure, even if the highway taxes it pays match the average highway agency costs attributable to it. The railroads argue that the public assumption of this risk also biases freight markets in favor of trucking.

Third, it is argued that rail freight transportation generates lower external costs per ton-mile (air pollution, highway congestion, and external accident costs) than truck and that favoring rail over truck would tend to promote more environmentally benign high-density urban development rather than low-density development. Fourth, the purpose of some large state aid projects has been to improve rail access to seaports, which the states regard as critical drivers of economic development. Finally, state programs to aid shortline railroads are often a means to indirectly aid farmers who use the lines.

Objections to rail aid programs have to do in part with administrative practicality. Would the government be able to discriminate between rail aid proposals that actually had a high chance of producing net benefits and required government support and proposals that were without merit or that should be left in the private sector? Evidently, the states would have to use sophisticated analysis methods that they do not now possess in order to make such distinctions. Without tight management controls, the risk would be that application for government aid whenever a railroad wished to undertake a capital improvement would become routine, regardless of the merits of each case, and that states would feel obliged to provide aid, as governments do now for sports stadiums, for fear of losing development to rival states. Finally, subsidies limited to capital expenditures would bias railroads toward favoring capital solutions to capacity constraints instead of operating improvements to better utilize existing capacity that might be more cost-effective. Financial discipline would be easier to maintain if the aid program offered only partial grants and required a high level of private contributions.

In cases where the main argument for rail subsidy is the existence of subsidies or high external costs in trucking, an alternative would be for the state to adjust truck taxes to ensure that trucks covered their costs. Shippers would then select the best transportation options on the basis of true costs. The bias of shippers' decisions would be further reduced if truck taxes were adjusted so that truck operators paid the costs of their use of roads not only on the average, but for classes of operations, or, ideally, for individual movements. For example, as noted above, some evidence indicates that urban highway users subsidize rural users. Any subsidy to rural truck travel being paid by urban road users could be eliminated by imposing route-specific fees. If this method was judged to be impractical, the market distortion could be reduced by adjusting registration fees on various classes of trucks and fuel tax rates so that fees generated by rural truck travel in the aggregate more nearly matched the costs of that travel.

Arguments can be put forth that having urban road users subsidize rural travel is a beneficial arrangement, either on economic grounds (i.e., that because of scale economies, efficient charges imposed on rural road users could never finance the level of investment in rural roads that is economically justified) or as a way to make congestion pricing on urban roads more attractive (e.g., Small et al. 1989, 122). However, neither argument is generally accepted or well supported empirically. The growth of traffic and congestion on several important intercity truck routes today suggests that self-financing through marginal cost-based user fees on these routes might be as feasible as on congested urban roads. In any case, it would be possible to maintain a user fee scheme that featured an urban-to-rural subsidy in the aggregate but did not subsidize intercity truck travel.

With regard to relative external costs of the freight modes, The TRB study *Paying Our Way* found that, although external costs per ton-mile generally are lower for rail than for truck transportation, marginal external costs as a percentage of freight rates are roughly similar for the two modes. This finding suggests that if all external costs were internalized, the competitive balance between the two modes might not change much (TRB 1996, 94). Finally, it should be noted that if a cost analysis indicated that satisfying projected demand growth on a route by increasing rail capacity would be cheaper than expanding highway capacity, an alternative for the state would be to do nothing rather than to build either highway or rail capacity. If rail is the

low-cost alternative for freight traffic and the state charges truckers their true costs and does not provide economically unjustified highway capacity, then private-sector investment in rail expansion ought to be profitable.

Upper Mississippi River Locks

The U.S. Army Corps of Engineers recently conducted a study evaluating proposals for improvements to locks and other navigation facilities on the Upper Mississippi River and its tributary the Illinois River, to allow faster lock traversals of barges and relieve congestion at the locks. The study was controversial, with critics asserting that the Corps overestimated shipper benefits from improvements, did not properly evaluate environmental costs, and dismissed traffic control measures and congestion pricing as alternatives to physical expansion (USACE n.d.).

The problems the Corps encountered in its efforts to evaluate the improvements and the recommendations of an NRC committee and of others on how evaluations should be done in the future contain lessons that are generally applicable to large, long-lifetime public transportation infrastructure projects. These lessons concern dealing with the risk that arises from uncertain future demand, the necessity of considering operational alternatives to capital improvements, and valuation of environmental impacts.

Waterway System

The waterways in question are operated by the Corps and include 28 dams equipped with locks on the Mississippi above St. Louis and nine on the Illinois River, which joins the Mississippi near St. Louis. The locks and dams were constructed by the Corps, mostly in the 1930s, to allow navigation of the rivers by vessels with 9-foot drafts (USACE 1997, 2-1-2-16, 4-59-4-60). Freight is carried in barges pushed by towboats. On the Upper Mississippi, a typical tow is a towboat pushing 15 barges, 1,200 feet in length, with a cargo capacity of 22,000 tons. Since all but four of the locks are 600 feet long, the barges in a tow must be disassembled and pushed through by their towboat in two groups at each lockage. A single lockage requires on the order of an hour (not including time spent waiting in the queue for the tow's turn at the lock). Processing a tow in two passages doubles this time. The improvement that received the greatest attention in the Corps study was extending the locks to 1,200 feet in length so that 15-barge tows could pass in a single lockage.

Tows on the Upper Mississippi experience substantial delay on account of congestion. A barge might typically expect to experience 30 hours of congestion-induced delay during a 300-hour trip from the Upper Midwest to New Orleans. [Thirty hours is the sum of the average delay at each lock in 1999 (USACE 2000a)]. Substantially reducing this delay would reduce the total cost of the trip by several percent. Savings in tow operators' costs would, in the long run, be roughly proportional to the reduction in trip time.

As an example, in 1999 at Lock 25, the last 600-foot lock above St. Louis, 84 percent of all tows experienced delay and the average delay for delayed tows was 4.5 hours. Delays at peak times can be much longer. The next lock downstream, below the confluence of the Illinois River—the Melvin Price Locks, a new facility with 1,200-foot lock chambers—handled 75 percent more tonnage with only one-sixth the average delay of Lock 25.

Lock 25 handled 39.5 million tons of freight in 1999. Seventy-one percent was downstream-bound farm products, mostly headed for export from the port of New Orleans. Eight percent of traffic was coal, primarily upstream-bound (USACE 2000b).

Since 1981, towing companies operating on the inland waterways have paid a federal excise tax on fuel. Today the tax is \$0.20/gallon (USACE 1997, 5-2), roughly \$0.0004/ton-mile for tows on the Upper Mississippi (TRB 1996, 155). Tax revenues, \$101 million in 1998 (BTS n.d., Table 3-A), are credited to the Inland Waterways Trust Fund. One-half of construction expenditures for inland waterway improvements are to be from the trust fund. The Inland Waterways Users Board, created by Congress and made up of representatives of primary waterway users and shippers, advises Congress on priorities for trust fund projects. The balance of construction expenditures and all operating and maintenance costs are paid from federal general revenues. Corps of Engineers operating and maintenance costs in 1995 were \$95 million (\$0.006/ton-mile) on the Upper Mississippi and \$20 million (\$0.002/ton-mile) on the Illinois. Capital expenditures averaged more than \$100 million annually on the Upper Mississippi from the late 1980s through the mid-1990s (USACE 1997, 4-2–4-26). Congress must authorize all waterway construction projects, which are carried out by the Corps.

The justification for subsidized construction and maintenance of freight infrastructure is a policy issue relevant to long-run freight capacity and to this study. However, the Corps evaluation of lock expansions did not consider any change in this policy, and the NRC committee that reviewed the Corps study regarded the issue as beyond its scope, although that committee's recommendation that congestion fees be considered as a management tool points toward finance alternatives. A proposal to make waterway users pay all maintenance costs through an increase in the fuel tax was offered to Congress by the administration in 1993 but not enacted (USACE 1997, 5-1). Implicit in the Corps' project evaluation procedure, which values transportation improvements according to waterway users' willingness to pay, is the assumption that one possible argument for subsidies, the existence of external benefits generated by the waterways, is invalid.

Infrastructure Planning and Operations Issues

On account of the controversy over the Corps study, the U.S. Army asked NRC to review that study's methods (NRC 2001). The Corps had not published a final version of its study, so the NRC committee reviewed drafts and other publicly released preliminary materials. The results of the latest economic evaluation released at the time of the NRC study were that immediate construction of extensions to 1,200 feet for the most congested Mississippi locks and other smaller capital improvements on the Illinois and Mississippi would yield net annual benefits

(before considering environmental costs) of \$16 million under the Corps' mid-growth traffic projection (USACE 1999). The construction cost would be about \$1 billion.

The following observations, which are based on the conclusions of the NRC committee, are relevant to the present study.

Benefits Estimation

The basic framework used by the Corps for evaluating the benefits of transportation improvements is appropriate. There are two key assumptions in this framework. First, the predominant benefit is the direct benefit to users of the transportation system in the form of reduction in their operating costs. In the Upper Mississippi study, the only significant benefit is the transportation cost reduction caused by the time savings from reduced congestion at locks. Second, the volume of traffic depends on the cost of using the waterway, including the cost of delays. Elastic demand indicates that shippers have alternatives for disposing of their products. If producers have available to them markets and transportation modes that are alternatives to transporting their grain by barge to New Orleans for export, then the benefits of waterway improvements will be lower than if few alternatives existed. Thus the more elastic demand is with respect to congestion costs, the less benefit there would be from expanding the locks.

Although these assumptions may seem elementary, they are not routinely used in transportation project evaluation. This study was the first navigation improvement evaluation in which the Corps assumed that demand is not perfectly inelastic. Corps standards have long specified that the value of the improvement to the direct users of the transportation facility is the correct measure of benefits. However, skepticism on the part of Corps officials that this measure actually captures all the important benefits perhaps was a source of some of the controversial assumptions that were made in its study. A Corps internal guidance that was later publicly released states: "There is a need to improve the system. The well being of the Midwest depends on agricultural exports. . . . If the demand curves, traffic growth projections, and associated variables that the economics model can consider, do not capture the need for navigation improvement, then we have to figure out some other way to do it" (Environmental Defense 2000). The implication of this statement seems to be that the standard benefit measure ignores indirect benefits related to regional development.

However, the implementation of this framework in the Corps study was inadequate because the Corps failed to collect the transactions data on shipment origins, destinations, quantities, and prices that are needed to implement a market model. Without data, the benefit estimates rested on unsupported assumptions about transportation supply and demand.

Traffic Projections

Traffic on the Upper Mississippi grew strongly for several decades until the mid-1980s, driven in large part by growth in agricultural product exports. Since the mid-1980s, traffic volumes have fluctuated, but the trend is nearly flat. The break in the trend may reflect fundamental changes in

the global grain market; in particular, large gains in production efficiency in several regions of the world.

The Corps based its evaluations on forecasts of the growth of traffic on the rivers through 2050. The forecasts are unconstrained by supply conditions; that is, they assume that traffic will not be curtailed by increasing congestion on the rivers. (The Corps evaluation model adjusts these projections downward to allow for the effect of congestion.) The forecasts are estimated with historical data through 1992. Low-, mid-, and high-traffic-growth scenarios projected growth averaging 0.7, 1.1, and 1.5 percent annually. By 1999, the forecasts were already substantially above actual traffic and appeared to deviate sharply from the recent trend.

The evaluation of navigation improvements is very sensitive to the rate of traffic growth. Under the Corps' low-growth projection, the November 1999 analysis showed that no major improvements would be justified at least until 2028. The Corps' sensitivity analysis illustrates how large, indivisible capital projects with long lifetimes are high-risk investments when demand is uncertain.

Traffic Management and Noncapital Alternatives

The Corps study, as described in the draft reports, did not fully examine options other than construction for relieving lock congestion. Possible nonstructural measures include traffic management through scheduling of tow movements, systematic use of helper boats (that is, use of a second towboat, either a towboat waiting in the queue or one stationed at the lock, to speed the process of disassembling and reassembling tows for lock passages), and use of congestion fees and tradable lock usage permits.

The NRC committee concluded that the locks are presently not being used efficiently and that lack of traffic management is causing shippers and tow operators to bear needlessly high costs. It recommended that lock performance with improved traffic management, rather than under current inefficient practices, be defined as the baseline from which to evaluate the benefits of major capital improvements. If this rule were applied in the evaluation of capital improvements on other publicly operated modes, in particular highways, it would greatly reduce the apparent benefits of many projects, since users of these modes also suffer from inefficient traffic management.

Environmental Costs

The Corps spent the majority of the \$50 million study budget on studies of the environmental impacts of the incremental changes in waterway traffic volumes that would result from lock improvements (e.g., changes in bank erosion, water turbidity, and fish mortality). However, the Corps did not define the relationship between the results of the environmental studies and the process of deciding whether the lock extensions should be built. The study lacked a theoretical framework specifying the scope of relevant environmental impacts and how trade-offs between environmental impacts and transportation cost savings are to be evaluated. In preliminary results, environmental costs entered only as costs of mitigation measures (for example, habitat

replacement projects) without any showing that mitigation measures would offset the estimated impacts.

The NRC committee noted that, in addition to options defined with the sole objective of reducing shipper and carrier costs, the Corps could have considered alternatives with the dual goals of enhancing environmental benefits of the rivers while maintaining transportation service. To allow consideration of such options, it recommended that a baseline study be conducted of the cumulative environmental impacts of the present waterway system.

Need for External Review

The NRC committee recommended that Corps studies of waterway navigation system capital improvements and management practices routinely be subject to technical review by outside, independent, interdisciplinary expert groups.

Risk Management

As noted in the discussion of traffic forecasts above, uncertain future demand makes large, indivisible transportation infrastructure projects risky investments. The Corps study evaluated multiple improvements of various kinds at multiple locations on the waterways system that could be staged over a 50-year planning horizon. However, the analysis tended to define alternatives as packages of improvements to be committed to in their entirety at one time. This approach is justified to some extent because of the interdependence of the system components: improving traffic flow at one lock may simply shift congestion to the next lock on the river without reducing trip times. Also, completion of lock construction projects takes many years once the decision to go ahead has been made, so if demand can be foreseen, benefits will be maximized by beginning construction before it materializes. However, the evaluation does not give a clear indication of the extent to which risk might be reduced by a strategy of staging construction and adjusting plans as demand develops.

The NRC committee noted several practices that can reduce the risk of large transportation infrastructure projects, including use of more sophisticated traffic forecasting models based on detailed structural analysis of underlying markets rather than on trend extrapolation; delaying construction until demand is evident; favoring low-capital alternatives and demand management over capital-intensive solutions; and continually monitoring conditions and retaining flexibility to change plans in response to new information.

FAST Corridor Project in Washington

The FAST Corridor in Washington State is a joint activity of the Washington State Department of Transportation (WSDOT) and the Puget Sound Regional Council (PSRC) that focuses on freight mobility in the north-south rail lines connecting Everett to Tacoma. Funded in 1999, Phase I of the FAST Corridor project is a collection of railroad grade crossing and port access improvements. Future phases will address truck-related issues and operational characteristics

among roads, railroads, and intermodal facilities (PSRC 1999a; PSRC 1999b). The partnership and funding arrangements of the project, which has been cited frequently as a model of freight planning, are described in this case study, and the possible impact of the project on port capacity and freight capacity throughout the Puget Sound region is considered.

Past policy studies, including the report of the National Commission on Intermodal Transportation, have asserted that local and state governments do not assign sufficiently high priority to projects important for freight mobility. Four causes for this failure are cited: first, government officials do not understand the needs of freight transportation; second, needed projects are ineligible for funding under the rules of established federal grant programs; third, projects are institutionally complex, involving multiple transport modes and multiple jurisdictions as well as private industries; and finally, certain important freight-related projects that benefit the nation as a whole fail to receive necessary local support on account of negative local impacts. These studies have proposed that if local governments did the right kind of freight planning, incorporating formal arrangements for receiving opinions from local freight carriers and shippers, they would find the high-payoff freight projects they are now missing. The FAST Corridor Project (as well as the Florida Freight Stakeholders Task Force described as the next case) can be viewed as experiments aimed at developing procedures and institutional arrangements to overcome these perceived problems in carrying out local freight projects.

Puget Sound Freight Capacity Issues

According to data of the American Association of Port Authorities, the Puget Sound region (Port of Seattle, Port of Tacoma, and Port of Everett) consistently ranks in the top three among U.S. port complexes in total container port traffic. The majority of cargo tonnage through the ports is containerized. The Puget Sound region ports also rank 20th in total cargo tonnage, both foreign and domestic (AAPA 2001). The region's container volume is far below that of the leading port complex, the Ports of Long Beach and Los Angeles. These California ports have recently begun a \$2.4 billion project, the Alameda Corridor, to construct a 20-mile rail cargo expressway linking the two ports to rail yards in downtown Los Angeles. The facility will eliminate the grade crossings in the corridor and allow increased speeds for rail traffic moving through the region. Aware of the Alameda Corridor project and its potential to affect competition among west coast ports, Puget Sound region officials see capacity and freight mobility as central to the region's ability to remain competitive and sustain economic growth.

The U.S. Maritime Administration (MARAD) projects U.S. waterborne trade to more than double by 2020 over 1996 levels (MARAD 2000a), and the Ports of Seattle and Tacoma expect a 50 percent increase in the number of containers over the next decade alone (FHWA 2000c). Freight mobility and port capacity are critically linked to the operational characteristics of the railroads. In addition, new services planned by Amtrak and planned additional regional commuter trains present significant challenges for rail infrastructure and operations in the region. The increasing cost of rail congestion was one of the primary motivations for the organizing efforts that led to the FAST Corridor project.

Partnership Arrangements: The Freight Mobility Roundtable

Since its inception, the FAST Corridor project has been implemented through partnership agreements among several public and private organizations. FAST participants include Washington State, PSRC, the Port of Tacoma, the Port of Seattle, the Port of Everett, 12 cities, 2 counties, the Burlington Northern Santa Fe Railroad, and the Union Pacific Railroad.

In 1994, PSRC and the public-private Economic Development Council of Seattle and King County, as part of an effort to update the Metropolitan Transportation Plan, founded the Freight Mobility Roundtable. An informal organization, the Roundtable is not an authority but a coalition to bring private-sector firms together with public agencies under a common goal of freight mobility. The Roundtable's initial objective was to establish a dialogue between public agencies and the private sector. Its participants included major shippers like Boeing and Weyerhaeuser, the railroads, the ports, and public agencies (MARAD, the Federal Transit Administration, FHWA, the Federal Railroad Administration, the Department of Defense's Medium Port Command, WSDOT, PSRC, the Regional Transit Authority, and the Puget Sound Air Pollution Control Agency). For the ports, the issue was competitiveness, driven primarily by their concern over the consequences of the Alameda Corridor and the possibility that the railroads might divert shippers away from the Northwest to Los Angeles. For the communities, the issues were increasing delays at intersections, increasing train volumes, pollution, and noise (TTI 2000). The involvement of the private sector in the planning process reportedly was instrumental in the identification of freight problems and possible solutions. Among the concerns of the private-sector participants were problems in the public decision-making process and operating difficulties due to congestion in the region.

A Regional Freight Mobility Conference in Seattle in September 1994 established the FAST Corridor concept and set up a working group to form a long-term strategy for the corridor. Among its goals were to advance a package of freight projects and integrate freight into other planning decisions (FHWA 2000c). By 1995, the FAST Corridor project framework was incorporated into the regional plan of PSRC. In 1996, local and state participants began working in an interagency team named the FAST Corridor Agency Staff Team, cosponsored by PSRC and the WSDOT Office of Urban Mobility. In 1997, the Freight Mobility Roundtable isolated the highway-rail intersection problem as the freight mobility issue that it wished to attack first and contracted with Texas Transportation Institute (TTI) to evaluate highway-rail intersections in the FAST Corridor. The researchers developed a method to evaluate intersection improvement projects intended to balance port-related and community concerns. TTI used a simulation model to predict conflicts between rail and street traffic. Crossings were ranked by balancing port and community concerns using both quantitative and qualitative measures. The goals and measures selected for evaluating each crossing were as follows:

- Improve general mobility—measured by the proposed grade separation's ability to reduce vehicle delay, reduce vehicle queuing, and serve as a major cross-corridor arterial or regionally significant route;

- Increase freight mobility—measured by the amount of truck traffic and the project’s ability to provide operational benefits for rail traffic;
- Maintain safety—measured by the number of accidents reported by the Federal Railroad Administration at the intersection and the ability of the project to preserve or improve emergency vehicle access;
- Enhance communities and the environment—measured by community-supplied values for political support, residential displacement, business development, strategic economic value, and vehicle emissions reduction; and
- Maximize cost-effectiveness—measured by the calculated ratio between capital cost and the potential of the project to reduce vehicle delay.

Weights were assigned to each objective (Table 3-1) and candidate projects were rated accordingly. From the Roundtable’s review of this evaluation emerged a 6-year, \$470 million package of 12 grade separation projects and three projects for truck access to the ports, each with a distinct funding package, all scheduled for completion by 2004. It must be presumed that negotiations among the participants, as well as participants’ willingness to fund their own projects, determined priorities along with the analysis (Gallagher 2001). To implement the program, each party agreed to a Memorandum of Understanding in 1998, which included the following provisions:

- Rail congestion and growth in vehicular traffic present challenges for international trade throughout the Puget Sound region.
- The “FAST Corridor” refers to a series of related but independent projects consistent with the PSRC’s transportation plan.
- Each selected project is the implementing agency’s responsibility to design and construct.
- Implementation of each project is dependent on funding authorization by the party responsible for each project.
- The Memorandum of Understanding does not create any legally enforceable rights or obligations on the part of any of the signatory agencies.

The Memorandum of Understanding thus was an informal, nonbinding framework establishing individually funded and administered, yet related, grade-separation and port access projects under a single label, the FAST Corridor.

After the signing of the Memorandum of Understanding, applications were made and approved for state and federal funding. With state and federal funding secured, each project was then financed under the authority of the lead agency for that particular project. In summary, funding sources are as follows:

| <i>Amount (\$ millions)</i> | <i>Percentage</i> | <i>Source</i> |
|-----------------------------|-------------------|--|
| 70.9 | 15 | Lead agency |
| 74.3 | 16 | TEA-21 Sec. 1118 Corridor Planning and Development Program |
| 44.3 | 9 | TEA-21 High Priority Earmark |
| 131.6 | 28 | Freight Mobility Strategic Investment Board (state) |
| 38.7 | 8 | Ports |
| 18.9 | 4 | Railroads |
| 91.6 | 19 | Other sources, including PSRC, cities, counties, other federal |

The single largest project in the FAST Corridor (almost one-third of the total investment) is the \$150 million SR-519 Intermodal Project. This project grade-separates SR-519 from the Burlington Northern Santa Fe mainline and provides access ramps among I-90, I-5, and the Port of Seattle waterfront.

The overall FAST Corridor concept includes five elements. The 15 Phase I projects constitute only one element. Other elements include site work at the ports, highway construction and reconstruction, and projects to improve mixed (freight and passenger) rail operations. Phase II is to focus on regional roadway needs. Planning activities are in the very early stages for elements not relating to Phase I, and funding for the later stages is uncertain.

Relation of the Project to Freight Capacity

Freight mobility in the Everett–Seattle–Tacoma Corridor is tied to the operational characteristics of the railroads, and rail performance today is constrained not by passenger-car conflicts but by the condition and capacity of the rail lines (TTI 2000). The principal direct benefit of the FAST Corridor Phase I projects is reduced local street congestion rather than improved train operations. Among the program's grade separation projects, three projects that facilitated rail yard expansions were the only ones among 40 grade crossing projects evaluated that were judged to have significant direct freight mobility benefits. Nonetheless, it is plausible that, as rail freight in the port area grows, interference with street traffic will eventually constrain port traffic growth. The projections indicate that without improvements some crossings would be closed to highway vehicles in excess of 40 percent of the time within 10 years.

The priority assessment of the Phase I projects was not structured to provide benefit–cost evaluations for each project or for the Phase I package. Therefore it is not possible to judge whether the combined benefits of reduced road delay, accidents avoided, and improved rail

system functioning are sufficient to justify the \$470 million investment, or to compare the return with that of alternative uses of the funds by the contributing governments. From the standpoint of the Roundtable participants, fostering a working public–private relationship and allaying community objections to freight traffic growth may be the main benefits. The Phase I package can be seen as a community mitigation action that is “politically essential to any regionwide increase in rail container transshipments to other regions” (Central Puget Sound Region 1999, 37).

The FAST Corridor project is financed primarily by state and local funds and by federal aid that could be used for other purposes within the state if it were not devoted to these projects. The largest benefit of the project is mitigation of congestion, nuisance, and accident costs imposed by port rail traffic on local residents. A closer examination is needed of the fairness and economic efficiency of this financing arrangement, which is the result of the legal assignment of responsibility for rail grade crossings to the road agency rather than to the railroad. Reliance on public funding to mitigate spillovers means that railroads and ports do not fully take into account the public costs of their decisions to expand facilities. It is noteworthy that the Alameda Corridor rail port access project in Los Angeles, a project with goals similar to those of the FAST project, plans to derive the majority of its funding from fees charged to the railroads and from port user-fee revenues. Public expenditures to mitigate harmful side effects of freight traffic growth may well stimulate local residents to ask whether it is really in their best interest to host the freight facilities, considering the negative spillovers, demands for public subsidies, and the facilities’ occupancy of valuable urban property.

Florida Freight Stakeholders Task Force

The 1991 federal surface transportation act (ISTEA), through its declared goal of developing a national intermodal transportation system, appeared to increase program emphasis on using federal aid to address freight mobility needs. The act also placed greater project selection authority in the hands of local governments and their metropolitan planning organizations (MPOs). Consequently, the freight industry and port authorities saw an urgent need for greater local engagement by freight interests in the transportation planning activities that determine public-sector investment priorities. Local public–private groups were formed in several areas to participate in planning and promote freight-related investments, and a coalition of national trade associations representing carriers, shippers, and port authorities formed the Freight Stakeholders National Network to support local freight advocacy nationwide (Freight Stakeholders National Network 1996).

The premise of these freight advocacy efforts is that local and state governments systematically miss high-payoff freight-related projects when they establish their transportation spending plans. This is the result of ignorance of freight needs or bias in favor of improvements benefiting primarily passengers, or because local governments are unwilling to expend local resources on transportation projects whose benefits are spread regionally or nationally. This case study and the Washington State FAST Corridor case examine the success of local public–private planning initiatives in improving the efficiency of public infrastructure investments.

The Stakeholders Task Force Process

The Florida Freight Stakeholders Task Force, organized as an outcome of the 1998 Governor's Intermodal Transportation Summit, was charged with identifying and prioritizing freight-related transportation projects for fast-track funding as well as developing recommendations for the *Year 2020 Florida Statewide Intermodal System Plan*. Task force members represented port and airport authorities, MPOs, state and local government agencies, shippers, carriers, and third-party transportation services (CUTR 1999). The Florida legislature appropriated \$10 million for fast-track funding of projects recommended by the task force, as an experiment to see how the new planning approach would work.

The task force contracted with the Center for Urban Transportation Research (CUTR) at the University of South Florida to define a Florida Strategic Freight Network. The resulting network definition includes the Florida intrastate highway system, ports, air freight terminals, rail intermodal terminals, highway freight terminals, and road connections between the Interstates and freight facilities. CUTR also developed eligibility criteria for project funding: projects were to be located on the Strategic Freight Network, facilitate freight movement, and have a ratio of public benefits to public costs greater than one. Finally, CUTR developed a prioritization methodology that rated projects according to the eligibility criteria, stage of development and environmental compliance, time to completion, current level of service, safety considerations, neighborhood impact, and current freight volume.

Project applications were solicited from task force members, MPOs, ports, and airports. Seventeen projects totaling \$101.3 million were identified and prioritized. The final project recommendations, selected to maximize the value of the projects funded, comprised five projects totaling \$10 million. The scale of the budget suggests that the activity was seen as a trial.

In addition to developing and demonstrating its project prioritizing method, the task force addressed seven recommendations to the state to improve planning and increase funding for freight infrastructure:

1. Establish the Florida Strategic Freight Network as part of the state's Intermodal Systems Plan,
2. Adopt the Florida Freight Stakeholders Task Force process for prioritization and selection of future freight projects,
3. Fund future research and planning studies,
4. Conduct a Florida International Trade and Port Strategy Study to define specific trader corridor strategies and the supporting port investment priorities,
5. Establish a Florida Freight Advisory Council within the Florida Department of Transportation,

6. Establish “freight mobility committees” in the largest MPOs; and
7. Create a Florida Freight Investment Bank to fund freight projects.

Thus the objectives were to find a mechanism for institutionalizing freight-sector input to state transportation planning, to develop a formal process for budgeting and setting priorities for freight-related improvements, and to study freight needs.

Impact of the Task Force

To fully judge the success of the freight task force planning experiment, answers would be needed to three questions: Did the state follow through on the task force recommendations? Did the task force’s project priority assignments actually redirect funding toward projects that otherwise would not have been conducted? Did the projects selected yield higher payoffs than the projects they displaced in state and local transportation programs?

The Florida Strategic Freight Network has been included in the Florida Department of Transportation’s *Year 2020 Florida Statewide Intermodal System Plan* and is being updated by CUTR for the state. In addition, the network will be the starting point for a planned passenger–freight network, the Strategic Intermodal System. Presumably, inclusion of a facility in this system will tend to elevate the priority of any improvement to that facility in the state’s spending program. However, because this system may be extensive, the average effect on priority rankings may be small. The state has not evaluated the benefit of favoring on-network projects in this way.

The task force went out of existence when it completed its report. However, several continuing state initiatives were affected by its work (FDOT 2000). As a complement to the task force’s efforts, in 1999 the state created the Fast Track Economic Growth Transportation Initiative, under which \$59 million was made available for projects in aviation, rail, transit, seaport, space, or intermodal freight and passenger facilities. The task force recommended projects to be funded through this program, and projects were to be evaluated by procedures related to those the task force developed. In 2000, the legislature established the Transportation Outreach Program, which replaced the Fast Track Initiative. The program establishes a mechanism for funding projects according to selection criteria specified in the statute, which were influenced by the task force’s work. The state department of transportation, in support of its 2020 Intermodal Systems Plan, is developing a Florida Freight Network and Linkages Study to address the future of Florida’s trade corridors, project demand, analyze infrastructure needs, and evaluate operational issues relating to freight movement. Finally in 2000, Florida created a new wholly state-funded infrastructure bank with flexible rules regarding the kinds of transportation projects that can be funded, as the task force recommended.

It is likely that the projects selected by the task force eventually would have been programmed as part of the department of transportation’s regular prioritization and funding process. However, it is also likely that the effort has raised the prominence of certain categories

of projects of significance for freight mobility and thereby increased these projects' chances of receiving funding. The task force's efforts enhanced awareness of freight issues and influenced subsequent executive and legislative policy directives on funding priorities.

It is not possible to ascertain whether the new priorities increase the efficiency of Florida's transportation capital expenditures. As the task force recommended, \$240,000 of its initial \$10 million funding was allocated for continuing research on project benefit quantification and related tasks. Such analysis will be necessary before it can be determined whether the diversion of priorities has been beneficial.

PrePass

Automatic clearance systems, which screen trucks on the road and allow trucks that meet certain criteria to bypass enforcement stops, can increase enforcement efficiency in three ways: officers can concentrate their efforts on trucks that are more likely to be in violation; some enforcement functions are automated, reducing their cost; and the cost of enforcement to carriers who obey regulations is reduced.

The most extensive such system in the United States is PrePass, which allows certified commercial vehicles to bypass designated weigh stations and port-of-entry facilities (where states, in addition to weighing, check that trucks entering the state comply with registration, fuel tax reporting, and other state requirements). As a truck that is enrolled in the program approaches a PrePass-equipped station, a transponder in the truck communicates with a terminal at the station, and its weight is checked automatically as it traverses a weigh-in-motion installation. If the computer verifies that the truck's credentials are in order and its weight is legal, the transponder in the truck displays a green light to the driver and sounds a tone. A red light alerts the driver to pull in to the station.

The PrePass program is administered by a nonprofit corporation jointly governed by motor carriers and the states. It is funded by transaction fees paid by the participating carriers. PrePass began operation in 1995 and has 170,000 vehicles enrolled. It is deployed at 181 sites in 21 states and continues to expand (PrePass n.d.). Another multistate program, Norpass, is in operation in other states, and some states have their own independent systems.

The system's voluntary public-private structure places certain limits on its application. It is not used to collect tolls, and if a carrier found that information in such a system was causing enforcement officials to single it out for greater scrutiny, it could respond by dropping its enrollment.

PrePass is one example of a technology with broad potential applications (Orban 2000). Already, similar automatic vehicle identification technology is used for toll collection. Extended applications would require enhancement of technical capabilities, greater investment in hardware by industry and public agencies, and new organizational arrangements. Improved enforcement capabilities could actually allow carriers greater freedom of operation with respect to routes,

dimensions, and hours restrictions, because enforcement feasibility would become a lesser consideration in the design of regulatory programs.

PrePass and related systems directly affect capacity. Trucks experience less delay; therefore equipment utilization is higher and fewer trucks are on the road at any time. The technique can smooth processing bottlenecks and increase throughput at terminals. The technology allows improved management of the road system by the highway agency in a variety of ways, including more efficient use of personnel and use of more refined and effective fees and regulations.

Conclusions from the Cases

The cases all illustrate how institutional complexities pose great challenges to public officials charged with construction and management of freight facilities. They suggest some reasons for optimism that progress is being made in overcoming these challenges. Innovation in planning is being attempted; examples are the use in state transportation departments of asset management systems and performance-based planning, which emphasizes performance measurement. More widespread and effective use of these methods is to be encouraged. In addition, transportation agency awareness of freight needs appears to be increasing. However, the cases do not reveal evidence that fundamental questions about the management of public transportation programs are being examined. The cases indicate that government evaluations of projects sometimes are weak; consequently there is inadequate assurance that low-payoff projects are not being selected while high-payoff ones are being overlooked.

Evidently, local and state government transportation agencies sometimes do not have methods for evaluating trade-offs between investments yielding benefits to freight traffic and those yielding predominantly passenger benefits. Local priorities will inevitably be set through political processes involving contending advocacy groups. If freight interests become more involved in this process, priorities will be shifted. Nonetheless, more credible objective analysis of the relative benefits of competing uses of funds would have an impact on decisions. A recent DOT analysis of public funding of freight infrastructure improvements reached the same conclusion: “Planners lack data and tools that they can employ to evaluate a freight project against a non-freight project” (FHWA n.d., 5). Development of improved methods for conducting evaluations that consider options involving alternative transportation modes has recently been a priority in research sponsored by the National Cooperative Highway Research Program and by DOT.

Benefit–cost analysis is necessary for evaluating the freight/nonfreight trade-off. The project evaluations in the Florida and Washington cases included benefit–cost analysis, although the results of the analyses were not heavily weighted in setting priorities and analyses were not highlighted or explained in the most widely distributed public reports of the activities. In general, in state highway programs throughout the United States, evaluation procedures for setting project priorities usually are defined in terms of engineering criteria rather than economic criteria (Hill et al. 2000, 100).

Governments do not, in general, evaluate how alternative funding mechanisms would affect the performance of transportation programs or follow project funding practices that maximize the chance of producing successful projects. Governments often appear to favor capital-intensive solutions over operational improvements. None of the cases selected indicates government interest in reexamining the scope of public involvement in freight transportation.

A common theme in the cases is that obstacles to problem resolution, as well as poor management decisions, often arise from inadequate communication among the private sector (shippers and carriers), government transportation agencies, and general government at the federal, state, and local levels. Intergovernmental communication, as well as public-private communication, evidently is necessary for efficient project execution. Public-private communication cannot be limited to soliciting the advice of interested parties in the private sector. Market transactions also are communications, in which buyers inform producers of their willingness to pay for transportation services. Communication might also be through scientific market surveys for use in project evaluations. The Upper Mississippi case shows that the government planners, although they listened to farm groups, lacked the hard data about present and future demand that they needed to evaluate the proposed capacity expansion.

Finally, PrePass is one example of the potential of technology applications to extend the effective capacity of infrastructure. The possibilities of these kinds of techniques may be just beginning to be realized. However, their success depends on institutional and management reforms in parallel with the opportunities opened by the technology.

INDUSTRY INTERVIEWS

The committee solicited views of shippers, carriers, and port operators, through informal interviews or requests for written comments, as an additional method of identifying freight capacity problems. The interviews were not a systematically conducted survey, so inferences must be limited. Nonetheless, the responses indicate the issues important to the respondents. The responses raised three sets of issues: characteristics of existing capacity constraints, emerging trends that affect those constraints, and potential solutions to existing and emerging problems.

Labor supply was the immediate constraint most commonly identified, especially by motor carriers, who universally reported that qualified drivers are difficult to attract and keep. The interviews took place before the 2001 recession. Carriers believe they could expand sales and handle more freight if they could hire more drivers. Port operators also reported difficulties obtaining certain kinds of skilled workers and cited a need for new training programs to increase the pool of qualified workers available to the industry.

A review of the labor practices of transport personnel in the port industry was called for by a port operator. Port operators identified needs to review and revise work practices that have

outlived their original purposes, and to extend marine terminal operating hours to accommodate carriers.

With regard to physical facilities, motor carriers were aware that road capacity is not keeping pace with growth in volume. They also cited the need for more efficient road operating practices, for example, faster toll collection and measures to reduce delays for weighings.

Port operators noted that lack of available land for expansion is a concern. Respondents expect continued strong growth in trade and therefore believe that it is urgent to plan for new and larger facilities and to secure land for terminals before competing uses block the possibility of expansion.

Respondents frequently cited regulatory constraints on efficient operation and expansion. Motor carriers identified interstate variability in vehicle size and weight limits and hours of service regulations that they regard as impractical and as aggravating the driver shortage. Shippers cited customs delays at ports and at the Mexican border as a substantial inefficiency. Port operators identified environmental regulations governing disposal of dredged material as a serious constraint on capacity expansion.

The emerging trends affecting the adequacy of freight capacity that were most often mentioned mainly relate to continued change in the characteristics of freight demand. Examples are the emergence of e-business, changes in supply chain management practices (including preferences with regard to freight mode, shipment size and frequency, and procurement and inventory strategies), and shippers' increasingly exacting requirements for reliability and speed. One respondent noted that higher energy prices may profoundly affect the market in the future.

Taken as a whole, the responses illustrate forcefully that physical plant is not the only potential capacity constraint on the freight transportation system. Short-run constraints are more likely to be equipment or labor shortages than shortages of road space or trackage. Reported labor supply concerns presumably reflect upward pressure on the wages that operators must pay to attract qualified employees. Labor and equipment supply are primarily short-run problems that carriers, suppliers, and workers can resolve in the private market. However, public policy concerning education, regulation of workplace conditions, immigration, and rights of foreign carriers to enter the United States will be important for the long-term labor outlook.

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Abbreviations

| | |
|--------|--|
| AAPA | American Association of Port Authorities |
| AAR | Association of American Railroads |
| AASHTO | American Association of State Highway and Transportation Officials |
| ATA | American Trucking Associations |
| BEA | Bureau of Economic Analysis |

| | |
|-------|--|
| BLS | Bureau of Labor Statistics |
| BTS | Bureau of Transportation Statistics |
| CUTR | Center for Urban Transportation Research |
| DOT | U.S. Department of Transportation |
| EIA | Energy Information Administration |
| FAA | Federal Aviation Administration |
| FDOT | Florida Department of Transportation |
| FHWA | Federal Highway Administration |
| GAO | U.S. General Accounting Office |
| MARAD | Maritime Administration |
| NRC | National Research Council |
| PSRC | Puget Sound Regional Council |
| SCAG | Southern California Association of Governments |
| TRB | Transportation Research Board |
| TTI | Texas Transportation Institute |
| USACE | U.S. Army Corps of Engineers |
| VDOT | Virginia Department of Transportation |

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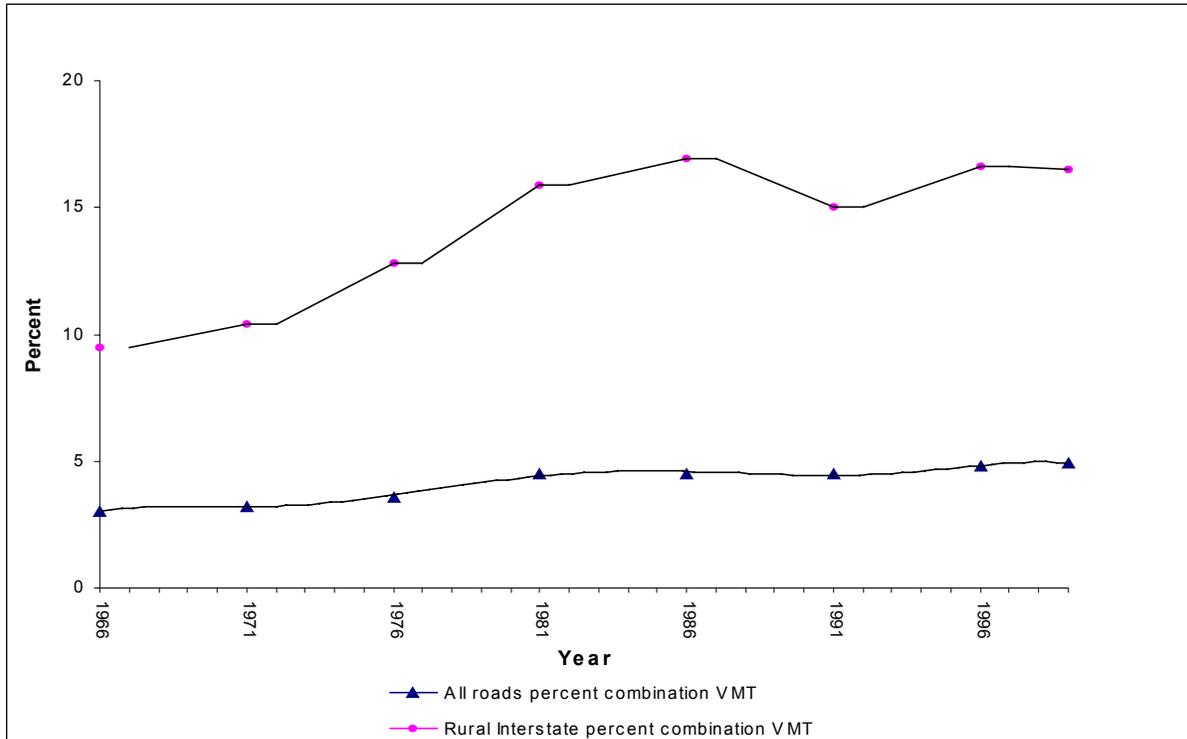
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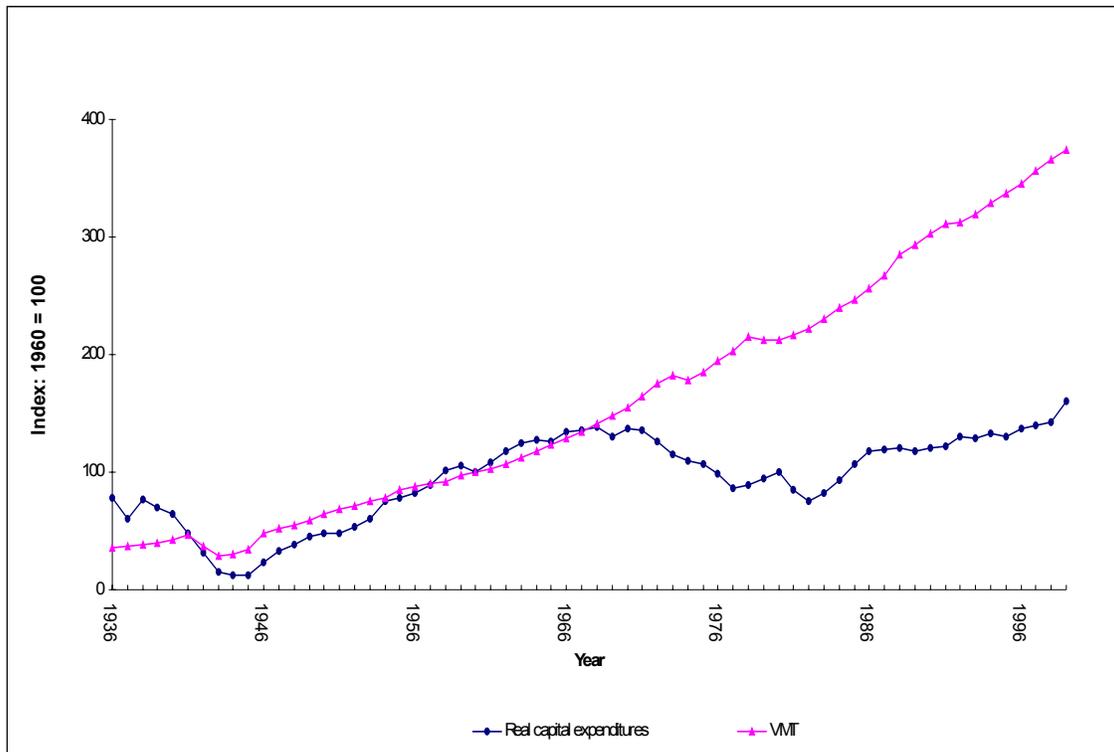
TABLE 3-1 TTI Project Priority Weighting Criteria (TTI 2000)

| Goal | Weight | Objective | Measure | |
|-------------------------------------|---------------|------------------|---------------------------|--|
| General Mobility | 25 | 10 | Potential to Reduce Delay | % Daily Impedance * ADT |
| | | 7 | Queue Length | vphpl * s/cycle/3600 |
| | | 8 | Cross-corridor Arterial | 1 = Major Cross-corridor Arterial 0 = Otherwise |
| Freight and Rail Mobility | 15 | 8 | Truck Trips | % Truck Use * ADT |
| | | 7 | Mainline Benefit | 3 = Moderate 2 = Minimal 1 = Negligible |
| Safety | 15 | 8 | Intersection Safety | 5 year FRA Accident History |
| | | 7 | Emergency Vehicle Access | 1 = Essential Access Route 0 = Otherwise |
| Community and Environmental Impacts | 25 | 5 | Public Support | Self-rated 1 - 5 scale, 5 = High, 1 = Low |
| | | 5 | Residences Displaced | Number of Displacements |
| | | 5 | Businesses Displaced | Number of Displacements |
| | | 5 | Strategic Economic Value | Self-rated 1 - 5 scale, 5 = High, 1 = Low |
| | | 5 | Emissions Reduced | Attainment Area = 1x Delay Non-attainment area = 1.5x Delay |
| Cost Effectiveness | 20 | 20 | Cost Effectiveness | Potential delay / Project Cost |



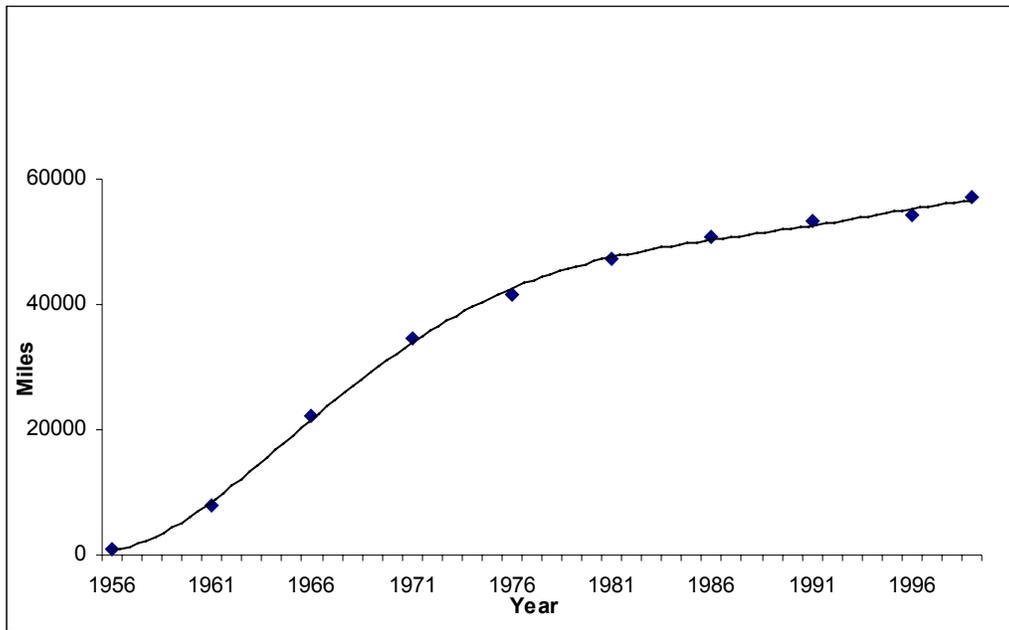
Source: FHWA, 1987-2000.

FIGURE 3-1 Combination Truck Share of Traffic



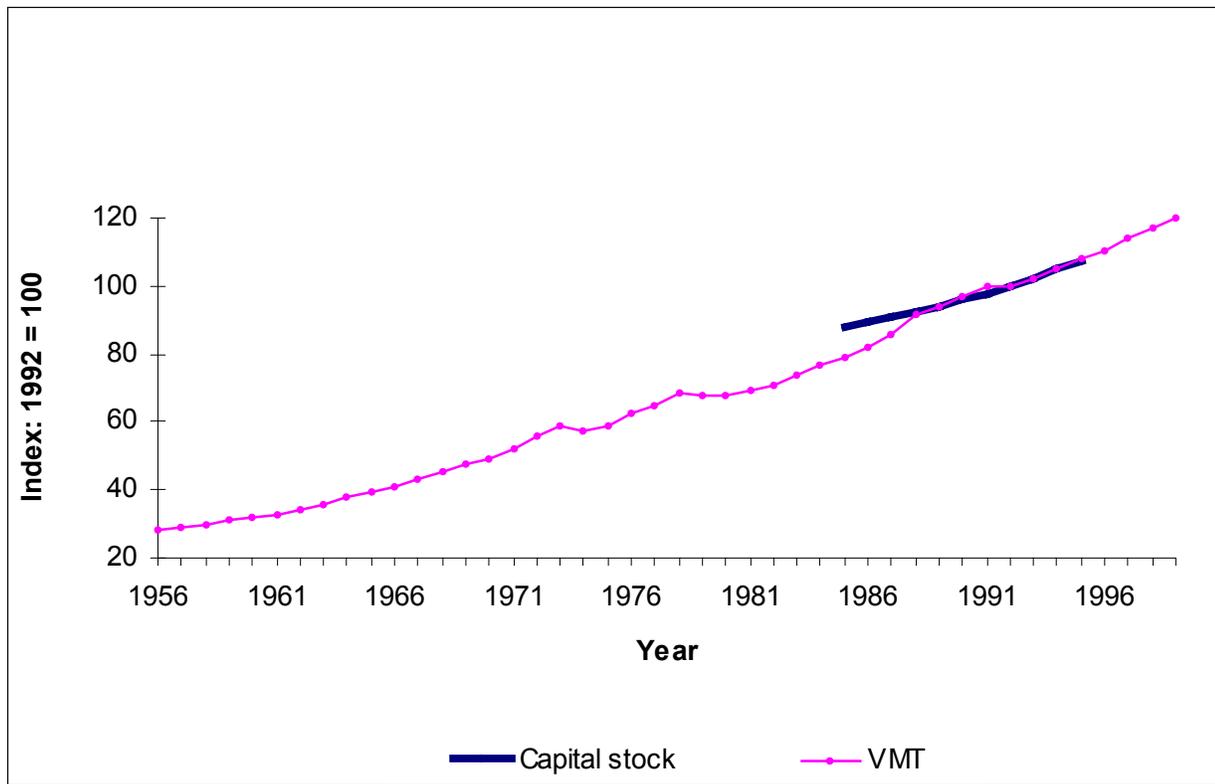
Sources: FHWA, 1987-2000; BEA 1998, 159; BEA 2000, 132.

FIGURE 3-2 Highway Capital Expenditures and Vehicle-Miles Traveled



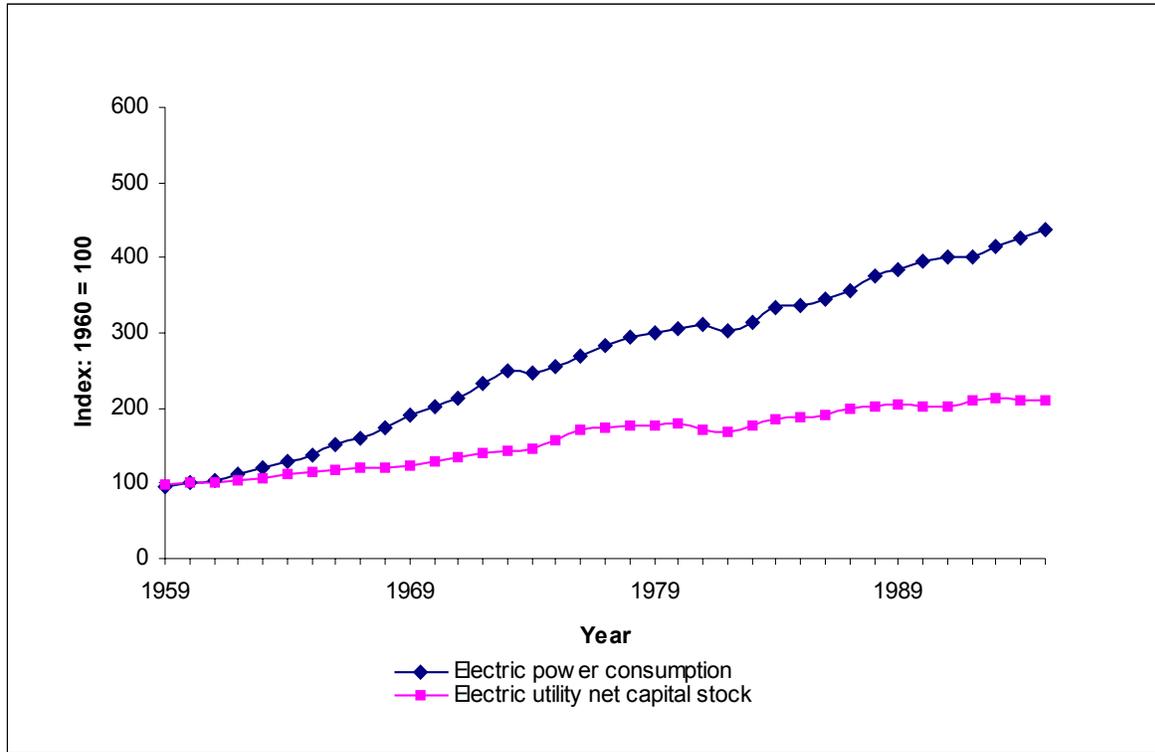
Source: FHWA 1987-2000.

FIGURE 3-3 Miles of Limited Access Divided Highway



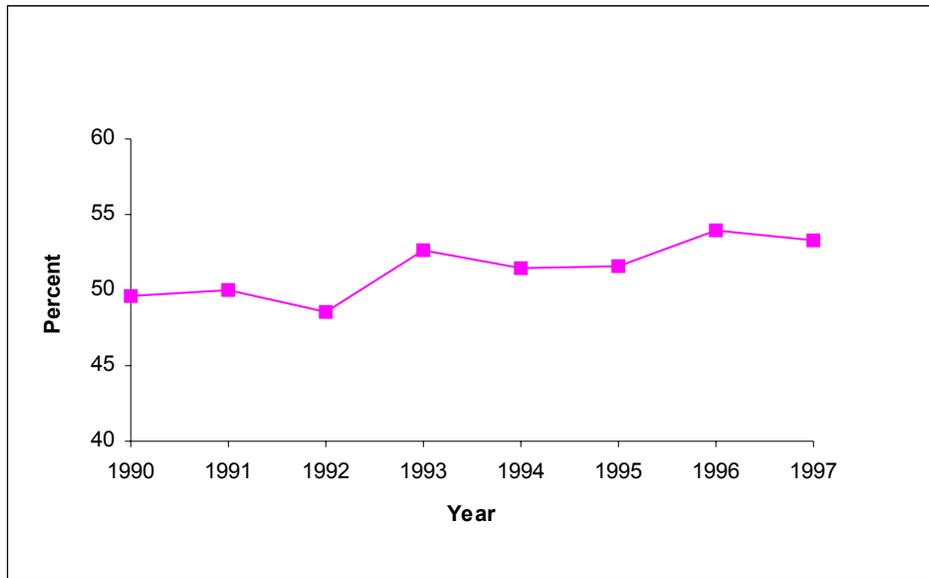
Sources: FHWA 1987-2000, BEA 1997.

FIGURE 3-4 Net Capital Stock of Highways and Streets; Annual Vehicle-Miles



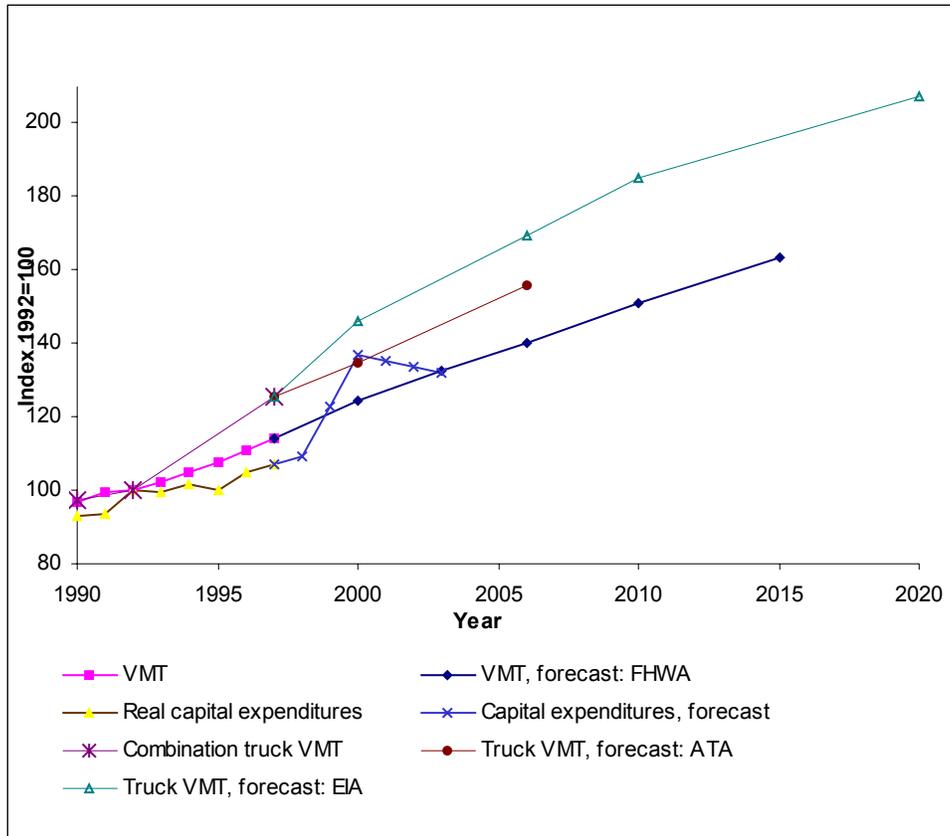
Sources: BEA 1997, EIA _____.

FIGURE 3-5 Electric Power Consumption and Utility Capital Stock



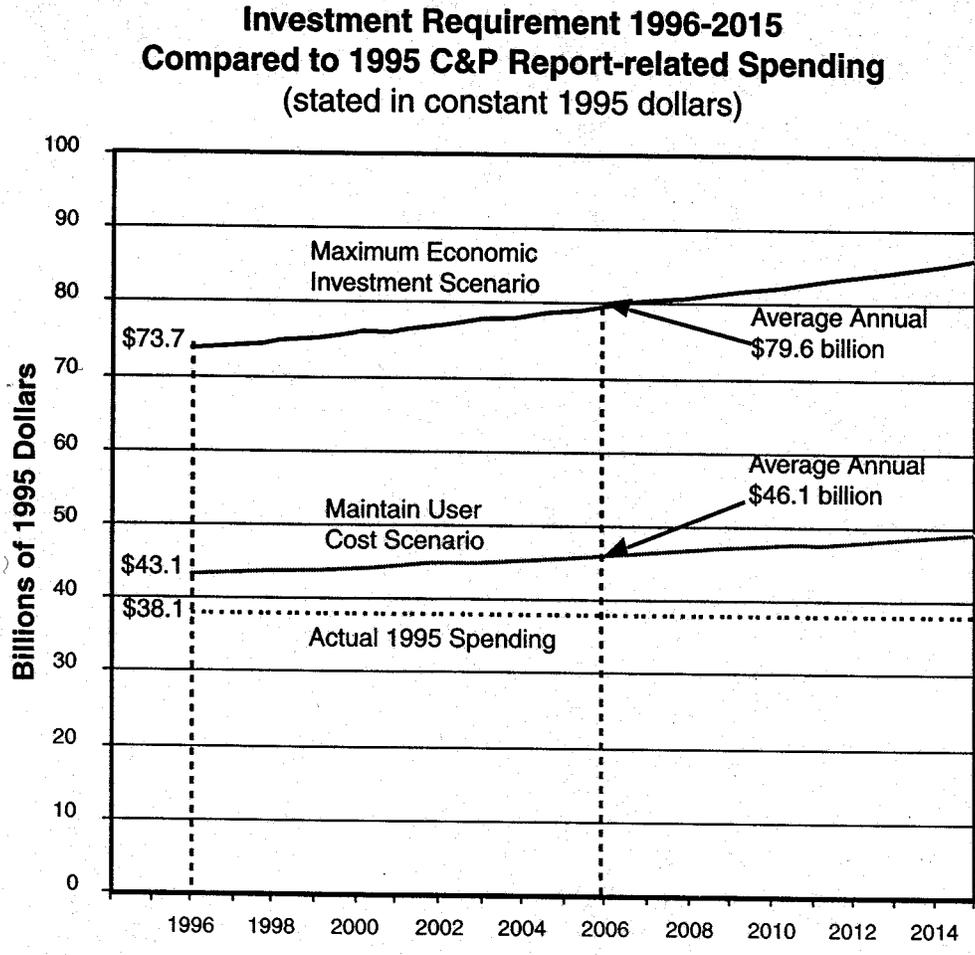
Sources: FHWA 1997b; FHWA 2000, Exhibit 45.

FIGURE 3-6 Percent of Peak Hour Travel that Occurs Under Congested Conditions, Urban Interstates



Sources: FHWA 1991-2000
 VMT, forecast: FHWA: FHWA, _____
 Real capital expenditures: FHWA 1991-2000; (deflator) BEA, ____
 Combination truck VMT: FHWA 1991-2000
 Truck VMT forecast, ATA: ATA 2000
 Truck VMT forecast, EIS: EIA, ____

FIGURE 3-7 Forecasts: VMT, Combination VMT, Capital Expenditures



Source: FHWA 1997a

FIGURE 3-8 Investment Requirement 1996–2015 Compared to 1995 C&P Report-related Spending (stated in constant 1995 dollars)

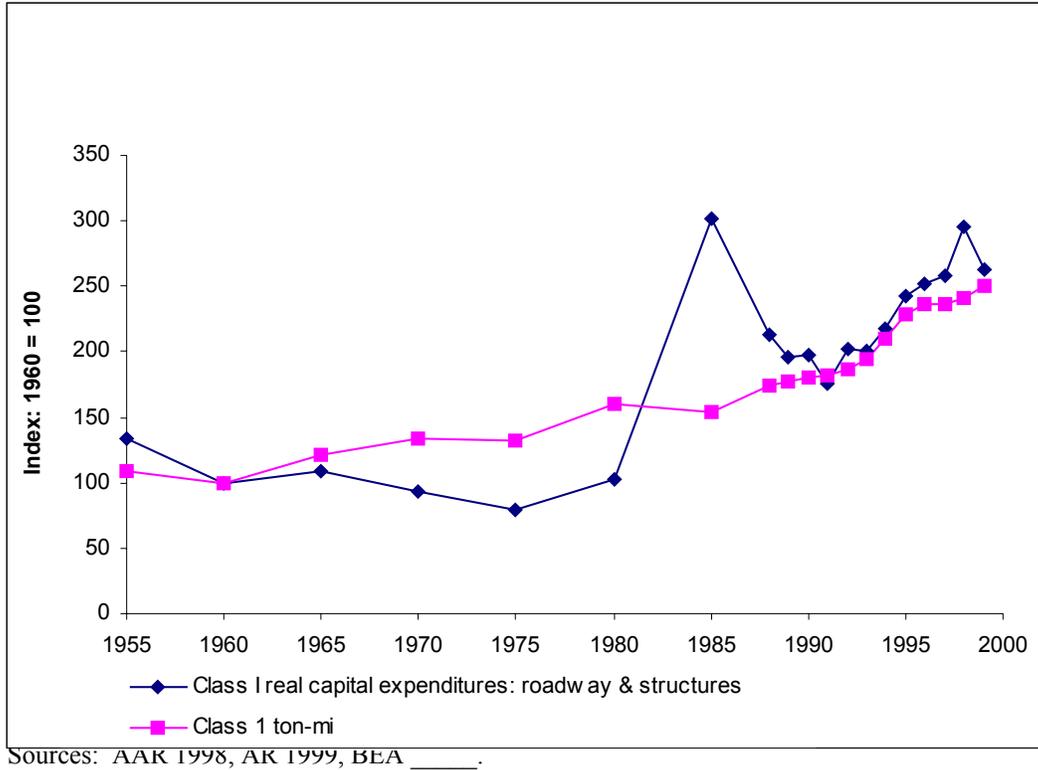
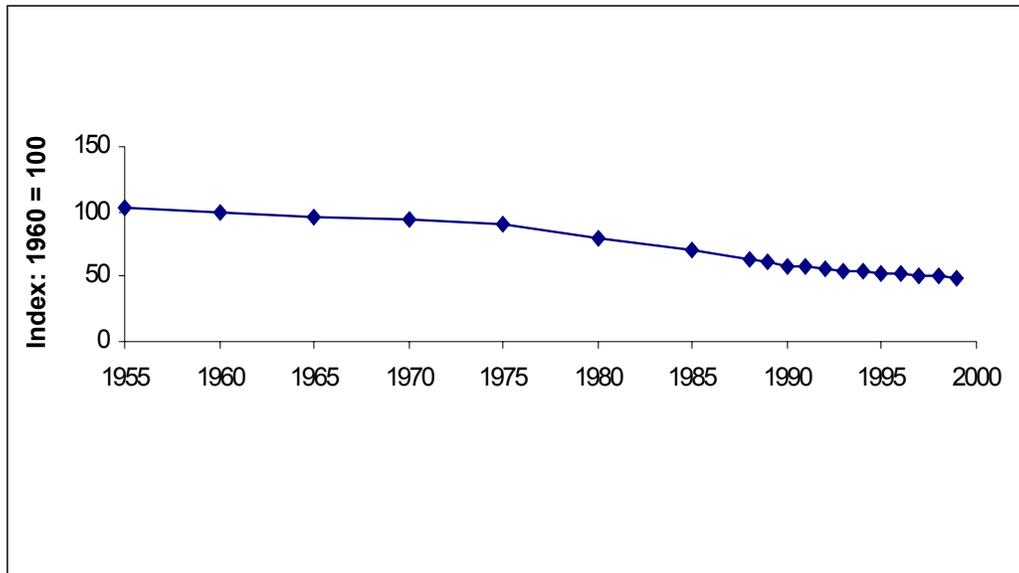
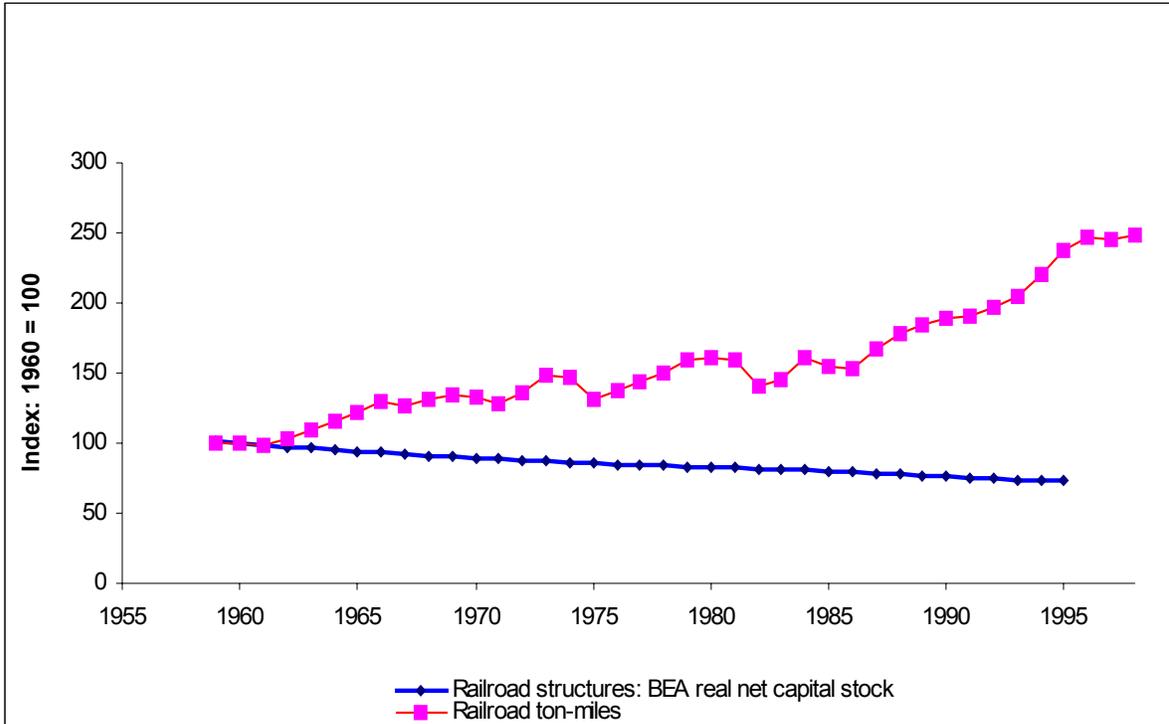


FIGURE 3-9 Class I Railroad Roadway and Structures Capital Expenditures and Ton-Miles



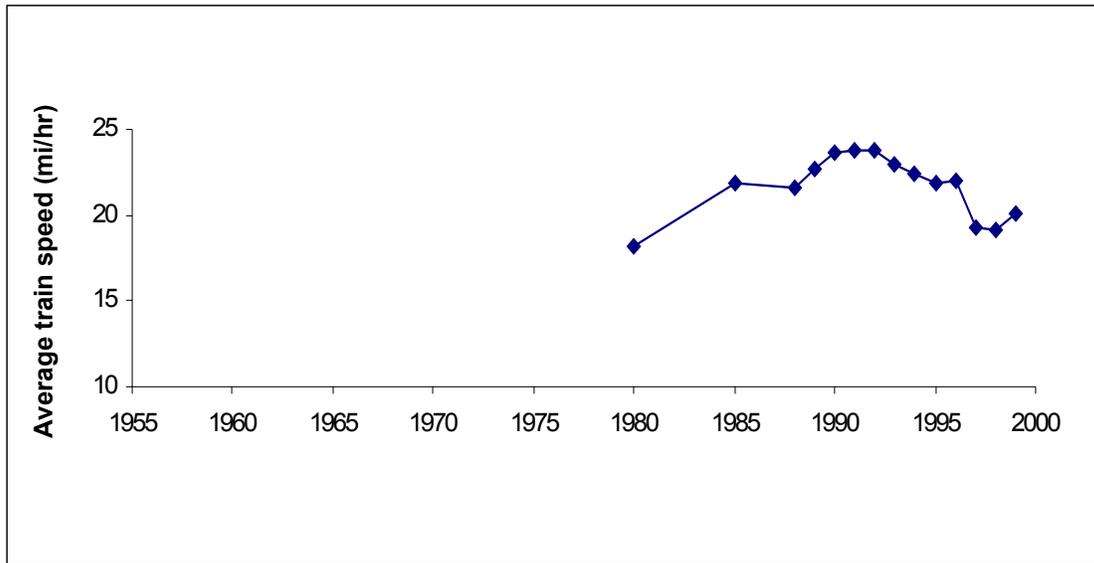
Sources: AAR 1998, AAR 1999.

FIGURE 3-10 Track Miles Owned, Class I Railroads



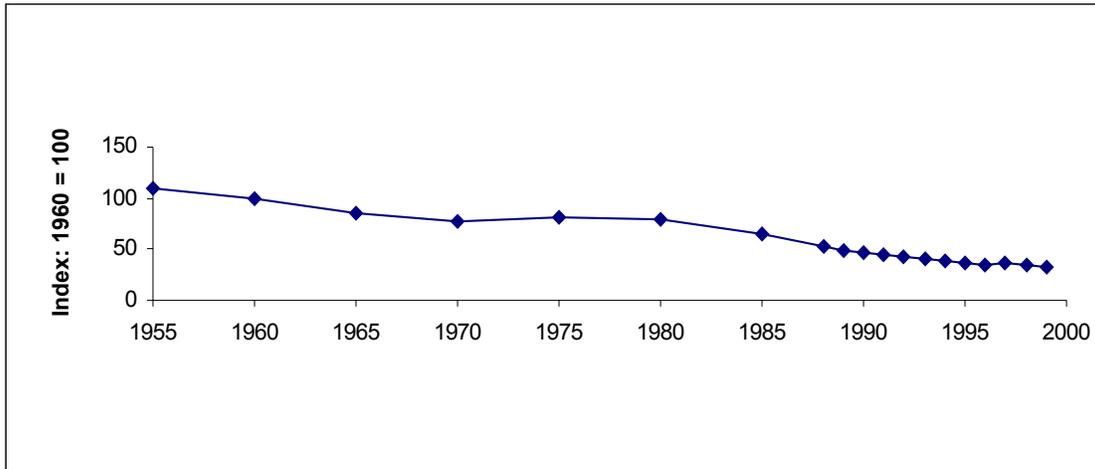
Sources: BEA 1997, Wilson 2001.

FIGURE 3-11 Railroad Structures Net Capital Stock and Ton-Miles (All Railroads)



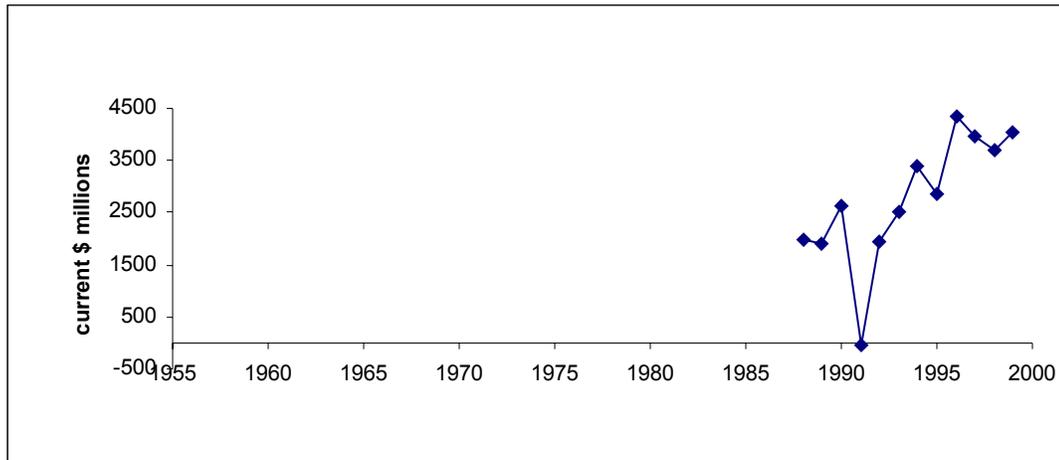
Sources: AAR 1998, 37, 38; AAR 1999, 37, 38.

FIGURE 3-12 Average Train Speed, Class I Railroads



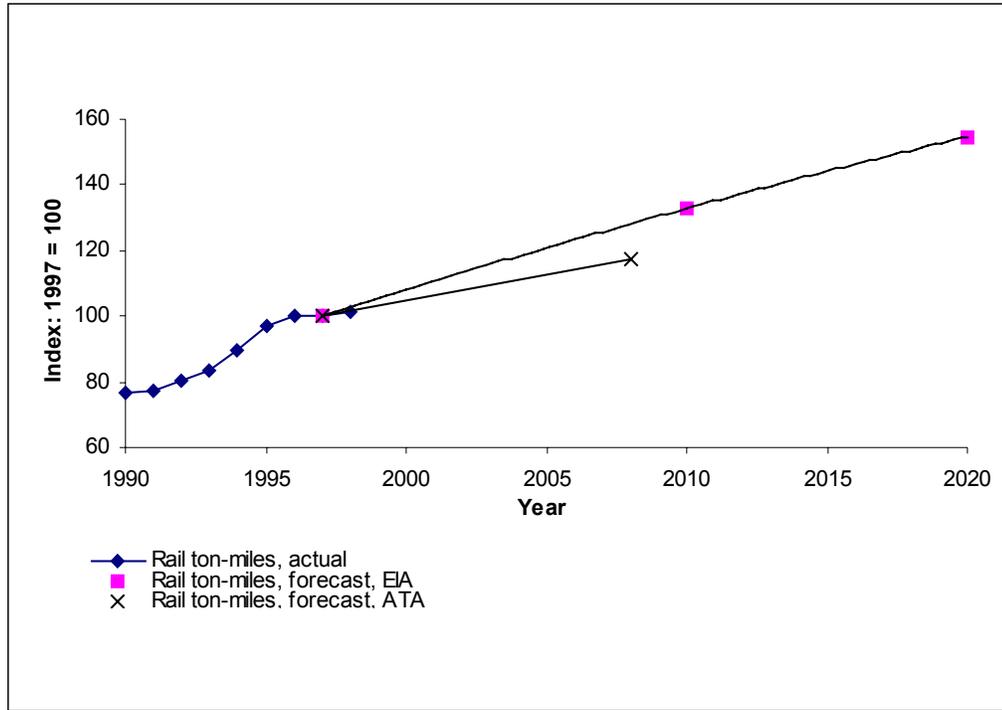
Source: AAR 1999.

FIGURE 3-13 Average Revenue per Ton-Mi, Class I Railroads (constant dollars)



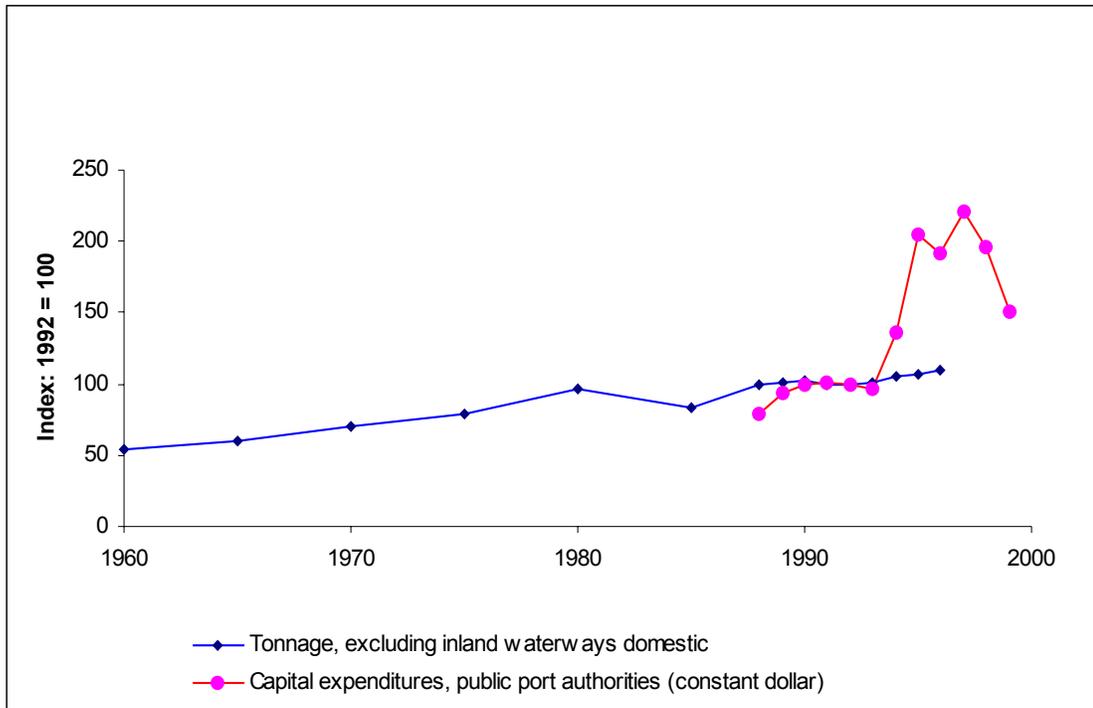
Source: AAR 1999.

FIGURE 3-14 Net Railway Operating Income, Class I Railroads



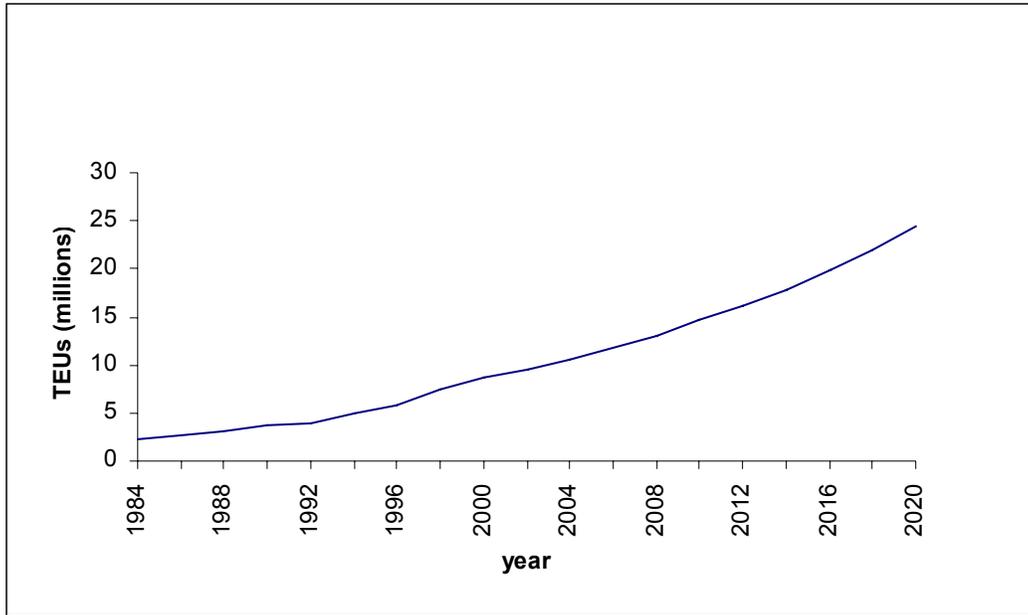
Sources: ATA 2000, 19; EIA 2000, 138; Wilson 2001.

FIGURE 3-15 Railroad Ton-Mile Forecasts



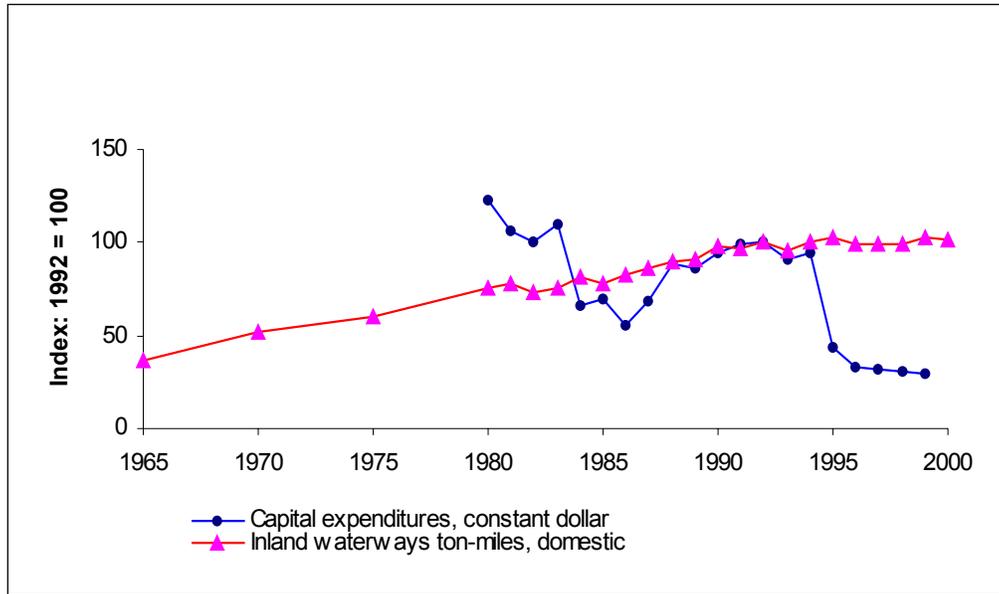
Sources: U.S. Maritime Administration 1990-1997, U.S. Maritime Administration 2000, BEA ____.

FIGURE 3-16 U.S. Port Authority Capital Expenditures and Waterborne Commerce Tonnage



1994-1998 historical; 1999-2020 projected. Source: SCAG 2000.

FIGURE 3-17 Container Volume, Ports of Los Angeles and Long Beach



Sources: USACE 1997, Table 4-1; USACE 2001, Table 1-9; USACE 2002, 12; BEA 2001, 121; Wilson 2001, 12.

FIGURE 3-18 Inland Waterways: Federal Government Capital Expenditures and Ton-Miles

Chapter 4

Conclusions and Recommendations

TRB's Committee for the Study of Freight Capacity for the Next Century was convened to examine indications that the freight transportation sector, which has in recent decades facilitated productivity growth, instead threatens to become a hindrance to the economy. Participants in the industry have noted that in some segments investment in capacity is not growing at the same rate as traffic, shifts in freight patterns related to structural changes in the economy are creating bottlenecks that degrade performance, and adding capacity is becoming more expensive and difficult.

The committee undertook two tasks: first, to examine the trends in the freight transportation sector that have been the sources of concern in order to determine whether they indicate a risk that the efficiency gains of recent decades might not continue; and second, to propose changes in government policy that will increase capacity by enhancing the efficiency of freight transportation and promoting more rational investment, especially over the long term. Government in the United States builds and operates major components of freight system infrastructure and regulates private-sector transportation firms.

In the two sections below, the committee's conclusions are summarized and its policy recommendations are presented. The conclusions and recommendations are addressed to federal and state government legislators and administrators, private-sector executives and industry associations, and the public. Significant change in the public sector's approach to provision and management of freight capacity would require legislation, which could only come about with the demand and support of industry, the public, and transportation professionals.

CONCLUSIONS

The committee relied on four kinds of information:

- Data on national trends in freight traffic volumes, extent of freight infrastructure, capital spending, and freight system performance;
- Case studies examining specific freight projects and planning efforts;
- Interviews with participants in the freight transportation industries; and
- Assessments of recent studies of related transportation questions by the federal government, NRC, industry groups, and others.

As described in the following subsections, these sources offer complementary perspectives. The aggregate trends provide an overview of the prospects for development of freight capacity in the coming decades, if fundamental policies and economic conditions continue as in the past. The cases studies and the interviews indicate how institutional and management factors affect the

response of freight capacity to changes in demand. Finally, the review of policy studies suggests alternatives for changes in government practices to improve freight system performance.

Prospects for Freight Capacity

The committee organized its examination of freight capacity trends in seven topical areas: highway trends; railroad industry trends; problems related to congestion at freight terminals and border crossings; the long lead times and rising costs of infrastructure projects; trends in congestion in urban areas, especially on facilities shared by passengers and freight; trends in other freight modes; and underlying trends in productivity, finance, and technology.

Taken together, the trends have indicated to many observers a pattern of unprecedented tight capacity in certain parts of the freight transportation system, expected continued growth of traffic, and slowing of the rate of addition of capacity in response to various external constraints. Concern has been magnified by extrapolating the trends: in the next two decades, the nation's total output of goods and services probably will increase by 70 percent, highway travel and all domestic freight traffic will increase by about 40 percent, and international container traffic may more than double. The strong economic growth of the 1990s and the resulting traffic growth placed exceptional demands on the transportation system and accentuated its weaknesses. In making decisions about transportation capacity it is important to distinguish long-run trends from cyclical peaks in traffic. The economic performance of the 1990s may not represent the trend of the next several decades; nonetheless, even sustained, modest growth will bring about deteriorating performance if freight capacity is allowed to stagnate.

The committee's task was to consider the implications of historical developments for freight system capacity and performance in the long run and the need for public-sector responses. The evidence appears to be consistent with the following assessment and qualitative predictions about developments over the next few decades.

First, without diminishing the legitimacy of concerns about capacity, to obtain a balanced view it must be recognized that certain trends have positive implications. On the highway system, demographic trends, in particular the slowing of the rate of labor force growth compared with the 1970s and 1980s, will moderate the traffic growth rate compared with the recent past (Pisarski 1999). The evidence is mixed on how much average highway trip times are actually increasing; apparently highway users' behavior changes are partially offsetting the effect of increased traffic density. Part of the trend toward greater traffic density in all modes reflects productivity improvement, a positive rather than a harmful development.

Furthermore, capacity is being added. For highways, recent additions more often take the forms of widening, alignment improvements, improvements in signal systems and other traffic management methods, and intersection improvements than construction of new routes. Although inflation-adjusted highway capital spending is today only moderately above the peak levels of the 1960s, spending has grown steadily over the past decade as a result of increased federal funding in the Transportation Equity Act for the 21st Century (TEA-21) and state efforts.

Overall, highway capital stock is being added faster than it is wearing out (although this circumstance does not demonstrate that the rate of growth is optimal).

Railroads and ports report ambitious infrastructure spending plans as well, although it is uncertain how much of planned spending will occur. Market developments, including future international trade patterns and global patterns of commodities production and consumption, will determine the future scale of the U.S. rail industry and which transport markets it will serve. It appears possible that the rail industry trend of consolidation and network rationalization will continue. An important uncertainty about future port development in the United States is where capacity will be added, that is, which ports and regions in the United States and neighboring countries will attract the expansions that will be needed to handle trade growth.

Congestion in the freight transportation system remains localized; it is not severe in all urban areas and as yet affects only small parts of the rural Interstate highway system and of the intercity links of the other modes. However, congestion at a bottleneck can have severe systemwide repercussions, as recent episodes in the aviation and rail systems have demonstrated. The growth of international trade may be exacerbating the bottleneck problem by concentrating freight traffic at a small number of nodes, including certain ports and border crossings, which are experiencing traffic growth rates much higher than those of the freight system as a whole.

The development of freight transportation throughout the past century has been characterized by increasing efficiency coupled with increasing diversity and sophistication of service offerings to provide greater utility to customers. The most important sources of productivity growth have differed in different time periods; they have included a combination of continuous incremental processes of capital accumulation and technological refinement, together with occasional major breakthroughs. Breakthroughs have been both technological—the revolutionary changes embodied in vehicles, infrastructure, and information systems—and institutional, in particular, turning points in government involvement with transportation. Two such turning points in the past half century were the federal commitment to the Interstate highway system and reform of the regulations governing trucking, railroads, aviation, and shipping.

Major boosts to productivity of this sort probably will occur again. Speculative projections the committee reviewed suggest that improvement in vehicle and infrastructure technology will continue to be important. Fully automated transportation systems may eventually appear. New technology will reduce pollutant emissions and increase energy efficiency. Possibly most important will be information technology applications that improve coordination and scheduling of transport operations (Meyer 1997; Pisarski 1999). In the administration of public-sector transportation systems, ample opportunities exist for reforms in management, operations, finance, and pricing that could yield dramatic gains in efficiency.

The trends show evidence of the emergence of social and political forces that will influence freight transportation development in new ways in the next decades. Increasing population density, urbanization, and wealth ensure that conflicts between freight and passenger traffic; conflicts between freight transportation and residential, recreational, and other competing

land uses; and requirements to control pollution will increase. These forces will tend to increase the cost of expanding capacity and add to the risk of investment.

As congestion worsens, demand for increased public spending will appear. The United States has ample resources for expanding the transportation system; in most regions, the densities of population, employment, transportation networks, and traffic are low in comparison with the Northeast or with western Europe.

If capacity addition does lag traffic growth and congestion worsens, as seems likely, the long-run consequence will not be massive breakdown. Freight markets have self-correcting capabilities. Users will make numerous adjustments over time to accommodate or avoid congestion. Shippers will change logistics practices, for example, by shipping more in bulk and holding larger inventories than they would if freight transport were cheaper. From a close-up perspective, these long-term repercussions of congestion may not be evident. One of the most important such coping mechanisms will be changes in land use and in the location of activities: workplaces and residences will move away from congestion within metropolitan areas and from more-congested to less-congested regions within the United States. Such adjustment has been the most important means of accommodating growth throughout U.S. history. Congestion will be a constraint on the growth of some urban areas. Some production will move from the United States to other countries if congestion costs cause the United States to lose comparative advantage in some industries.

Therefore, one plausible course of development is that the nation will continue to accommodate growing freight traffic volumes by increasing capital spending on infrastructure, accepting more congestion, altering production and logistics practices, and moving away from the most congested locations. This resolution might be tolerable, but will certainly be far from the economic optimum, for two reasons. First, the available capacity will continue to be used poorly on those parts of the system where users do not pay prices that reflect costs and where operators lack incentives to be responsive to user costs and preferences. Second, obstacles exist to effective targeting of capital expenditures, particularly in the public sector. Public capital spending will dissipate much of its impact because some high-payoff projects are passed by and some low-payoff ones are carried out. Private-sector capital expenditure may not be efficient if a suboptimally small number of firms dominate a market, hindering competition.

The potential future costs of delay and other direct consequences of congestion can be estimated, but other costs of this “business-as-usual” scenario—for example, the costs of distortion of land use and regional development patterns—are difficult to observe or predict. Changes in government policy that would allow the nation to make better use of existing capacity and investment decisions, compared with this scenario, would have important economic benefits.

Institutional and Management Factors

Aggregate trend data are insufficient as indicators of the adequacy of capacity because constraints in transportation systems generally are localized in time and space. The average link

at an average time period may be operating well below capacity even if the performance of the system as a whole is hampered at bottlenecks during peak periods. In addition, understanding the determinants of performance requires examining institutional arrangements and management practices as well as physical conditions. Therefore the committee examined individual system components as case studies to provide a more concrete understanding of freight supply problems and the institutional setting of project-level decision making. In addition, the committee solicited the views of freight industry executives in a series of informal interviews and inquiries.

The five cases were the FAST (Freight Action Strategy) Corridor port access project in the state of Washington; the Florida Freight Stakeholders Task Force, a public-private body charged with advising the Florida Department of Transportation on its intermodal facilities improvements program; Virginia's 20-year plan for expanding capacity on I-81, a major truck corridor; the U.S. Army Corps of Engineers' plan for expanding lock capacity on the Upper Mississippi River; and PrePass, a public-private system to automate certain trucking regulatory enforcement functions. The Virginia and Mississippi River cases each involve efforts of a government agency to expand capacity on a mainline route that it operates. The Florida and Washington cases are efforts to foster public-private cooperation in identifying and resolving terminal access problems in local areas. Although the case studies alone cannot provide sufficient evidence to support definite conclusions about the obstacles to efficient supply of freight capacity, they do suggest hypotheses that are worthy of consideration.

FAST Corridor; Florida Freight Task Force

The FAST Corridor is a \$470 million project of the Washington State Department of Transportation, the state's ports, the Puget Sound Regional Council, cities of the region, and the railroads to improve access to the ports and reduce freight-passenger conflicts, primarily through construction of rail grade separations. The Florida Freight Stakeholders Task Force was a public-private body charged with advising the state department of transportation on its intermodal facilities improvements program. The task force developed a method of setting project priorities that incorporates freight-related benefits into project evaluations; recommended a program of improvements, including terminal access roads and a rail access line; and recommended new mechanisms for freight project funding and private-sector input to local government decisions on transportation capital expenditures.

Past policy studies, including the report of the National Commission on Intermodal Transportation, have asserted that local and state governments do not assign sufficiently high priority to projects important for freight mobility. Four causes for this failure are cited: first, government officials do not understand the needs of freight transportation; second, needed projects are ineligible for funding under the rules of established federal grant programs; third, projects are institutionally complex, involving multiple transport modes and multiple jurisdictions as well as private industries; and finally, certain important freight-related projects that benefit the nation as a whole fail to receive necessary local support because of negative local impacts. These studies have proposed that if local governments did the right kind of freight planning, incorporating formal arrangements for receiving opinions from local freight carriers and shippers, they would find the high-payoff freight projects they are now missing.

FAST and the Florida task force both were experiments aimed at developing procedures and institutional arrangements to overcome these perceived problems in carrying out local freight projects. Both efforts targeted freight-related improvements, recruited participation of industry and all affected jurisdictions in project selection, and gained commitments from the public agencies controlling funds to support their chosen improvements.

One of the justifications for initiating both the Washington and Florida programs was that prior project selection practices in these locations had overlooked high-payoff freight-related projects; the new planning and coordination procedures could bring recognition and resources to such projects. The case studies could not confirm that the two programs improved the states' returns on their transportation investments in this way. This is not to say that worthwhile freight projects are never overlooked. However, governments do not evaluate transportation investment projects in a manner that allows comparison of benefits from improved freight mobility with benefits from improved passenger mobility. Therefore, while input from freight interests may have changed government investment priorities in these two cases, the governments involved do not know whether the projects displaced would have yielded a higher or lower payoff than the freight-related capital projects that were moved ahead of them. Both programs began with the presumption that additional resources were to be devoted to freight-related projects, so evaluation of freight projects versus competing transportation projects was not regarded as a relevant issue in either case. It is conceivable that the priorities assigned by transportation planners following traditional project programming methods (i.e., considering primarily passenger mobility benefits) have been correct. That is, in urban areas where budgets are tight and many worthwhile projects go unfunded, freight projects that do not also yield high passenger benefits may rarely merit high priority.

A second reason these cases did not document that governments are overlooking high-payoff projects is that most government transportation expenditure is for roads, and most road projects that yield large benefits for passenger traffic also yield substantial freight traffic benefits. In the case studies, the bodies responsible for deciding capital program priorities appeared to be struggling to identify high-priority freight projects within the state and local governments' spheres of responsibility that were distinct from projects that would have been programmed under established prioritizing procedures.

These cases suggest that governments often fail to recognize and take advantage of the link between project finance and performance. For example, the Seattle FAST project is financed primarily by state and local funds and by federal aid that could be used for other purposes within the state if it were not devoted to this project. The largest benefit of the project is mitigation of congestion, nuisance, and accident costs imposed by port rail traffic on local residents. This financing arrangement is the result of the long-established legal assignment of responsibility for rail grade crossings to the road agency rather than to the railroad; nonetheless, its implications for fairness and economic efficiency should be examined. Reliance on public funding to mitigate spillovers means that railroads and ports do not fully take into account the public costs of their decisions to expand facilities. It is noteworthy that the Alameda Corridor rail port access project in Los Angeles plans, in contrast to FAST, to derive the majority of its funding from fees charged to the railroads and from port user fee revenues.

Public expenditures to mitigate harmful side effects of freight traffic growth may well stimulate local residents to ask whether it is really in their best interests to host the freight facilities, considering the negative spillovers, demands for public subsidies, and the facilities' occupancy of valuable urban property.

I-81; Upper Mississippi River Locks

Interstate 81 in Virginia is a major truck route but carries relatively moderate automobile traffic. The state has a plan for several billion dollars in improvements to the highway in the next 20 years to accommodate expected traffic growth. The state is considering construction of exclusive truck lanes as part of the project. The Norfolk Southern Railroad has a parallel route on which it believes there is potential for growth of container traffic. There may be a connection between the level of state investment in upgrading I-81 and the railroad's willingness to invest in building up rail service.

The U.S. Army Corps of Engineers conducted a controversial study evaluating proposals for construction of lock extensions on the Upper Mississippi River to allow faster lock traversals of barges and relieve congestion. Critics asserted that the Corps overestimated shipper benefits from the expansion, improperly evaluated environmental costs, and dismissed traffic control measures and congestion pricing as alternatives to capacity expansion.

Both these cases suggest that some government transportation agencies do not routinely consider facility management alternatives to physical expansion as means to increase effective capacity. The cases show that transportation agencies sometimes lack data and proper models for comparing the benefits and costs of all alternatives, including management alternatives. Moreover, the agencies sometimes do not recognize the potential value of such alternatives. The cases and other evidence also indicate that some public agencies have recognized these deficiencies and have made progress toward correcting them.

The Virginia case highlights the question of the extent to which intermodal rail is an alternative to highway expansion to handle freight traffic growth. The only valid argument for a state policy directly promoting rail intermodal development as an alternative to highway expansion would be that truck user fees are less than the full cost of their use of I-81. The state policy in this circumstance that would promote the greatest efficiency in freight transportation would be to charge trucks appropriate fees. It probably would be possible under the innovative finance provisions of TEA-21 to institute tolls on the expanded highway for this purpose.

Conclusions from the Cases

The cases all illustrate how institutional complexities pose great challenges to public officials charged with construction and management of freight facilities. There are some reasons for optimism that progress is being made in overcoming these challenges: improved planning methods are being applied and transportation agency awareness of freight needs appears to be increasing.

However, government evaluations of projects sometimes are not broadly conceived, do not employ proper analytical techniques, or are not subjected to expert review. Consequently there is inadequate assurance that low-payoff projects are not being selected or that high-payoff ones are not being overlooked. Public agencies in general do not evaluate how alternative funding mechanisms or user fee arrangements would affect the performance of transportation programs, and they do not follow project funding practices that maximize the chance of producing successful projects. They sometimes appear to favor capital-intensive solutions over operational improvements.

The case studies did not document systematic misallocation in government investment decisions in favor of projects primarily serving passengers over projects of particular importance to freight because the project evaluation methods governments used in the cases did not compare returns from the freight-related projects that were selected for funding with returns from alternative transportation uses of the funds. They do illustrate that freight capacity problems in those parts of the transportation system for which government is responsible often are simultaneously passenger transport capacity problems. Solutions to freight and passenger capacity problems may often be complementary.

Repeatedly, the case studies as well as the aggregate trends indicate how capacity problems often originate in operating practices that are not optimal. The cases suggest that solutions to capacity problems typically involve a mix of operational improvements and physical expansion and are facilitated by cooperative institutional arrangements between the public and private sectors and among jurisdictions. However, as physical expansion becomes more expensive, the necessity of optimizing operations will become more important than ever.

A common theme in the cases is that obstacles to problem resolution, as well as poor management decisions, often arise from inadequate communication among the private sector (shippers and carriers), government transportation agencies, and other government bodies at the federal, state, and local levels. Intergovernmental communication, as well as public-private communication, evidently is necessary for efficient project execution. Public-private communication cannot be limited to soliciting the advice of interested private-sector parties. Market transactions also are communications, in which buyers inform producers of their willingness to pay for transportation services. Communication can also be through scientific market surveys for use in project evaluations.

Industry Interviews

The committee solicited views of shippers, carriers, and port operators, through informal interviews or requests for written comments, as an additional method of identifying freight capacity problems. The interviews were not a systematically conducted survey, so inferences must be limited. The responses revealed three sets of issues important to the respondents: sources of present capacity constraints, emerging trends that affect those constraints, and potential solutions to existing and emerging problems.

Labor shortage was the immediate constraint most commonly identified, especially by motor carriers. Port operators also reported shortages of certain kinds of skilled workers. The interviews were conducted before the 2001 recession. Port operators also identified needs to review and revise work practices that have outlived their original purposes, and to extend marine terminal operating hours to accommodate carriers.

With regard to physical facilities, motor carriers believe that road capacity is not keeping pace with growth in volume and cited the need for more efficient road operating practices. Port operators noted that lack of available land for expansion is a concern. Respondents frequently cited regulatory constraints on efficient operation and expansion. Motor carriers identified interstate variability in regulations as a source of inefficiency. Shippers cited customs delays. Port operators identified environmental regulations governing disposal of dredged material as a constraint on expansion.

The emerging trends affecting the adequacy of freight capacity that were most often mentioned mainly relate to continued change in the characteristics of freight demand, for example, the emergence of e-business, changes in supply chain management practices (including preferences with regard to freight mode, shipment size and frequency, and procurement and inventory strategies), and shippers' increasingly exacting requirements for reliability and speed.

Taken as a whole, the responses illustrate forcefully that physical plant is not the only potential capacity constraint on the freight transportation system. Short-run constraints are more likely to be equipment or labor shortages than shortages of road space or trackage. Labor and equipment supply are problems that carriers, suppliers, and workers can resolve in the private market. However, public policy with regard to education, regulation of workplace conditions, immigration, and rights of foreign carriers to enter the United States will be important for the long-term labor outlook.

Policy Alternatives

The committee took advantage of several recent studies by nationally prominent groups that analyzed public policy problems related to provision of freight capacity and recommended changes in government policy. These include NRC studies on public policy for intermodal freight transportation, port landside access, and Mississippi River navigation; the 1994 congressionally mandated report of the National Commission on Intermodal Freight Transportation; and studies and statements of the U.S. Department of Transportation, the General Accounting Office (GAO), industry groups, and other organizations. The committee noted specific policy proposals of these groups as well as the principles concerning evaluation criteria and the responsibilities of government in freight transportation that guided its conclusions. Taken together, the recommendations from these sources indicate the range of options that are open.

All these sources agree that freight transportation efficiency or the social benefits derived from freight transportation could be increased through changes in government transportation

programs. The philosophies underlying the recommendations in the various statements might be grouped in three categories:

- Incrementalist: more resources for existing programs, refinements in program structure or new initiatives within the precedents of established policy, more coordination and cooperation among the interested parties.
- Activist government: new government programs departing from established structures, expanded responsibilities for government, partnerships with the private sector, private-sector grants, increased regulatory oversight, government promotion or advocacy of particular business practices or institutional structures.
- Limited government: deregulation, privatization, pricing, devolution of government responsibilities to the local level.

The divergence of prescriptions is in part a symptom of lack of information, the consequence of the failure of government transportation agencies to conduct adequate evaluations of many projects. There is a lack of policy experimentation—for example, states have shown reluctance to participate in federally sponsored efforts to stimulate innovations such as the pilot programs for toll finance and congestion pricing. The recommendations indicate some opportunities for evaluation and experimentation to provide a better factual basis for policy.

RECOMMENDATIONS

In the first two sections below, principles to guide decisions on government programs affecting freight capacity are proposed, and the scope of the government policy public agenda relevant to freight capacity is described. Specific recommendations related to investment, management of facilities, decision-making methods, and regulation are presented in the final section. The main recommendations are italicized.

Guiding Principles for Government Freight Programs

The differences among the policy prescriptions described in the preceding section arise from differing conceptions of the proper role of government in freight transportation. Therefore, it is appropriate to state the principles, or assumptions regarding government responsibilities, that underlie the committee's recommendations. Experience in the United States and other countries demonstrates that respecting the principles listed below will put the freight infrastructure system on course to provide the level of capacity and performance that makes the greatest contribution to the nation's economic well-being.

- Economic efficiency ought to be the primary goal of government transportation policy; that is, capital improvements and operating practices for public facilities should be selected that yield the greatest net economic benefit, considering all costs.

- Government involvement should be limited to certain defined circumstances in which market-dictated outcomes would be far from economically efficient. These include, in particular, preventing exercise of monopoly power and dealing with nonmarket costs of pollution, congestion, and accidents. In addition, government is responsible for management of parts of the transportation system for which it has a historically established responsibility that it would not be feasible to alter in the near term, and in settings where institutional complexity—arising from the involvement of multiple government jurisdictions, dense development, and sensitive environmental issues—necessitates government leadership. It sometimes makes sense for government to accept the up-front risk in genuinely innovative projects. The federal government is responsible in instances where a potential conflict exists between nationwide and local interests. The federal government also is responsible for ensuring transportation facilities for national defense.
- A government responsibility to provide facilities or leadership in developing a project does not necessarily justify government subsidy of the costs. The important benefits of most public-sector freight transportation-related investments are the direct benefits that users of the facilities receive in the form of reduced transportation and logistics costs. Although exceptions exist, as a general rule, if such a project could not be financed by any scheme of user fees, then the responsible agency should question whether the project's benefits are adequate to justify the investment.
- Finance provisions in public-sector transportation programs are a major determinant of performance, affecting both the quality of investment decisions and the efficiency of operations. Reliance on revenue from users, and from local matching funds in federal grant programs, will increase the likelihood that the most worthwhile improvements will be carried out and that facilities will be operated and maintained efficiently.

There is a degree of acknowledgment of these principles in federal policy. They are partially paralleled in DOT's 1997 National Freight Transportation Policy Statement, which set forth "principles of federal freight transportation policy." These include allocation of federal resources to cost-effective projects supporting national goals, removal of unnecessary regulation, efficient pricing of publicly financed transportation infrastructure, assurance of safety and environmental protection, application of technology advances to promote efficiency and safety, and fulfillment of defense needs. The 1994 Presidential Executive Order "Principles for Federal Infrastructure Investments" requires that "infrastructure investments shall be based on systematic analysis of expected benefits and costs" and directs that "since efficient levels of service can often best be achieved by properly pricing infrastructure, the Federal Government—through its direct investment, grants, and regulation—should promote consideration of market-based mechanisms for managing infrastructure." Congress has sometimes supported the principles in legislation.

Nonetheless, application of these principles frequently is controversial, and many government investment and operating decisions are not consistent with them. Controversy is especially likely when proposals are made for changing existing practices concerning user fees or funding sources (e.g., instituting user charges on previously uncharged public facilities) and when particular industries or local interests argue that a project's national significance justifies federal or state subsidy instead of funding through project-generated revenues. Consideration of

the distribution of benefits commonly is a factor in public-sector transportation spending decisions, as when federal funding is allocated to ensure that the states receive comparable shares, or when public investment is targeted to increase income in particular urban areas. Policy makers should keep in mind that these practices have efficiency costs. It is important to long-run economic welfare that resources be concentrated on high-payoff capital investments rather than diverted to constructing facilities that will be high-cost or underutilized. The cumulative effect of such diversions will be to reduce system capacity compared with the capacity that equal investment, more effectively targeted, could provide.

Action to continually extend the application of these principles affords the only realistic prospect that the nation can continue to enjoy the benefits of freight transportation productivity growth in the long run. By themselves, technology, better planning, and increased spending levels will be unable to achieve comparable results. Keeping up with growth within the constraints that will be imposed on the transportation system in the future will be possible only if operators extract more service from existing facilities and higher returns on investment by selecting better projects. Finance reform in government programs and greater reliance on markets can help attain both of these goals. The present inefficient use of much existing transportation capacity should be regarded as a large hidden capacity reserve waiting to be tapped through improved management practices. Revenues from appropriate user fees in many circumstances would be the best indication of where capital expenditure to expand capacity would be most valuable.

Reliance on user fees and pricing in finance and management of public facilities is already extensive, even though existing schemes are imperfectly designed. Numerous opportunities exist for incremental extension and refinement of rational fee systems. These include changes in motor vehicle user fees to more closely tie fees to costs, increased use of concessions and commercialization in airport and port operations and for waterway maintenance, development of public and private toll roads, and use of congestion pricing or other market mechanisms to manage congestion of inland waterways. Congress and the responsible federal agencies must promote state and local government experiments with these practices, and federal agencies should monitor experience in countries where applications of these methods have advanced farther than in the United States.

Comprehensive Federal Freight Policy Agenda

The committee urges that the Congress, as well as the federal agencies responsible for transportation infrastructure and regulation, recognize the full range of federal programs that affect freight and endeavor to make decisions on these programs that are consistent with the principles outlined above.

The periodic reauthorization of the federal surface transportation program (most recently, TEA-21 in 1998) has been the focus of debate and policy initiatives concerning federal freight policy in recent years. Congress's objective in ISTEA (the 1991 act) was "to develop a National Intermodal Transportation System that is economically efficient, environmentally sound, provides the foundation for the Nation to compete in the global economy and will move people

and goods in an energy-efficient manner.” Congress apparently meant “intermodal” broadly, as a reference to the national transportation system as a whole. The goal is appropriate, but is too broad to be attainable through the limited means available within the historical scope of the federal surface transportation act or any other single federal program.

Freight transportation is a joint venture of government and the private sector. Therefore, the performance of the system and the adequacy of freight capacity in the next decades will reflect the outcomes of government decisions on numerous spending, regulatory, and operational questions that arise in the course of administering established programs. The range of relevant activities goes well beyond the programs in TEA-21 and any successor legislation. It includes federal programs that are likely to undergo legislative revisions in the next few years that will have far-reaching influence on the adequacy of freight capacity. Decisions on these matters often appear to address narrow concerns and to be guided by short-run considerations. What is needed instead is a coherent government effort at the national level to improve freight efficiency and provide adequate capacity that takes into account the cumulative long-run consequences of these government decisions and applies consistent principles to guide decision making.

Present government activities that directly affect freight transportation can be classified into four categories:

- Provision of infrastructure,
- Operation of transportation facilities,
- Finance of the construction and operation of facilities and collection of fees from their users, and
- Regulation.

The four activities are interconnected: financing sources limit the scale of construction and influence where funds are spent; user fee collection can be a mechanism for managing use of facilities and for guiding investment; and regulations are integral to the management of public facilities. In each of these four areas, government decisions that will affect long-run freight capacity are pending.

Three major federal infrastructure programs build freight facilities: the surface transportation program (as most recently defined in TEA-21), the water resources development acts (most recently, WRDA 1999 and WRDA 2000), and federal airport improvement and airways traffic control programs (most recently the Aviation Investment and Reform Act for the 21st Century of 2000). Each of these is a periodically reauthorized program providing grants to nonfederal public agencies and direct federal spending; includes funding for operating as well as capital expenditures; specifies rules on project eligibility and selection; and specifies finance provisions including maintenance of trust fund accounts, collection of user fees, and rules on federal and nonfederal cost sharing.

Policies on operation and management of government-provided freight facilities—highways, ports, airports, air traffic control, and waterways—encompass traffic management,

fees, maintenance management, and safety and pollution control activities. Decisions of Congress and the operating agencies on how to use technology and market incentives to manage traffic and control operating costs will determine the effective capacity and quality of service of existing facilities. One example, described in Chapter 3, is proposed traffic management improvement as an alternative to physical expansion on the inland waterways.

Examples of immediate finance issues whose outcomes can affect freight capacity include deciding on federal shares and revenue sources for port channel development, finding a new source of funding for harbor dredging, current efforts promoting toll funding and private-sector participation in development of highways, and proposals for commercialization of air traffic control.

Examples of immediate regulatory issues relevant to freight capacity include proposals for changes in federal economic regulation of railroads and airlines, proposals for reform of international aviation regulation as it applies to air freight, truck size and weight regulation, implementation of North American Free Trade Agreement (NAFTA) international carrier access provisions, and proposals for streamlining environmental review of transportation infrastructure projects to avoid unjustified delays. Environmental streamlining is a good illustration of a problem that cannot be addressed within the boundaries of a single executive agency or public works program because of the breadth of government activities affecting freight capacity. Improving the cost-effectiveness of environmental reviews of infrastructure projects will require examination of environmental laws and regulations as well as transportation agency practices.

These examples of pending critical decisions refer to federal actions, but parallel decisions are made continually in every state. States are the direct providers and operators of highways and state and local governments and special authorities build and operate ports and airports; the private sector provides infrastructure components and is the direct provider of all freight services. Freight transportation system development in the United States is a decentralized, rather than centrally planned, enterprise, and the scope of federal control is limited. Nonetheless, the list suggests that federal government influence is pervasive and is the outcome of a large number of recurring legislative and administrative decisions. The success of government efforts to ensure adequate future capacity will depend on the quality of decisions in these areas of established responsibility.

Recommendations on Specific Programs

The recommendations that follow are illustrations of how the principles stated above can be applied to clarify choices concerning pending government decisions on investment, operations, finance, and regulation. The examination of freight capacity problems in this study points to numerous immediate, practical opportunities for incremental improvements in government performance that will substantially contribute to ensuring adequate future capacity. Adjustments will allow the established public works programs to start producing better results: better project selection and better facility operation. Then over time the resources available will build a system that provides greater benefits for its users and the public.

The recommendations address selected policy issues affecting all the freight modes and are grouped under three headings: federal infrastructure programs, decision-making processes and planning, and regulatory issues. They do not constitute a comprehensive freight program; instead, they were selected to illustrate the application of the principles listed above to immediate decisions facing Congress and government agencies that will have long-run consequences for freight capacity, in order to indicate the direction in which policy ought to evolve.

Federal Freight Infrastructure Programs: Capital Expenditures, Finance, and Operations

Surface Transportation Act Reauthorization

Because trucking accounts for the majority of U.S. freight transportation expenditures and the federal government has a leading roll in national highway programs, no federal activity has greater significance for freight capacity than the federal-aid highway program. Highway services are essential to the functioning of the rail, air freight, port, and waterway systems. Congress is now drafting successor legislation to the present surface transportation program, TEA-21. Since cars and trucks use the same facilities, measures to better serve freight traffic are for the most part the same as those required to improve the overall performance of the highway system. *The committee recommends that the new program further these three goals:*

- 1. Maintain and reinforce the principle of user financing, reforming the structure of fees so that they more closely relate to costs each highway user imposes.*

Measures that Congress can take toward improving the system of federal highway finance include the following:

- Making adjustments to more closely align average user fee payments of vehicles with estimates of cost responsibility in DOT's most recent federal highway cost allocation study. The existing federal excise tax scheme is an imperfect form of user fee because it does not allow fees to be charged that are very close to actual costs generated (which depend, for trucks, on axle weights, mileage, route, and other factors) and because the states charge fees in addition to the federal fees. Nonetheless, better matching of fees to costs, even within the existing fee structure, could provide some incentive for shippers to make logistics decisions and for carriers to make equipment and operating decisions that reduce the costs of truck transportation and permit better utilization of existing capacity. In considering fee changes, Congress should evaluate how proposed changes would affect incentives for efficient highway use.

Congress should ensure that federal truck size and weight regulations (which historically have been addressed in the highway program legislation) are consonant with user fees. Motor carriers should be allowed to operate equipment that minimizes their costs, provided the equipment is consistent with safety and fees on the equipment cover the cost of providing infrastructure for it. Size and weight limits directly affect the freight-carrying capacity of the highways. Size and weight reform facilitates trade, and NAFTA commits the parties to harmonization of motor vehicle regulations. At the request of Congress, another TRB study

committee has recently published recommendations on specific changes in federal size and weight regulations (TRB 2002).

- Continuing the Value Pricing Pilot Program of TEA-21 and strengthening incentives for state and local governments to participate. The value pricing program, a continuation of the earlier Congestion Pricing Pilot Program, provided funding to support the costs of implementing pilot projects to demonstrate road pricing or related market-based traffic management strategies.
- Continuing the provisions of TEA-21 and ISTEA that encourage highway development using toll finance. These include, in addition to the value pricing program, provisions allowing states to use federal-aid funds to construct or reconstruct toll roads or to lend funds for these purposes to private toll operators, as well as the pilot program that allows states to institute tolls on Interstate highways to finance reconstruction. These programs have been lightly utilized, and Congress should provide incentives for states to participate in pilots. The pilots themselves will have little impact on highway finance; however, it is imperative that highway agencies begin to develop experience with new forms of user fees. Improved pricing offers the only serious long-run opportunity to improve utilization of existing highway capacity, reduce the costs of highway congestion, and more accurately target highway investment to the projects with the greatest benefits.

As an incentive for states to experiment with alternative finance and management methods, Congress could set aside a fund dedicated to projects on roads where the highway agency has implemented efficient maintenance, traffic control, and other management measures, according to specified definitions. Appropriate user fees would be evidence of efficient management in the competition for funding under the program.

Private-sector equity participation in construction and operation of highways is another mechanism for using market forces to direct investment and manage highway operation. As part of the highway program reauthorization, Congress should consider measures to reduce obstacles and provide incentives to private participation in highway development, as pilot programs with continuation dependent on evaluation of the results.

The most recent DOT highway cost allocation study concluded that user fee revenues from all vehicles nearly equal highway expenditures and that large trucks' user fees almost equal the highway expenditures for which they were allocated responsibility according to the study's assumptions (DOT 1997, ES-9). The methods of cost allocation studies are controversial; nonetheless, there does not appear to be a basis for arguing that large trucks as a class should be required to pay a much larger share of the cost of highway construction and maintenance. The need is for fees that are structured in a way that encourages efficient use of the highways, for example, fees that provide incentives for operators to select equipment that reduces bridge and pavement wear.

2. Support improved operation and maintenance of existing highway facilities.

The user fee reforms recommended above would be a step in the direction of improved highway operation. In addition, Congress should act to strengthen oversight of state administration of federal motor vehicle size and weight regulations and to evaluate the

effectiveness of enforcement of federal motor carrier safety regulations. The recent report of another TRB policy study committee concludes that although size and weight regulation for interstate traffic is a legitimate federal responsibility, the effectiveness of the regulations as a highway management tool is hampered by weak federal oversight of the states' administration of them (TRB 2002). A recent GAO study concluded that information needed for DOT to evaluate the effectiveness of its truck safety regulatory programs is lacking and that such evaluations will be necessary for the department to meet its accident reduction objectives (GAO 2000). Congress should continue support for research on highway maintenance practices and methods and on intelligent transportation system applications for traffic management. A recent TRB study has assessed promising lines of research in these areas (TRB 2001).

Congress should instruct DOT to review, in cooperation with the states, experience with the state infrastructure management systems, in order to develop ways that the federal aid program can help improve the effectiveness of these management tools in all states.

3. Provide funding adequate to ensure that the states have resources to maintain the overall performance of the highway system.

In deciding on justifiable highway spending levels, Congress should consider the estimates of benefits of alternative highway funding levels in DOT's Conditions and Performance (C&P) studies. The DOT C&P reports have significant imperfections, but they are the best available projections of returns on federal transportation investments. The methods DOT uses in these evaluations were reviewed recently by the Congressional Budget Office and GAO. Both reviews identified needed improvements in the methods, but concluded that the reports are useful for general guidance. The DOT studies indicate that highway projects that are marginal at present funding levels have high rates of return on average and that federal-aid funding sufficient to maintain or improve system performance would be economically justified as long as the bulk of funds went to the best projects. In spite of the uncertainty of these estimates of investment returns, there is little reason to doubt the general conclusions. Highway freight and passenger traffic is growing; much of the reserve of capacity created by the construction of the Interstate system has been used up; highway productivity is not growing fast enough to offset the effects of growth in traffic volume. There are no grounds for arguing that consumers of highway services would not be willing to pay fees sufficient to maintain present levels of service. Government efforts to promote alternative freight transportation modes are unlikely to significantly reduce the justified level of highway funding.

At any level of funding, greater benefit could be obtained from the federal-aid highway program if highway pricing were reformed, best operating practices were generally applied, and economic evaluations were used more consistently to guide capital expenditure and maintenance decisions.

Freight Priorities in the Federal-Aid Program. TEA-21 contained programs intended to redirect state and local government project selection toward freight-related projects. These include the Transportation Infrastructure Finance and Innovation Act, the Rail Revitalization and

Improvement Financing program, and other provisions. *Any programs Congress enacts for this purpose in successor legislation to TEA-21 should satisfy these criteria:*

- They should sustain the user-pays principle that underlies the federal-aid program; that is, capital and operating costs should be paid from the revenues of fees charged to the direct users of the facilities. By itself, user fee finance does not ensure that efficient investment decisions are made or that facilities will be efficiently operated. Nonetheless, when fees are used for demand management and fee revenues are used as one index of the merits of capacity expansion investments, efficiency will be promoted.
- They should sustain the broad support of the affected parties that the federal user fee financing system enjoys by funding projects that fee payers recognize as having value to them. The Inland Waterways Users Board is a precedent for a mechanism to give rate payers a voice in the use of revenues. Supporting underused facilities with revenues from heavily used facilities usually will not promote efficiency.
- To ensure that the market outcomes of competition between trucking and other modes are in the public interest, primary reliance should be placed on adjusting user fees rather than supplying offsetting subsidies to the competing modes.
- Rules for federal multimodal credit assistance programs should include requirements for ongoing and retrospective evaluation of the performance of the programs.

Increasing federal controls on state project selection in the federal-aid program for the purpose of directing funds toward freight-related projects would entail a risk of reducing the overall effectiveness of the program. Any bias in state and local project selection caused by failure to recognize freight benefits can only be corrected by systematic improvement in evaluations of project benefits.

New Systems. *Congress should direct DOT to study the costs and market potential of exclusive truck facilities.* The research should include examination of how user fee policies on exclusive truck roads and competing unrestricted routes would affect feasibility. DOT, in cooperation with the states and the private sector, also should examine needs for additional ancillary highway facilities for trucks to reduce truck-car conflicts, including rest areas and parking and staging areas. Such facilities should be paid for by fees collected from users.

Construction of exclusive truck roads is one novel kind of infrastructure program that may be justifiable at some point. The mixing of cars and trucks in the traffic stream generates costs that would be avoided if the two kinds of vehicles did not share the same roads. In addition to the potential traffic and safety benefits of separation, savings would be possible because car-only facilities would have more lightly constructed pavement and bridges. Truck-only roads are in operation or planned in a few locations today, but experience has been insufficient to establish the scope of their practical application. Although it appears that they could be justified only on routes with traffic volumes that are very high by today's standards, traffic growth on certain routes, mainly within urban areas, may render separation feasible in the coming decades.

Port Development

The Administration and Congress should reexamine the planning process for new coastal harbor and channel improvement projects as well as the present rules on funding formulas and sources for these projects, with the goal of ensuring that available funding is concentrated on the projects with greatest net benefits. The following reform measures should be considered:

- Deauthorization review, a congressionally mandated review by the U.S. Army Corps of Engineers of the justification for all authorized harbor and waterway projects, considering commercial, defense, and environmental criteria. The review would be an opportunity to improve past evaluations by more thorough consideration of noncapital alternatives, updated demand forecasting, and submission to independent review. A legislative instruction to rank projects so as to allow selection of the package that would yield the greatest return for a specified budget would encourage closer scrutiny of estimates of costs and benefits by the beneficiaries of the Civil Works Program.
- Regional planning for port capacity or regionalization of port investment decisions. Regional decision making could help avoid inefficient duplication of facilities and encourage each port to concentrate on those market segments where it possessed advantages. It would be possible for Congress to provide incentives in federal assistance programs for multiport regions to make coordinated proposals for harbor projects.
- Greater reliance on local cost-sharing and user fees. Growth of the backlog will be inhibited and the best projects will rise to the top of the priority list if local cost-sharing requirements are maintained or increased. Creation of mechanisms whereby the costs of a federally executed harbor improvement could be repaid by fees paid by the users of that improvement also would tend to bring the projects with greatest net benefit to the forefront.
- Strengthened requirements for independent, outside review of the economic and environmental evaluations of large or controversial federal harbor and waterway projects.
- Sustaining the cost-sharing reforms of the Water Resources Development Act of 1986 (Public Law 99-662, Title I) by refraining from waiving or bypassing local match requirements. The 1986 legislation required that nonfederal participants in navigation construction projects pay specified shares of construction costs and a share of operating and maintenance costs of deep draft harbors and channels.

Individual coastal harbor and channel improvements are jointly planned and implemented by the federal government and public port authorities. The U.S. Army Corps of Engineers plans new projects, and the federal share of improvements is funded through its Civil Works appropriations. Because Congress has authorized projects at a much greater rate than it has been willing to fund their implementation for the past several years, the backlog of unfunded new federal water project construction has continued to grow. The unfunded backlog of active Civil Works projects amounted to some \$38 billion in 2000. The backlog is symptomatic of a project selection process that is failing to establish priorities. To make the best use of available financial resources, legislation will be required to bring the planning process and project selection criteria

into consonance with the financial capabilities of the federal government and the nonfederal project sponsors to implement new projects. Without new planning and financing models, development of new port channel capacity will not meet the requirements of growth in commerce and increases in vessel capacities in an efficient and timely manner.

Harbor Maintenance

The appropriations for maintenance of navigation channels are made annually from the Harbor Maintenance Trust Fund, which is the depository for the receipts from the Harbor Maintenance Tax (HMT). Expenditures from the trust fund averaged about \$500 million annually during the 1990s. The portion of the ad valorem HMT that applied to exports was ruled by the courts to violate the constitutional prohibition on export taxes in 1998. The remaining fee on imports is vulnerable to charges of being in violation of international trade agreements. Therefore, a new revenue source for maintenance dredging is needed.

The committee makes no specific recommendation but notes that options that have been proposed for harbor maintenance finance include the following:

- General revenue funding.
- Harbor Services User Fee. The administration proposed a fee system to replace the HMT in 1998. The fee would be collected from the owner or operator of each vessel using a U.S. port on a per-voyage basis. The amount would depend on the vessel capacity and vessel category (general, bulk, tanker, or cruise). The variation in fees among categories was described as reflecting differences in the average level of services required. Revenue from the fee would be credited to a trust fund, appropriations from which would pay all federal costs of operating, maintaining, and constructing and improving. Capital expenditures are now funded from general revenues. This proposal has been opposed by shippers, carriers, and port interests because of their perceived impacts on U.S. trade volume and on the competitive position of U.S. ports relative to Canadian ports.
- A fee scheme more closely matching fees to costs. Fees could be more closely matched to costs than in the Harbor Services User Fee proposal. For example, fees could be related to a vessel's operating draft for each movement and to the costs of specific channels. Linking spending in each harbor to revenues generated could also be considered.
- Other dedicated revenue streams. Dedicating a portion of customs revenues to a fund to finance federal harbor expenditures has been suggested.

The principal argument in favor of general revenue funding is expediency. Parties that would be harmed have successfully opposed enactment of any cost-based fee scheme since before passage of the HMT in 1986. General revenue funding would be a way to provide for maintenance while alternatives were debated. Proponents also have argued that general revenue funding would afford protection for U.S. ports from foreign competition, would avoid constitutional problems and conflicts with U.S. obligations under trade agreements, is appropriate because the benefits of ports are shared broadly by the entire population, and would

preserve some U.S. ports (those with relatively high dredging costs or small traffic volumes) that might be put out of business without subsidies or if maintenance expenditures were related to fee revenues.

However, tying channel capacity expansion and maintenance to project-specific user fees would benefit overall economic welfare. Channels are not public goods; with current technology all users can be identified and their use can be charged for as is the use of a toll road or a telephone line. Subsidizing ports to protect them from loss of traffic to lower-cost foreign ports harms the U.S. economy by raising the cost of trade. Competition among North American ports is a trade issue analogous to issues that are dealt with today through arrangements under NAFTA. The freight transportation system would become more efficient if ports that cannot sustain their own operations are allowed to lose traffic to lower-cost competitors. Controversy over finance of channel improvements and maintenance arises from distributional issues: some ports and shippers would be harmed by the change.

Operation and Management of the Inland Waterways

Congress and the Administration should direct the Corps of Engineers to improve the efficiency of congested locks on inland waterways through implementation of demand management practices. Promising methods include traffic scheduling, congestion charges, and lock time reservations. This recommendation is consistent with that of an NRC committee that examined waterway planning (NRC 2001) and recommended that Congress direct the Corps to explore traffic management options.

In its authorizations and appropriations for Corps Civil Works activities, Congress should begin to rely on revenues from user fees to fund inland waterway operation and maintenance as well as capital expenditures. (Today, operating and maintenance expenditures and part of capital expenditures are funded from general tax revenues.) Waterway charges that are not levied for the purpose of congestion management should be structured to minimize traffic diversions to other modes. Efficiency does not require that fee revenues cover the full costs of the waterways. Fees should cover traffic-dependent waterway operating costs; in addition, congestion fees should be imposed. That is, fees should be determined solely to promote efficient use of existing facilities, rather than according to consideration of cost recovery or future project financing.

Effective demand management, including improved pricing, would reduce the cost of lock congestion by giving better access to the most time-sensitive cargoes (i.e., the shipments for which delays are most costly) and by giving barge operators incentives to change their practices in ways that reduced delays at locks. It is likely that in many cases, demand management would be a more cost-effective means of reducing the costs of congestion than capital improvements.

Increased reliance on segment-specific user fees would tend to discourage expenditures on little-used waterway segments. Regional patterns of production and consumption adjust through time, as does the demand for transportation service; consequently waterways that were once vital may become obsolete. Therefore, the benefits and costs of low-volume waterways should be evaluated. A scheme might be developed to evaluate the demand for low-traffic

waterways through increased reliance on user fees that reflect the operation and maintenance costs of these river segments. If user fees collected on a segment fail to cover its operations and maintenance costs, then the segment should become a candidate for rationalization. Improved targeting of scarce resources to the most beneficial uses is critical for maintaining adequate freight capacity. Improved targeting implies fewer resources for system elements with relatively low returns and increased resources for the most promising elements.

For the longer run, the Administration and Congress should evaluate new institutional arrangements for inland waterway management that would entail less federal subsidization of waterway operations and expansion. Regional authorities could better address conflicts in resource use and have greater flexibility in management and funding. For example, regional authorities would provide a mechanism for resolving conflicts between upstream and downstream interests over management of river flows for multiple purposes.

To promote efficient use of waterways and harbors and to be perceived as fair by the payers, fee structures should take into account the costs attributable to all users, including commercial navigation, other private navigation, and public and nonnavigation uses of facilities. There is a need for government and industry to examine how to achieve a reasonable user fee structure that assesses all users appropriately according to the costs each imposes.

Public–Private Joint Funding of Freight-Related Public Works Projects

State and local governments should routinely conduct evaluations to quantitatively test the economic rationale for government involvement in their freight transportation infrastructure projects, prospectively for each new proposal for government participation and retrospectively for each completed government project. The rules of federal programs should require such evaluations of projects receiving federal assistance. Congress should base its future decisions on whether to adjust federal-aid program rules to encourage such projects on review of the outcomes of prospective and retrospective evaluations of past projects.

In recent years, governments have experimented with expanding the scope of their involvement in freight transportation infrastructure. Port access projects and intermodal terminal developments have been prominent among these public undertakings. The proposal for state rail aid as an alternative or complement to adding Interstate highway capacity, described in the Virginia I-81 case study in Chapter 3, would be an example of this expanded conception of public responsibility. These projects often involve some form of public–private joint undertaking and complex financing packages with support from multiple public and private sources, often center on intermodal facilities, and often entail public support for rail or other facilities that are commonly provided by the private sector.

These projects usually are controversial. Proponents of these kinds of expanded public-sector involvement argue as follows:

- Artificial boundaries in traditional programs are obstacles to the flexibility governments require to solve transportation problems by the most effective means. For example,

handling freight traffic growth by aiding railroads might be cheaper for government budgets than expanding road capacity.

- User fees on trucks do not cover the full cost of their use of roads, so shippers often choose truck when rail would be the cheaper option overall. If underpricing of trucking cannot be corrected, investment in rail by the highway agency is justified to attain efficient use of the two modes.
- Public demands placed on the railroads to accommodate intercity and commuter passenger rail traffic justify greater public contributions for capital and operating costs of jointly used facilities.
- Public leadership is indispensable because of the scale and institutional complexity of some projects.
- Subsidies are justified because the facilities involved, especially ports, generate important nonmarket benefits and therefore are essential to local economic development plans.

Opponents have made the following arguments:

- Subsidizing railroads to compensate for subsidizing trucking leads to excess capacity in both modes.
- Governments have other options to mitigate market distortions arising from any underpricing of trucks, including not expanding roads to accommodate uneconomical truck traffic and reforming fees.
- Proposals for public investment in infrastructure that will not earn a commercial return should be examined skeptically, since the opportunity cost of the funds in alternative public uses may be high.
- Hopes of diverting significant traffic off highways and thus reducing the need for highway expansion are unrealistic, as are hopes of stimulating regional development by freight subsidies.
- Government aid will tend to reinforce pressures for greater regulation of railroad operating and service decisions and rates, eroding the benefits of deregulation in the industry.
- State and local governments are not equipped to evaluate proposals for intermodal or rail assistance or to resist demands for economically unjustified aid.

State and local governments confront this issue in developing their public works programs, and it has become a federal concern as well. In debates preceding the last two surface transportation authorization acts, changes in federal-aid rules were considered that would encourage state and local governments to undertake these kinds of projects, although measures enacted for this purpose have been modest. Some project sponsors have also sought special federal assistance.

Most of the competing claims concerning this issue that are listed above can be empirically assessed for individual projects, although such assessments are rarely conducted. The first step in considering public funding for such a proposal should be a quantitative analysis to demonstrate that the rationale for government support is sound. The analysis would estimate the benefits, costs, and government budgetary impacts of proposed infrastructure improvements and compare them with alternative means of serving freight and with alternative institutional arrangements. If the proposal is for government support of a project that cannot obtain private-sector financing, the evaluation should demonstrate that public benefits exist that raise the public rate of return above the private rate.

One such evaluation was begun in 2001. The Mid-Atlantic Rail Operations Project is a joint effort of five states and the major Eastern railroads to examine the complementarity of rail freight infrastructure development and Interstate highway capacity expansion in the Northeast United States.

Decision-Making Processes and Planning

DOT Data and Analysis Programs

Congress should give continued support to the development of DOT capabilities for economic analysis of the federal-aid highway program and federal highway user fees and to the application of this analysis in support of decisions. Congress should provide for joint state–federal efforts to transfer and adapt these federally developed policy guidance tools to state and local needs.

DOT has made progress in recent years in the development of methods and data for its C&P reports (biennial reports to Congress describing the condition of the highway system and projecting the effects of alternative federal-aid funding levels on condition), its Highway Economic Requirements System (a model supporting the economic analysis of alternative funding levels in the C&P reports), and its highway cost allocation studies (estimates of fees and taxes paid by and costs attributable to various classes of highway vehicles, to guide the setting of highway user excise tax rates). However, better guidance for federal decisions would be possible with improvements to these tools. The DOT model has two major shortcomings. First, it does not support comparisons of highway expansions with congestion pricing or other demand management alternatives. Therefore, the model overlooks attractive policy alternatives in many instances. Second, it does not incorporate a network model. Consequently, the estimate of benefits from expansion of a highway link does not change if a decision is made to simultaneously expand a substitute or complementary link. The value of the model for policy planning would be greatly enhanced if it were refined to include these capabilities.

In planning future highway cost allocation studies, DOT should review the 1996 recommendations of the TRB Committee for Review of the Federal Highway Cost Allocation Study concerning methods for analyzing whether changes in highway user fees could increase the net economic benefit the nation derives from its highway system. Fees affect efficiency (that is, the economic payoff from the highway system) through their influence on the volume of

highway travel, freight shippers' selections of truck freight versus other modes, truck operators' choices of equipment, and other highway user decisions. In particular, future cost allocation studies should examine whether urban road users are subsidizing intercity highway travel and the implications of any such subsidy for freight transportation efficiency.

Measures of freight transportation activity are necessary for evaluation of transportation improvements. Projections of freight traffic are needed to estimate the benefits of new facilities, which depend primarily on use. Evaluating regulations and user fee policies also requires data on freight markets. Since much of the nation's freight transportation infrastructure is owned and almost all freight is carried by private firms, collection of freight data requires the participation of industry. Congress should provide for the ongoing collection of freight transportation statistics by DOT, through the Bureau of Transportation Statistics. The survey capabilities of the Census Bureau should be utilized unless it can be demonstrated that the data necessary for government decisions can be obtained without exercising the Census Bureau's reporting compliance powers. The shipper-based Commodity Flow Survey program should be continued. To be useful for most federal, state, and local government planning applications, this freight transportation data program must receive sufficient funding to allow publication of shipper statistics by commodity, by transport mode, and by origin-destination pair.

Waterborne freight transportation data programs of the U.S. Army Corps of Engineers should also be continued while encouraging further integration across other modal freight data collection efforts within DOT. The freight data programs within the federal government should be coordinated through the Bureau of Transportation Statistics, whose tasks should include data collection, auditing of all DOT freight transportation data programs, and publication of data and analytical summaries. The bureau should define the objectives of its activities in terms of three classes of information: strategic (i.e., to reveal large departures from historical patterns in performance or demand), benchmarking (comparative evaluations of the performance of components of the transportation system according to specified criteria), and special studies relevant to critical or emerging issues.

Evaluation Methods

As one means of promoting more useful evaluation at the federal and state levels, Congress should create a clearinghouse devoted to evaluation methods within DOT, where DOT program agencies and local and state governments could share and compare methods and examples of evaluations. The clearinghouse would not supplant any agency's evaluation responsibilities, but would work to define best practices and produce manuals and case studies. The scope would include project evaluation, regulatory evaluation, follow-up evaluations of programs and projects, and evaluation of excise tax and user fee schemes. This function must not add to delay by creating additional layers of project approval requirements. Rather, the clearinghouse ought to contribute to streamlining through development of clearly defined and accepted methods and by providing supporting staff expertise. The clearinghouse could contribute, for example, to developing effective methods for the evaluations recommended above in the section on public-private joint funding of freight-related public works projects.

In creating the Bureau of Transportation Statistics in DOT, Congress acknowledged the importance of data to effective management. Appropriate evaluation methods are as important as reliable data in supporting management decisions. The case studies have highlighted how public choices are made more difficult by weak analysis capabilities. The sources of this problem lie in the lack of an explicitly defined evaluation framework (that is, decision makers and planners often do not define the standards of evaluation in a measurable way); political or bureaucratic incentives that discourage evaluation; and failure to devote resources to research, data collection, and model development.

The following guidelines for evaluations are not controversial, but often are not followed in practice:

1. Evaluation, especially of projects that may involve trade-offs among freight mobility benefits, passenger benefits, and environmental protection, requires use of benefit–cost analysis. Traditional engineering standards for judging projects are insufficient. Transportation benefits should be evaluated in terms of users' willingness to pay for the change in service produced by the project. Estimating the demand response to changes in transportation cost is necessary.
2. Evaluations of capital improvements must include comparison with noncapital alternatives including traffic control improvements and congestion pricing.
3. External costs, including environmental costs, must be included in the benefit–cost analysis, and specification of alternatives must give consideration to opportunities for modifications to project design that mitigate environmental costs.
4. The evaluation must include analysis of risks and sources of uncertainty, including uncertainty in traffic projections, and consider strategies for reducing risk.

These guidelines are consistent with the requirements of Executive Order 12893 on principles for federal infrastructure investments (Executive Office of the President 1994).

Other recent examinations of federal transportation infrastructure programs, by other NRC committees and by GAO, have concluded that necessary evaluations of federal infrastructure spending proposals sometimes either are not carried out or are incorrectly executed. They have recommended actions to ensure conscientious evaluation in direct federal infrastructure spending programs, DOT planning studies for advising Congress on federal-aid programs, and DOT review of proposals for discretionary grants for transportation infrastructure. In addition, DOT should actively promote state application of appropriate economic evaluation methods in state programs that receive federal aid, in particular, the highway programs.

Modeling requirements and methods for evaluating alternative management practices and capital improvement proposals according to the criterion of economic efficiency, applicable to the inland waterways, were described in the report *Inland Navigation System Planning* (NRC 2001). Requirements for cost and demand models to support analysis of tax alternatives, to be employed in future DOT highway cost allocation studies, are identified in the reports of the 1996 TRB committee that reviewed the federal cost allocation studies (TRB 1996a).

Regulatory Issues

Reducing Project Delivery Time

The Secretary of Transportation should implement a coordinated, streamlined environmental review process at the earliest possible date that furthers the basic congressional intent of improving the efficiency of project delivery. The focus of the federal streamlining efforts has been major projects that require preparation of an Environmental Impact Statement, the most comprehensive class of environmental review defined in federal law. In addition to this effort, DOT should not overlook opportunities to streamline reviews of more common rehabilitation projects (which follow the Environmental Assessment or Categorical Exclusion processes defined in federal law rather than the Environmental Impact Statement process).

Section 214 of WRDA 2000 authorizes a federal agency evaluating permit applications (in this legislation, permits under the jurisdiction of the Department of the Army) to accept funds from a nonfederal public agency applicant to pay administrative costs in order to speed review. *Congress should consider options for funding federal agency reviews of highway projects analogous to this provision.*

Too little objective information is available about the impacts of environmental reviews and alternative approaches to carrying out reviews. *Congress should direct DOT to conduct, in cooperation with the states and the federal environmental agencies, an assessment of the effects of required environmental reviews of transportation projects.* The assessment should have two components. First, DOT and the states should collect data on durations and costs of reviews and the impact of reviews on project delivery times. The 2000 American Association of State Highway and Transportation Officials (AASHTO) survey of state experiences with project delays was a constructive step but was not designed to provide objective, quantitative information on review durations and costs. Second, DOT and the states should assess the impact of the review process on final project design, which is the ultimate test of the benefits of the process.

In addition, Congress should direct DOT, in cooperation with the states, to conduct a program of research to identify and document best practices in state transportation programs and other federal and state infrastructure programs regarding innovative project development, design, and management aimed at reducing project delivery times. Studies should examine practices relating not just to environmental reviews but to all aspects of design and management.

Congress should direct DOT to conduct cooperative research and evaluations of successful and unsuccessful projects with the states to examine the distributions of the direct costs and benefits of publicly supported freight infrastructure developments among all the affected individuals and groups. The research should examine how these distributions are affected by project financial, legal, and institutional arrangements. The object would be to determine how distributional outcomes affect the likelihood of public acceptance and successful completion of projects.

Infrastructure providers see curtailing the growth of project delivery times as essential to their ability to control the costs of future capacity expansion. The adjustment of infrastructure to changing markets is slowed as a consequence of lengthening project delivery times. Investment becomes more risky because decisions are more dependent on highly uncertain long-term forecasts and because final decisions to proceed with projects cannot be made until after many years of development and review. Changes in practices and policies that reduced delivery time would greatly reduce the difficulty of efficiently matching capacity to demand.

The attention of the state transportation agencies and the federal government has recently been focused on the issue of environmental streamlining, that is, efforts to reduce the time and cost of environmental regulatory reviews of transportation projects. Legally required environmental reviews of infrastructure projects serve an essential function but add to cost, completion time, and uncertainty. The agencies controlling the reviews may be insensitive to these impacts because they do not directly affect the agencies' own budgets and missions. In particular, the states have petitioned the federal government for more expeditious review of highway projects. A policy statement of AASHTO concludes that "only if federal agencies commit to developing a simplified coordinated review process that maintains substantive environmental protection and takes less time, will States be able to deliver, in a timely manner, the investments in transportation envisioned by Congress and expected by the public" (AASHTO 1995).

TEA-21 in 1998 required DOT to work with the federal environmental regulatory agencies to develop procedures to facilitate reviews of projects to reduce delay and costs. The act requires the Secretary of Transportation to "develop and implement a coordinated environmental review process for highway construction projects. . . . The . . . review process for each project shall ensure that, whenever practicable . . . , all environmental reviews, analyses, opinions, and any permits, licenses, or approvals that must be issued or made by any Federal agency for the project concerned shall be conducted concurrently and completed within a cooperatively determined time period" (P.L. 105-178, Section 1309). A 2002 presidential executive order creates new procedures for federal agencies to follow to "promote environmental stewardship in the Nation's transportation system and expedite environmental reviews of high-priority transportation infrastructure projects" (Executive Office of the President 2002).

Streamlining will allow federal and state agencies to "move paper faster," that is, to comply more expeditiously with the requirements and the spirit of the National Environmental Policy Act. However, attaining the goal of improved efficiency of project delivery demands multiple strategies, including the following:

- Administrative streamlining of environmental assessments (i.e., procedural reforms that DOT, acting together with other state and federal agencies, can implement on its own authority).
- Fundamental review and evaluation of the environmental assessment requirements in U.S. law. Requirements that have produced demonstrable benefits should be strengthened, and those that have not should be modified or deleted. Such a review would consider changes whose implementation would be beyond DOT's authority.

- Better initial project planning to foresee and ameliorate potential environmental conflicts.
- Application of innovative methods of project design, development, and management to speed project delivery. Integration of design and construction, use of performance incentives, and other innovative contracting practices can greatly expedite project delivery in certain circumstances (TRB 1996, 27–32). Another TRB committee has recommended federal actions to develop methods to dramatically reduce highway delivery times (TRB 1998).

Liberalization of International Air Freight

The committee endorses past U.S. government efforts to liberalize the international air freight market through bilateral agreements with other nations but recommends that the multilateral approach be pursued as well, since it is the method with the greatest potential benefit.

International air cargo is probably the most regulated major freight market. International competition is governed by the system of bilateral treaties that also regulates passenger traffic. The treaties restrict landing rights, nationality of ownership, cabotage, and other aspects of operations.

Increased competition and carrier flexibility would be expected to yield the same improvements in efficiency in the international air cargo system as they have in other transportation sectors. Increased efficiency means that better use is made of existing capacity. Lower costs would lead to more air cargo, but the system would be better able to respond to growing demand.

An alternative to the present system of regulation would be to govern international air cargo, as is trade in other international services, by a multilateral free trade agreement within the World Trade Organization structure. The agreement would reduce barriers to ownership, market entry, and cabotage. International air cargo could be liberalized through this approach without changing the present rules governing passenger transport. Such a proposal has been made recently by international business groups.

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Abbreviations

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| AASHTO | American Association of State Highway and Transportation Officials |
| DOT | U.S. Department of Transportation |
| GAO | U.S. General Accounting Office |
| NRC | National Research Council |
| TRB | Transportation Research Board |

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Appendix A

Recent Statements on Freight Policy

The committee reviewed recommendations and policy statements of three past TRB committees and the National Commission on Intermodal Transportation (NCIT), proposals published by the Brookings Institution and the Reason Foundation (two policy research organizations), and the 1998 white paper of the U.K. government, *A New Deal For Transport*. These are each summarized below. An overview of the recommendations from these sources appears in Chapter 2.

TRB STUDIES

The TRB Committee on Landside Access to Ports was charged with examining the problem of improving landside access to general cargo and bulk terminals at U.S. seaports (TRB 1993). Its work was sponsored by the Maritime Administration of DOT. Port access has been a focus of discussions of needs for freight transportation policy reform because of the multimodal nature of the problem, the national economic significance of the major ports, and the complexities of infrastructure development in large cities.

The committee identified sources of access problems, which it classified into four groups: road and infrastructure congestion; land prices and land use restrictions near ports; environmental regulations; and various institutional frictions, including divergence of goals among different units of government and ineffective communication among governments and with the private sector. Among the recommendations of the committee's 1993 report, the following would significantly affect the capacity of port landside connections and the national network of which they are components:

- State and local governments should give more detailed consideration to freight transportation needs in setting infrastructure investment priorities.
- Metropolitan planning organizations (MPOs) should provide for reservation of right-of-way and waterfront in long-range plans.
- The rules applied by the Federal Highway Administration (FHWA) in determining roads eligible for federal highway aid should consider importance for commerce and the benefits of improvements.
- FHWA should approve state use of federal highway aid for improvements in support of nontraditional projects (including freight access corridors, inland terminal development, and facilities for coastal shipping) to the extent federal law allows.
- DOT should study the concept of a federal landside access trust fund that would receive revenues from fees on port use.

- Legislation should be enacted allowing the Department of Defense to pay the local share of federal-aid projects that are military priorities.
- The Corps of Engineers should streamline its environmental review and permitting of port projects.
- States should consider establishing multimodal trust funds to fund port access projects.
- Operators and users should improve port operating efficiency by extending hours of operation and scheduling activities to manage peak demands.
- The federal government's role should be to provide incentives to state and local governments to ensure that interstate and international commerce and military requirements are adequately considered when transportation funding priorities are set.

In 1998, TRB's Committee for Study of Policy Options to Address Intermodal Freight Transportation, in a study funded by FHWA and the Federal Railroad Administration, continued the review of intermodal freight transportation policy begun in the 1993 study (TRB 1998). The committee was charged with identifying changes in public policy that could promote intermodal freight transportation efficiency. It gave special attention to the problems governments are facing as they find themselves called upon to alter traditional public-sector roles and priorities in provision of services supporting freight transportation (e.g., involvement in public-private joint projects, rail access projects, or terminal development). Most of the committee's recommendations deal with principles to guide government involvement in freight:

- Governments ought to define criteria for deciding whether public-sector involvement in particular freight ventures is appropriate. Quantitative methods should be defined for testing whether a proposal meets the criteria. Possible criteria are outlined in the report.
- Government subsidy of a freight project (that is, support of a project that does not fully pay its way from the revenues it generates) ought to be justified by estimates of external benefits (i.e., benefits that users could not be charged for).
- Standardized methods for evaluating public infrastructure investment proposals should be developed. The performance of completed projects should be evaluated systematically. Evaluations should concentrate on quantifying and valuing projects' direct transportation benefits.
- When the predominant benefits of a project in which the government participates accrue to users, as will be the case with most transportation projects, the project should be financed by user fees and private-sector contributions.
- Government should promote applications of information technology by ensuring that its information systems in customs, enforcement, and military logistics are interoperable with industry systems.

- DOT should examine how economic regulation of ocean and coastal shipping affects freight transportation and the efficiency of use of U.S. ports.

The 1996 report of the TRB Committee for the Study of Public Policy for Surface Freight Transportation examined a question that is fundamental to government freight transportation policy: comparison of market prices with social marginal costs for freight services in several case study markets as an indicator of potential inefficiencies (TRB 1996). The committee's key recommendation was that federal and state government agencies that operate highway and water transportation facilities should "routinely consider the effects of the structure of road and waterway user fees on freight transportation efficiency and consumer welfare and search for user fee schedules that improve economic efficiency" whenever they consider alternative fee schedules and capacity expansion investments (TRB 1996:126). That is, the committee urged public agencies managing freight facilities to place greater reliance on the market mechanism to manage capacity. The committee observed that private-sector transportation companies routinely use pricing to regulate use of facilities most in demand and base their investment decisions on revenue-generating potential, and that greater use of such practices in the public sector would have a positive impact on operations and investment returns.

NATIONAL COMMISSION ON INTERMODAL TRANSPORTATION

NCIT was created by ISTEA, the 1991 surface transportation act. It was charged with "investigating the intermodal transportation system in the U.S.," both passenger and freight, and recommending policies to achieve an efficient intermodal transportation system. Specific matters Congress directed it to address included standards, infrastructure needs, regulatory impediments, finance (including the desirability of increased flexibility in the use of the federal transportation trust funds), technology, and research (P.L. 102-240, Section 5005).

ISTEA was presented as a new federal approach to surface transportation and has particular significance for federal involvement in freight transportation. Title V of the act, "Intermodal Transportation," declared, "It is the policy of the United States Government to encourage and promote development of a national intermodal transportation system in the United States to move people and goods in an energy efficient manner, provide the foundation for improved productivity growth, strengthen the Nation's ability to compete in the global economy, and attain the optimum yield from the Nation's transportation resources." Congress presumably meant "intermodal" not just in the narrow sense of a particular set of technologies (e.g., containers on flatcars) but broadly, as a reference to the national transportation system as an integrated whole. The other sections of Title V created the Office of Intermodalism within DOT, provided funding for grants to states for intermodal planning, called for a study of reorganization of DOT along intermodal lines, and created NCIT.

The commission grouped its 12 recommendations into three areas: "policies needed to capture the synergistic potential of this Nation's transportation system," investment issues, and institutional reform. The recommendations most relevant to long-run freight capacity are the following (NCIT 1994):

- Federal policy should foster development of the private-sector freight intermodal system and reduce barriers to freight flow, especially at ports and border crossings.
- Federal transportation infrastructure programs should be fully funded at authorized levels.
- Expanded use should be made of innovative finance methods.
- The federal government should allow greater flexibility in the use of federal aid for intermodal projects.
- Special federal funding should be provided for projects of national significance.
- DOT should be reorganized to better support intermodal transportation.
- Transportation infrastructure planning and project delivery should be expedited.
- Legislation should require DOT concurrence in actions of other federal agencies that affect intermodal transportation.
- The process established in ISTEA for greater local authority in planning transportation investments, through the MPOs, should be strengthened.
- Federal policy should be to support private-sector innovation and allow maximum flexibility for state and local government.

In the debate leading up to enactment of ISTEA, proponents of intermodalism as a principle of federal policy had a vision of transforming the traditional highway program into a mode-neutral federal-aid program administered by a mode-neutral DOT. For passenger transportation, this goal was partially achieved, since states were given greater discretion to use federal aid for highway or transit projects as they chose. Similar flexibility for freight would imply that recipients could spend federal funds for port, rail, or terminal improvements that were not primarily highway projects.

ISTEA disappointed the advocates of such multimodal freight funding (Huerta 1996). It created programs permitting small amounts of nonhighway freight spending, but the federal-aid program remained a highway and transit program and the modal organization of DOT was not changed. In the mid-1990s, DOT and others again proposed greater funding flexibility and freight emphasis for the next round of surface transportation legislation. DOT, the General Accounting Office (GAO 1992, 42–46), and the port authorities, as well as NCIT, argued the need for an expanded direct federal role in resolving certain nationally significant multimodal freight infrastructure bottlenecks, on the grounds that some problems are beyond the capacity of the private sector and because the benefits of improvements would be national rather than local.

However, the NCIT report did not endorse significant relaxation of constraints on the use of federal-aid highway funds. The American Association of State Highway and Transportation Officials continued its support of the existing basic rules of the federal-aid program. The

trucking industry opposed diversion of highway funds, and the railroads were wary of greater government involvement in their industry. The 1998 report of the TRB Committee for Study of Policy Options to Address Intermodal Freight Transportation, summarized above, expressed skepticism, noting that increased flexibility could promote uneconomic interstate rivalries in development of freight facilities and encourage private-sector transportation companies to demand more government funding for their infrastructure projects. In the next surface transportation act, the Transportation Equity Act for the 21st Century (TEA-21), enacted in 1998, Congress again chose not to greatly increase flexibility.

One theme that appears in the NCIT report, that inadequate capacity investment reflects poor understanding among the public and government officials of the economic role of transportation, has received support in the freight industry. For example, a proposal to remedy the communication problem, from a state motor carriers association executive (Fulton 1999), calls for development of a national freight policy document jointly authored by government, shippers, and carriers; a federal requirement that freight be a component of all transportation plans of state and local governments and that plans incorporate input from industry; and founding of freight advisory councils in all metropolitan areas to serve as forums for government–industry communication.

OTHER VIEWS

The TRB committees and NCIT addressed freight transportation issues within the confines of U.S. federal transportation programs as they have historically been structured. It is useful also to look at freight policy proposals from sources that are less constrained by these particular institutional limits.

Two analyses from private “think tanks” are examples of proposals that go much further in recommending market-based reforms than the TRB committees whose recommendations were outlined above. A study by a Brookings Institution fellow (Winston 1999) argues that there is great potential for increasing the efficiency of the U.S. transportation system—reducing unit costs and improving service quality—by greater reliance on the private sector. Policy proposals that would affect freight capacity include the following:

- Eliminating the restraints on competition contained in international aviation treaties and in the restrictions of the Jones Act on domestic waterborne freight.
- Implementing user fees better aligned with costs, including electronically assessed and collected tolls on congested highways, truck infrastructure charges based on mileage and weight, and airport takeoff and landing fees that include a congestion toll.
- Investing more in capacity-enhancing technology, airport capacity expansion, and heavier pavements for highways. These are among the areas where investment levels have been incorrect.
- Imposing pollution taxes on motor vehicle and stationary source pollutant emissions that encourage changes in consumption and equipment to reduce pollution.

- Pursuing privatization or commercialization. The study argues that it would be extremely difficult for government to implement the needed pricing and investment changes within existing organizational structures. Air traffic control and airports could be privatized. Highways could more readily be commercialized, that is, the government would hand operation of its roads to private companies that would be regulated as public utilities and would finance their operations through user fees.

The second example of a proposal for fundamental changes, both institutional and technological, is a study (Samuel and Poole 1999) from the Reason Foundation, a nonprofit research organization that promotes market-based solutions to social problems. It argues that congestion on high-volume urban freeway systems can be eased, in spite of the difficulty that “pushing new freeways through dense and expensive urban landscapes will seldom be economically or politically feasible,” by making better use of existing right-of-way. A set of innovations is proposed that the authors argue would be feasible if implemented jointly. The study cites successful experience abroad with similar measures. The proposals are as follows:

- Separate operation of trucks from cars on high-volume urban expressways. Construct truck-only lanes with pavement and structure designs needed to carry bigger trucks.
- Adopt innovative highway redesign, including double-decking existing freeways and construction of urban tunnels for cars. These structures are cheaper to build if they do not have to be sized for trucks.
- Finance the new construction through tolls assessed electronically. In addition to providing adequate revenue, tolls would allow congestion pricing, which would reduce the peak capacity requirements, improving economic feasibility.

Finally, one example of approaches to these problems outside the United States is the 1998 *A New Deal for Transport: Better for Everyone: The Government's White Paper on the Future of Transport*, a statement and explanation of government transportation policy in the United Kingdom (Department for Transport, Local Government, and the Regions 1998). Although institutions differ greatly, the underlying challenges facing freight transportation development are similar in most of the developed economies: the industry is a mixed public-private enterprise that has been experiencing a period of growth and changing demand characteristics, including expansion of international trade and containerization. Freight requirements conflict with environmental values and competing land uses.

The U.K. white paper devotes most attention to the goals of reducing car dependence and improving public transport, but also presents freight policies. The freight proposals include market-oriented reforms alongside policies to promote explicit goals for altering the market shares of the modes. Rail and general surface freight transportation proposals include the following:

- A set of actions is to be undertaken to promote the shifting of freight out of truck and onto rail, waterways, and coastal shipping. The goals of the private rail freight operators of

achieving a doubling of freight ton-kilometers and a 50 percent increase in container traffic in 5 years are endorsed.

- A new Strategic Rail Authority is to be created, responsible for coordinating freight and passenger use of the rail infrastructure and promoting growth of rail freight by providing more capacity.
- New land use planning rules will require local authorities to protect opportunities for targeting industrial development in areas with good rail access.
- Grants will be provided to the private sector to encourage shifts in freight from road to rail.

Proposals dealing specifically with trucks and highways include the following:

- The truck weight limit is to be raised from 38 to 41 metric tons. The limit is not to be raised to 44 tons, which is the common standard in Europe, to minimize shifts of freight from rail to road.
- Vehicle excise taxes are to be reviewed to ensure that rates reflect environmental and road costs of different truck types. Higher truck weight limits will be considered in conjunction with tax reform.
- Pilot schemes for collecting road user charges on trunk roads will be instigated. Dedicated income streams from new road user charges will be available for local transport improvements.
- “Quality partnerships for freight” involving truck operators, local authorities, and shippers will be formed to resolve local distribution issues. Peak-hour truck delivery restrictions will be encouraged.

Port and waterborne commerce proposals include the following:

- The Strategic Rail Authority is to plan improved rail access to seaports, in conjunction with the private rail operators. The authority will have funds for subsidizing construction of rail connections.
- Port operators will be encouraged to increase capacity by improving efficiency of operations rather than by physical expansion, to avoid environmental degradation.
- Grants will be provided to promote use of domestic coastal shipping and inland waterways.

Aviation proposals include the following:

- A new national airports policy will be developed that provides for growth in air freight.

- Air traffic control is to be partly privatized (with the government retaining 49 percent of shares) as a way of obtaining the capital needed for upgrading.

Measures since 1998 have furthered some of these proposals. The Transport Act 2000 created the Strategic Rail Authority and authorized local governments to impose user charges on their roads. Several local governments, including that of London, are preparing to institute charges. Research is under way on motorway user charging schemes, and a proposal for reform of truck taxes has been published. In 2001, the government sold a controlling interest in National Air Traffic Services, the British air traffic control system, to a consortium of British airlines.

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Abbreviations

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| NCIT | National Commission on Intermodal Transportation |
| TRB | Transportation Research Board |

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Study Committee Biographical Information

Benjamin J. Allen, *Chair*, is Provost in the Interim of Iowa State University. During 2001–2002 he served as Interim Vice President for External Affairs and from 1994 to 2000 he was Dean of the College of Business. In 1988 Dr. Allen was named the first University Distinguished Professor in Business at Iowa State. Before joining the Iowa State University faculty in 1979, Dr. Allen taught at Washington State University and was a Brookings Economic Policy Fellow at the U.S. Department of Transportation. He received a Ph.D. in 1974 in economics and an M.A. in 1973 from the University of Illinois and a B.S. in 1969 from Indiana University. He is a member of the American Economic Association, the Transportation Research Forum, and the American Society of Transportation and Logistics. Dr. Allen's research has been in motor carrier management, rail industry structure, and regulation.

Paul H. Bingham is Principal, Global Insight, Inc. Previously he was with the Columbus Group; Booz Allen & Hamilton; ICF Kaiser International, Inc.; and DRI/McGraw-Hill. He is Chair of TRB's Committee on Freight Transportation Data and a member of the Transportation Research Forum and the International Trade Data Users Group. His professional interests include freight forecasting and freight databases. He received a B.S. from the University of Maryland.

Lillian C. Borrone is former Director of Port Commerce, Port Authority of New York and New Jersey. She is a former Chair of the American Association of Port Authorities and Board Member of the International Association of Ports and Harbors, North Atlantic Ports Association, and the Regional Business Partnership in Newark, New Jersey. She is a member of the National Academy of Engineering. She is Chairman of the DOT Advisory Committee to the Bureau of Transportation Statistics. She is a former Chair of TRB's Executive Committee and a member of the Marine Board Executive Committee. She received an M.S. from Manhattan College and a B.S. from American University.

Kenneth J. Button is Distinguished Research Professor at the Institute of Public Policy, George Mason University. He was on the faculty of Loughborough University (United Kingdom) from 1983 to 1996. He received a Ph.D. in economics from Loughborough University. His research interests include urban and regional economics, land use, regulation, and transport policy.

Joseph J. Catto is President, Professional Representation, Inc., a consultancy in transportation and distribution services. He was with American Cyanamid Company/Cytec Industries from 1974 to 1995 as Director, Transportation, and in other positions. He was in financial positions with Precision Polymer, Allied Chemical, RCA Victor, and Dun and Bradstreet from 1957 to 1974. He received an M.B.A. from Seton Hall University and a B.S. from Fordham University.

G. Edward Dickey is a consultant and a Professor of Economics at Loyola College, Maryland. He is a former Chief of the U.S. Army Corps of Engineers Civil Works Planning Division and a former Acting Principal Deputy Assistant Secretary of the Army (Civil Works). He is a member of the National Research Council's Committee to Review the New York City Watershed

Management Strategy. He received a Ph.D. in economics and an M.A. from Northwestern University and a B.A. from Johns Hopkins University.

Stephen W. Fuller is Professor, Department of Agricultural Economics, at Texas A&M University. He has been on the Texas A&M faculty since 1974. Formerly he was Assistant Professor of Agricultural Economics at New Mexico State University. He received a B.S., an M.S., and a Ph.D in economics from Kansas State University. Dr. Fuller's research interests include agricultural marketing, transportation and logistics, and international agricultural trade.

Cameron Gordon is Executive Director of the American Council on Intergovernmental Relations. He was formerly Assistant Professor at the University of Southern California School of Public Policy. He has been on the staff of the U.S. Advisory Commission on Intergovernmental Relations and on the staff of the Joint Committee on Taxation of the U.S. Congress; he was also with the New York City Department of Environmental Protection. He received a Ph.D. in economics from the City University of New York.

Randall K. Halvorson is Assistant Commissioner for Transportation Research and Investment Management at the Minnesota Department of Transportation. His administrative responsibilities include statewide planning; research; and rail, motor carrier, and waterway programs. He has been with the department since 1974. He was a member of TRB's Committee on Statewide Multimodal Transportation Planning and Committee on Intergovernmental Relations and Policy Processes. He received an M.A. in political science and a B.A. from the University of Minnesota.

James R. Hertwig is President, Landstar Logistics, Inc. He has over 30 years experience as an executive in the transportation industry. He has served on the Board of Directors of the Intermodal Association of North America and the Board of Directors of the Florida Trucking Association. In 1998, he was appointed by the Governor of Florida to serve on the state's Intermodal Freight Task Force. He is a member of the Council of Logistics Management and the American Society of Transportation and Logistics.

James W. McClellan is Senior Vice President, Planning, Norfolk Southern Corporation. He has been with Norfolk Southern since 1977; he was formerly with the Association of American Railroads, the Federal Railroad Administration, and Amtrak. He is a member of TRB's Committee for the High-Speed Rail IDEA Program. He received a B.S. from the University of Pennsylvania.

Edward K. Morlok is UPS Foundation Professor of Transportation, Department of Systems Engineering, University of Pennsylvania. He has been at Penn since 1973 and has served as Chairman of the Systems Engineering and Transportation graduate programs. He was formerly on the faculty of Northwestern University. His Ph.D. in civil engineering is from Northwestern University and his undergraduate degree is from Yale University. He is a past Chair of TRB's Committee on Freight Transportation and Logistics and the Committee for the Study of Policy Options to Address Intermodal Freight Transportation. He is a member and past President of the Transportation Research Forum. Professor Morlok's research interests include intermodal freight transportation, information technology, and logistics.

Carmine Palombo is Director of Transportation Programs, Southeast Michigan Council of Governments (SEMCOG). He is responsible for transportation planning and development of the region's Transportation Improvement Program; he has been with SEMCOG since 1976. He is a member of the Institute of Transportation Engineers and a Registered Engineer in Michigan. He received a B.C.E. from the University of Detroit.

Evelyn A. Thomchick is Associate Professor of Business Logistics at Pennsylvania State University. Her research interests include international freight transportation and logistics. She was formerly with Bethlehem Steel and the NASA Langley Research Center. She is a member of the Board of Directors of the American Society of Transportation and Logistics and is a member of the Council of Logistics Management. She received an M.S. and a Ph.D. in engineering management from Clemson University and a B.S. from Pennsylvania State University.

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