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Report to the Ranking Minority Member, Committee on Commerce, Science, and Transportation, U.S. Senate

June 2004

SURFACE TRANSPORTATION

Many Factors Affect Investment Decisions

GAO-04-744

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Highlights

Highlights of GAO-04-744, a report to the Ranking Minority Member, Committee on Commerce, Science, and Transportation, U.S. Senate

Why GAO Did This Study

Passenger and freight traffic are expected to grow substantially in the future, generating additional congestion and requiring continued investment in the nation's surface transportation system. Over the past 12 years, the federal government has provided hundreds of billions of dollars for investment in surface transportation projects through the Intermodal Surface Transportation Efficiency Act of 1991 and its successor legislation, the Transportation Equity Act for the 21st Century. Reauthorization of this legislation is expected to provide hundreds of billions of dollars more in federal funding for surface transportation projects. For this investment to have the greatest positive effect, agencies at all levels of government need to select investments that yield the greatest benefits for a given level of cost.

This report provides information about the processes that state and regional transportation decision-makers use to analyze and select transportation infrastructure investments. GAO identified (1) key federal requirements for planning and deciding on such investments, (2) how benefit-cost analysis facilitates sound decision-making, and (3) other factors that decision-makers consider in evaluating and deciding on investments. We provided copies of this report to the Department of Transportation for its review. The Department generally agreed with the report's contents and provided technical comments, which we incorporated as appropriate.

www.gao.gov/cgi-bin/getrpt?GAO-04-744.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Kate Siggerud, (202) 512-2834, siggerudk@gao.gov.

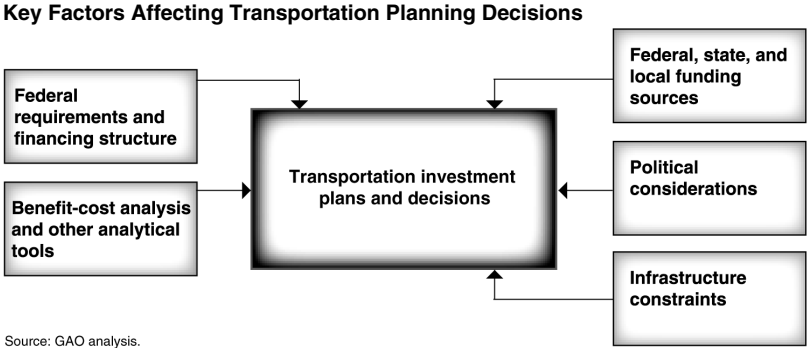
What GAO Found

Federal requirements specify the overall approach that states and regional organizations should use in planning transportation infrastructure projects, but generally do not specify what analytical tools planners should use to evaluate projects. These key requirements include developing strategic goals and objectives; considering a wide range of environmental and economic factors; preparing long- and short-range plans; and ensuring an inclusive process that involves many stakeholders.

The Office of Management and Budget, the Department of Transportation (DOT), and GAO have identified benefit-cost analysis as a tool to help decision-makers identify projects with the greatest net benefits. The systematic process of benefit-cost analysis helps decision-makers organize information about, and determine trade-offs between, alternatives. Researchers also acknowledged challenges in applying benefit-cost analysis, including quantifying some benefits and costs, defining the scope of the project, and ensuring the precision of estimates used in the analysis. Ongoing research by DOT and others is aimed at improving and expanding state and regional decision-makers' application of benefit-cost analysis.

Many of the transportation planners we interviewed said that factors other than the analyses developed during the planning process often influenced final investment decisions. For example, state and regional decision-makers must consider the structure of federal funding sources. Since federal funding often is tied to a single transportation mode, it may be difficult to finance projects that do not have dedicated funding, such as railroad improvement projects. In addition, decision-makers must ensure that wide-ranging public participation is reflected in their deliberations and that their choices take into account numerous views. In some cases, voter support through referenda is required before a project may proceed or financing can be secured. The physical constraints of an area may also affect investment choices. Difficulties in expanding capacity and limits on existing infrastructure may direct investments to preserving and maintaining existing facilities or improving operations. Finally, multistate transportation corridors present special challenges in coordinating investment decisions.

Key Factors Affecting Transportation Planning Decisions



Source: GAO analysis.

Contents

Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
APTA	American Public Transportation Association
CALTRANS	California Department of Transportation
CMAQ	Congestion Mitigation and Air Quality Improvement Program
CREATE	Chicago Regional Environmental and Transportation Efficiency
DOT	Department of Transportation
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FAF	Freight Analysis Framework
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITS	Intelligent Transportation Systems
MPO	Metropolitan Planning Organization
NCHRP	National Cooperative Highway Research Program
OMB	Office of Management and Budget
NEPA	National Environmental Policy Act
SCAG	Southern California Association of Governments
STIP	State Transportation Improvement Program
STP	Surface Transportation Program
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century
TIP	Transportation Improvement Program
TRB	Transportation Research Board

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Accountability * Integrity * Reliability

United States General Accounting Office
Washington, DC 20548

June 30, 2004

The Honorable Ernest Hollings
Ranking Minority Member
Committee on Commerce, Science and Transportation
United States Senate

Dear Mr. Hollings:

The scope of the U.S. surface transportation system—which primarily includes roads, mass transit systems, and railroads—is vast and increasingly congested.[1] Passenger and freight traffic are expected to grow substantially in the future, requiring continued investment in the surface transportation system. For example, from 2000 to 2010, passenger travel on roads is expected to grow by about 25 percent, and passenger travel on transit systems is expected to increase by about 17 percent, according to U.S. Department of Transportation (DOT) forecasts. DOT also estimates that freight traffic will increase by 43 percent from 1998 to 2010.

Over the past 12 years, the federal government has provided hundreds of billions of dollars for investment in surface transportation projects through the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and its successor legislation, the Transportation Equity Act for the 21st Century (TEA-21), which expired in 2003 but has been subsequently extended.[2] Reauthorization of this legislation—an issue currently before Congress—is expected to provide hundreds of billions of dollars more in federal funding for surface transportation projects over the next 6 years. For this investment to have the greatest positive effect on emerging transportation problems, agencies at all levels of government will need to select projects that provide the greatest benefits for a given level of cost. Making cost-effective investment choices will become even more critical if, as some experts believe, the nation faces a sustained

[1]In this report, we specifically included highways, mass transit systems, intercity passenger railroads, commuter railroads, and freight railroads in our definition of surface transportation modes.

[2]State and local governments provide an even greater share of the funding for surface transportation investments than the federal government. For example, in fiscal year 1999, state and local governments contributed 75 percent of the total public sector spending for public roads and 85 percent of total public spending for transit systems.

period of deficits and fiscal imbalance, resulting from growing mandatory commitments for Social Security and Medicare and increased homeland security and defense commitments. These challenges require the nation to think critically about existing government programs and commitments and implement decision-making processes that will provide the most cost-beneficial outcomes.

The federal government has established a framework of planning requirements and processes designed to improve the quality of decisions about investing in transportation infrastructure investments. ISTEA and TEA-21 specified much of this planning and decision-making framework. Various analytical approaches have been refined over time to better calculate the benefits and costs of transportation investments and provide decision-makers with the tools to make better-informed choices. This report responds to your request for information about the processes that transportation decision-makers at all levels of government use to analyze and select surface transportation infrastructure investments. As agreed with your office we identified (1) key federal requirements for planning and deciding on surface transportation infrastructure investments, (2) how benefit-cost analysis facilitates sound transportation investment decisions, and (3) other factors that transportation decision-makers consider in evaluating and deciding on investments.

To identify the key processes for transportation infrastructure planning and decision-making, we reviewed existing federal laws, regulations, and guidance on the transportation planning process and interviewed federal, state, regional, and local transportation agency officials to gain their perspective on the different federal requirements. To identify how benefit-cost analysis facilitates sound transportation investment decisions, we analyzed the existing economics literature and transportation planning studies containing evaluations of benefit-cost analysis, and we interviewed academics and representatives of a broad range of transportation organizations to gain their perspective on issues, including the generalizability of benefit-cost analysis and the feasibility of comparisons among various transportation modes. To identify other factors that decision-makers consider in evaluating and deciding on investments, we (1) analyzed pertinent research on transportation planning and decision-making, as identified by our own review of the research and by transportation researchers we interviewed; (2) reviewed planning documents and analyses used by state, regional, and local transportation decision-makers; and (3) interviewed federal, regional, state, and local transportation officials; representatives of private sector and civic organizations; and other transportation experts involved in the planning

and decision-making processes. Many of these interviews and document reviews were part of site visits that we conducted in three metropolitan areas that are major centers of passenger and freight traffic—Chicago, IL; Los Angeles, CA; and San Francisco, CA—to understand how investment decisions were actually made in those locations. To ensure the reliability of information presented in this report, we relied to a large extent on studies from the economics and transportation literature that were reviewed by peers prior to publication; and we corroborated much of the testimonial information provided during our three site visits by obtaining documentation of investment decision-making processes and results. We conducted our work from September 2003 through June 2004 in accordance with generally accepted government auditing standards. (See app. I for more information about our scope and methodology.)

Results in Brief

Federal laws and requirements specify an overall approach for transportation planning and decision-making that states and regional agencies must follow in order to receive federal funds. This approach includes involving numerous stakeholders, identifying state and regional goals, developing long- and short-range state and metropolitan planning documents, and ensuring that a wide range of transportation planning factors are considered. The many stakeholders include not only state, regional, and local agencies, but also private industry and the public. The planning process begins with the definition of overall state and regional goals and objectives. As part of this process, states and Metropolitan Planning Organizations (MPO)[3] must collect and analyze data to help evaluate project priorities. These priorities are specified in state and metropolitan long-range plans and short-range programs. Long-range plans identify transportation needs for the next 20 years or more, and short-range programs identify specific projects to be initiated in the near future, usually about 3 years. Both state and metropolitan short-range programs must specify funding sources and be financially constrained.[4] In selecting

[3]MPOs are regional transportation policy bodies made up of representatives from various governmental and other organizations. The Federal Highway Act of 1970 required the development of such agencies in areas with populations of 50,000 or greater to carry out cooperative planning at the metropolitan level. These organizations were created to ensure that federal funds would be spent through a transportation planning process that was based on continuing, comprehensive, and cooperative planning.

[4]To be financially constrained, state and MPO short-range programs must include a financial plan that demonstrates which projects can be implemented using existing revenue sources and which projects are to be implemented using projected revenue sources.

projects for the plan, states and MPOs must consider a wide range of planning factors specified by the federal government, such as conformity with environmental and civil rights laws, preservation of existing systems, and increasing accessibility and mobility, among others. While federal requirements specify a wide range of these specific factors, they generally do not specify what analytical tools—such as benefit-cost analysis—planners should use to evaluate these factors. Instead, states and MPOs are largely responsible for selecting the methods used to analyze these factors.

The Office of Management and Budget (OMB), DOT, and GAO have identified benefit-cost analysis as a useful tool for integrating the social, environmental, economic, and other effects of investment alternatives and for helping decision-makers identify projects with the greatest net benefits. In addition, the systematic process of benefit-cost analysis helps decision-makers organize and evaluate information about, and determine trade-offs between, alternatives. Research and best practices indicate key steps of the analysis to ensure that the analyst defines the project objectives, identifies all reasonable alternatives, and systematically evaluates and compares the projected effects of each alternative. Challenges of benefit-cost analysis include difficulties in identifying the distribution of benefits and costs of alternative projects across affected locations and population groups, quantifying and assigning a dollar value to some effects, defining the scope of the alternative projects, and ensuring the precision of estimates used in the analysis. Notwithstanding these challenges, benefit-cost analysis remains an important and useful tool in helping select transportation infrastructure projects. DOT agencies and the National Research Council's Transportation Research Board have initiatives under way to improve benefit-cost analysis done by planners and to expand its use.

Transportation planners with whom we talked, particularly at the regional level, said that other factors, many of which are recognized in existing transportation legislation, can play a major role in final investment decisions. For example, transportation decision-makers consider the availability of federal funding sources, which are largely structured to direct funds to highways and transit systems, rather than railroads or intermodal projects. Also, transportation decision-makers are aware that they must achieve a consensus on improvements while incorporating public participation into the process. In some cases, achieving support from the voters through referenda is required before projects may proceed or financing can be secured. This need for voter support is an especially important factor in California, where sales taxes have become a primary

source of funding new transportation infrastructure. Furthermore, physical limitations also affect choices of transportation investments. Difficulties in expanding capacity and limits on existing infrastructure may direct available investments toward preserving and maintaining facilities or improving operations rather than building new infrastructure. Nationwide, spending on system preservation—as a share of highway capital spending—from all sources increased from 45 percent to 52 percent from 1993 to 2000. In Chicago, transportation planners cited system preservation as a primary consideration in making decisions about projects and in the Los Angeles and San Francisco regions, fully 80 percent of transportation funds are spent on system preservation, maintenance, and operations. Finally, long, multistate transportation corridors may present special planning and coordination challenges. Achieving cooperation and coordination among multiple agencies, communities, and transportation modes—each with its own priorities—makes the planning and implementation of multistate and multiregion projects difficult. In some cases, ad hoc state coalitions have emerged to try to meet this need, especially in coordinating intelligent transportation system technologies.[5] However, planning for intrastate transportation corridors fits more easily into the framework of state planning.

We provided copies of this report to the Department of Transportation for its review and comment. The department generally agreed with the report's contents and also provided technical comments, which we incorporated as appropriate.

Background

The nation's federal surface transportation investment policy has become increasingly complex, changing from a narrow focus on completing the nation's interstate highway system to a broader emphasis on maintaining and more efficiently operating our highways, supporting mass transit, protecting the environment, and encouraging innovative technologies. With the interstate system largely completed in the 1980s—and continuing with the passage of ISTEA in 1991 and TEA-21 in 1998—the federal government has shifted its focus toward preserving and enhancing the capacity of the transportation system by supporting a large network of highway, mass transit, and other surface transportation programs and projects.

[5]Intelligent Transportation Systems are technology-based systems intended to improve the safety, efficiency, and effectiveness of transportation facilities.

The funding for transportation plans and projects comes from a variety of sources including federal, state, and local governments; special taxing authorities and assessment districts; and user fees and tolls. While metropolitan areas receive transportation funds from state and local sources, the federal government also is a significant funding source, using revenues from federal highway tax receipts and supplemented by general fund revenues. ISTEA and TEA-21 continued the use of the federal Highway Trust Fund—which is divided into a Highway Account and Mass Transit Account—as the mechanism to account for federal highway user tax receipts that fund various surface transportation programs. The Federal Highway Administration (FHWA) distributes highway program funds to state transportation departments that, in turn, allocate the funds to urban and rural areas on the basis of local priorities and needs.[6] The Federal Transit Administration (FTA) sends most urban transit funds directly to local transit operators while state transportation departments administer rural transit funds. In some cases, Congress may designate specific transportation projects for funding. For example, TEA-21 allocated $9.4 billion over 6 years to 1,850 congressionally designated projects. Finally, ISTEA and TEA-21 also allowed the use of certain federal highway program funds for either highway or transit projects, referred to as flexible funding.[7]

Key issues—such as traffic congestion, air pollution, land use and sprawl, the economic viability of neighborhoods and commercial areas, and facilitating national economic growth—are significantly affected by decisions about how federal transportation funds are spent. These decisions grow out of an overall transportation planning and decision-making process involving states, MPOs, local governments, and other stakeholders.

[6]A portion of the Surface Transportation Program funds is allocated directly to Transportation Management Areas, which are urbanized areas over 200,000 in population.

[7]Flexible funding is primarily available in FHWA's National Highway System, Surface Transportation Program, Congestion Mitigation and Air Quality Improvement Program, and for FTA's Urban Formula Funds.

Federal Requirements Specify an Approach for Planning and Deciding on Transportation Projects

Federal laws and requirements specify an overall approach for transportation planning agencies to use in planning and deciding on projects. State, regional, and local government agencies must operate within these requirements to receive federal funds. The laws and requirements—which include ISTEA, TEA-21, and their associated regulations—establish certain requirements governing the way states and local governments plan and decide upon transportation projects. In particular, the requirements describe various planning tasks that states and MPOs must perform, including (1) involving a wide range of stakeholders in the process; (2) identifying overall goals and objectives and data to support transportation investment choices; (3) developing long- and short-range transportation programs and plans; (4) specifying financing for the transportation programs and projects; and (5) ensuring that the transportation planning and decision-making process reflects a variety of planning factors, such as environmental concerns. States and MPOs must consider a wide range of planning factors laid out in federal statutes and regulations. However, federal planning requirements generally do not provide specific guidance on how transportation planners should evaluate these factors.

Transportation Planning Involves Multiple Stakeholders

ISTEA and TEA-21 provided stakeholders with greater control over transportation decisions in their own regions than was done in the past and recognized that multiple agencies were responsible for planning, operating, and maintaining the entire transportation system. For this reason, the laws established a planning process that emphasizes cooperation and coordination among transportation stakeholders in the investment decision-making process. To achieve this goal, both ISTEA and TEA-21 sought to strengthen planning practices and coordination between states and metropolitan areas and between the private and public sectors and to improve connections between different forms of transportation. To foster involvement by all interested parties, states and MPOs are expected to provide opportunities for notice and public involvement throughout the planning and project selection process. For stakeholders and other interested parties (see table 1), federal regulations require a formal public involvement process that includes reasonable access to technical and policy information used in developing transportation plans as well as adequate periods for public comment.

Table 1: Potential Stakeholders Involved during the Metropolitan and Statewide Planning Process

Potential stakeholders
• Elected officials, • Public transit operators, • Affected public agencies, • Representatives of transportation agency employees, • Freight shippers, • Providers of freight transportation services, • Private providers of transportation, • Representatives of users of public transit, • Citizens, and • Other interested parties.

Source: GAO analysis of federal metropolitan and statewide transportation planning statutes and regulations.

State departments of transportation—working with transportation organizations, local governments, and the public—develop state transportation goals and plans. Local governments, such as cities and counties, and regional entities, such as MPOs, carry out additional transportation planning and project implementation functions, especially for highway projects. Transit agencies, in addition to operating transit services such as bus, subway, light rail, commuter railroad, and other forms of mass transit, also plan and implement capital projects. Other organizations, such as nonprofit, environmental, and community organizations, are involved in transportation decision-making through the public participation process. Finally, private sector firms also may participate as advisors in the planning and decision-making process, especially when public decisions directly affect their interests.

MPOs, which are regional transportation policy bodies composed of representatives from various governmental and other organizations, are key players in the coordination of transportation plans and projects. MPOs are designed to provide a setting for impartial transportation decision-making by facilitating evaluation of alternatives, development of long- and short-range planning documents, and public involvement. In particular, MPOs provide the forum for the various providers of transportation

facilities[8] to come together to develop a more comprehensive approach to meeting regional transportation needs. Finally, DOT oversees state and metropolitan transportation planning and provides advice and training on transportation issues.

Transportation Planning Requires Identifying an Overall Vision and Analyzing Alternatives before Deciding on Projects

In initiating the transportation planning process, states and MPOs are expected to have a long-term vision that articulates broad goals for the future of the transportation systems in the state or region. DOT guidance states that in developing the long-term vision, states and regions are to consider several factors, including projected population growth and economic changes, current and future transportation needs, maintenance and operation of existing transportation facilities, preservation of the human and natural environment, and projected land uses. States and MPOs may also conduct investment and planning studies to identify major transportation corridors in the state or region.

In deciding which proposed transportation projects meet the needs and reflect the long-range vision of the state or region, states and MPOs are required to establish a process for collecting and analyzing data to evaluate different transportation alternatives and using the resulting information to establish priorities for improving the area's transportation assets. As part of this process, transportation planners may develop performance measures and transportation models to evaluate existing or proposed projects. Performance measures are important indicators of how well the transportation system is operating. Some examples of user-oriented performance measures are average trip travel time, length of delay, and reliability of trip making. Transportation models are simulations of the "real world" that can be used to show the impact of changes in a metropolitan area on the transportation system (such as addition of a new road or transit line or increases in population or employment). Specific types of transportation models are not required by federal planning regulations.

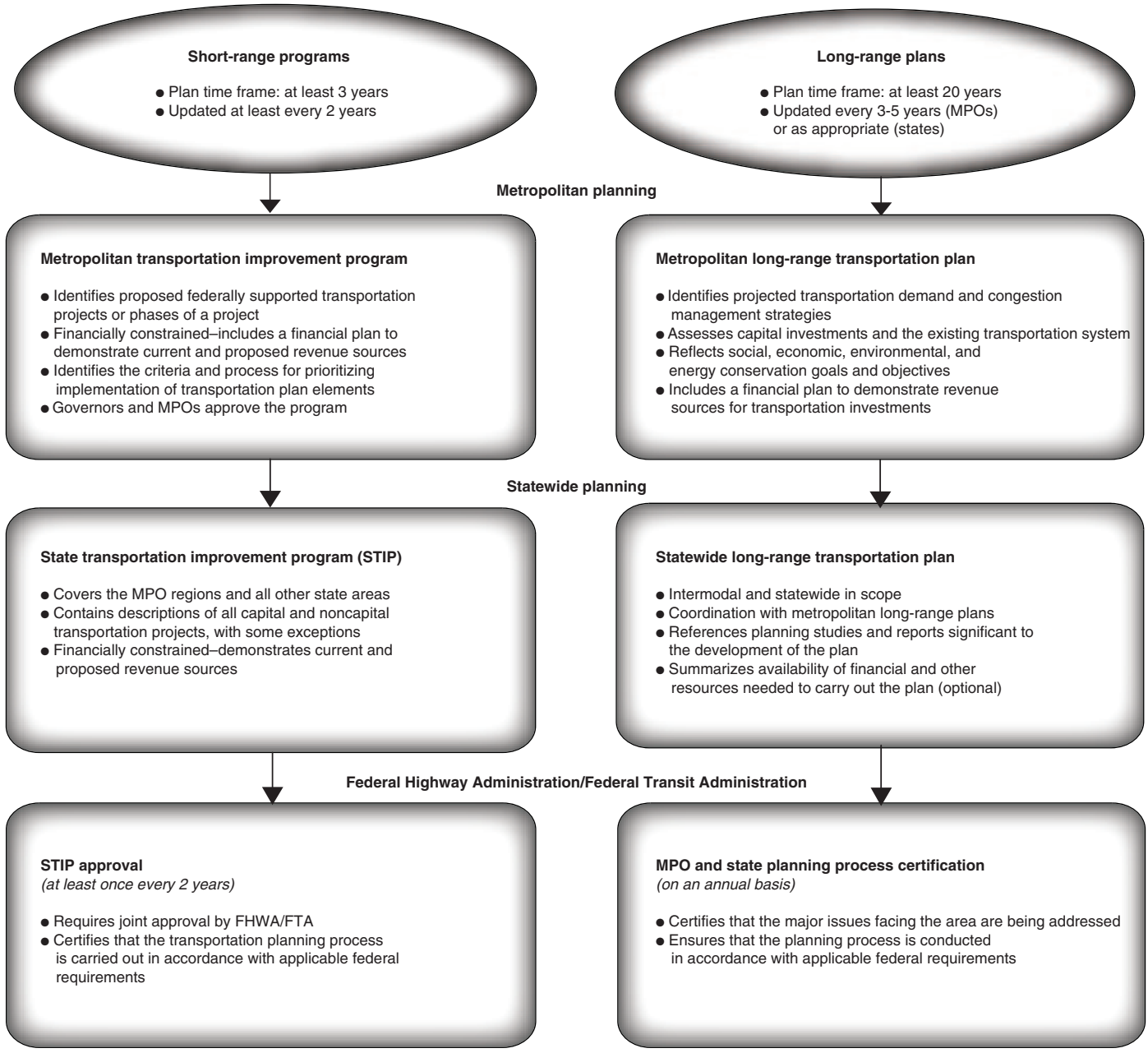
[8]Transportation facilities refers to all of the fixed physical assets of a transportation system, such as roads, train stations, bus terminals, bridges, and bike paths.

Federal Laws Require That Transportation Needs and Proposed Projects Be Documented in Long-Range Plans and Short-Range Programs

After articulating a vision of overall transportation goals and considering alternative ways of reaching those goals, federal laws and regulations require that states and metropolitan areas document their decisions about future transportation needs and their selection of federally funded surface transportation projects through long-range transportation plans and short-range programs.[9] A metropolitan long-range transportation plan identifies transportation needs for at least the next 20 years, but does not necessarily identify specific projects. It is expected to include a description of congestion management strategies as well as capital investments and other measures necessary to (1) ensure the preservation of the existing transportation system and (2) make the most efficient use of existing transportation facilities to relieve congestion and enhance the mobility of people and goods. A state long-range plan is expected to be developed in cooperation with MPOs in the state and to be intermodal and statewide in scope. (see fig. 1).

[9]23 U.S.C. 134 (metropolitan planning); 23 U.S.C. 135 (statewide planning); 23 C.F.R. 450 (planning assistance and standards).

Figure 1: Federally Required Elements of Metropolitan and Statewide Transportation Plans



Source: GAO analysis of federal regulations governing metropolitan and statewide transportation planning.

In contrast to the long-range plan, a short-range program covers a more limited time frame—usually about 3 years—and describes specific transportation projects or phases of an included project, including the scope and estimated costs of those projects. In a metropolitan short-range Transportation Improvement Program (TIP), MPOs are required to identify the criteria and process for prioritizing proposed transportation projects, including the extent to which comparisons among modes were considered. In addition, all surface transportation projects that are to receive federal funding must be included in the metropolitan and state programs to receive federal funds. At the state level, each state DOT is expected to work cooperatively with its MPOs to develop a single State Transportation Improvement Program (STIP), which is an intermodal program of projects encompassing all the areas of the state. The STIP incorporates TIPs developed by the MPOs within the state, and a project in a metropolitan region must be included in the TIP before it may be included in the state program. Once adopted by the state, the STIP is concurrently submitted to FHWA and FTA for approval at least once every 2 years. In addition to approving the STIP, FHWA and FTA are also responsible for certifying that the state planning processes are conducted in accordance with all applicable federal requirements.

Under federal requirements, states and MPOs must specify funding amounts and sources for transportation programs and projects. States and MPOs must consider funding needs for both new projects and the maintenance and operation of the existing transportation system. Financial planning is part of both the short- and long-range planning processes and includes identification of resources that are reasonably expected to be available. Projects in the TIP and STIP are specifically linked to funding sources and additional strategies for securing funds are included in the plan.

While federal requirements specify that all MPOs have an analytical process in place to help prioritize and select projects, how projects originate and are selected for inclusion in transportation plans and programs may vary in different regions. In some instances, state DOTs are heavily involved in the metropolitan planning process. For example, the Illinois DOT heavily influences the planning process in metropolitan Chicago. In contrast, by state law, California has chosen to give more planning and decision-making power to counties by directly allocating a

greater share of transportation funds to the counties.[10] Another defining characteristic of transportation project development in the sites we visited in California is direct citizen involvement in selecting transportation projects through local ballot initiatives.

Many Factors To Be Considered Throughout the Planning and Decision-Making Process

Federal legislation has identified many factors that states and metropolitan areas are to consider in planning and deciding on surface transportation investments. As shown in table 2, these factors include environmental compliance, safety, system maintenance and operations, and land use, among others.[11]

[10]California state law requires that 75 percent of state transportation funds be allocated directly to counties under the Regional Transportation Program, with the remaining 25 percent allocated to the state transportation planning agency for its interregional transportation program. Counties within the MPO region do the actual project planning.

[11]See Federal Highway Administration and Federal Transit Administration, *The Metropolitan Planning Process: Key Issues*, (Washington, D.C.: November 2001).

Table 2: Key Factors To Be Considered in Planning and Deciding on Transportation Investments, as Identified in Federal Requirements

Key factors
• Ensure compliance with provisions of the National Environmental Policy Act, Clean Air Act, and Civil Rights Act;
• Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;[a]
• Increase the safety and security of the transportation system for motorized and nonmotorized users;[a]
• Increase the accessibility and mobility options available to people and for freight;[a]
• Protect and enhance the environment, promote energy conservation, and improve quality of life;[a]
• Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight;[a]
• Promote efficient system management and operation;[a]
• Emphasize the preservation of the existing transportation system;[a]
• Promote congestion relief and prevention through management strategies/systems;
• Consider the likely effect of transportation policies on land use and development;
• Consider using innovative mechanisms for financing projects;
• Expand, enhance, and increase use of transit services;
• Examine the overall social, economic, energy, and environmental effects of transportation decisions;
• Consider access to ports, airports, and intermodal transportation facilities;
• Preserve rights-of-way access for future transportation projects;
• Consider connectivity of roads in areas outside MPO planning boundaries and in other states; and
• Consider recreational travel and tourism needs.

Source: GAO analysis of federal regulations governing metropolitan and statewide transportation planning.

[a]Planning factors designated in TEA-21.

For example, transportation planners and decision-makers must develop alternatives and select projects that conform to the requirements of a variety of laws, such as the National Environmental Policy Act (NEPA) of 1969 and Title VI of the Civil Rights Act.[12] Under NEPA, federal agencies must assess the impact of major federal actions significantly affecting environmental quality. Agencies document these analyses in environmental impact statements. This analysis serves two principal purposes: (1) to ensure that agencies have available detailed information concerning potentially significant environmental impacts to inform their

[12]The Civil Rights Act of 1964: 42 U.S.C. 2000(d).

decision-making, and (2) to ensure that the public has this information so that it may play a role in both the decision-making process and the implementation of the decision.

In analyzing the effects of a proposed action and alternatives, agencies must assess a variety of effects—including ecological, economic, and social. Agencies may include or refer to benefit-cost analyses in environmental impact statements. However, for purposes of complying with NEPA, the weighing of the merits and the drawbacks of the various alternatives need not be displayed in a monetary benefit-cost analysis and should not be when there are important qualitative considerations.[13] When it is uncertain whether the proposed action would have significant environmental effects, agencies use environmental assessments to determine whether the proposed action would have such effects and therefore whether an environmental impact statement is necessary. Environmental assessments are relatively brief documents that need not include detailed effects analyses. Most transportation projects do not require the preparation of the more detailed environmental impact statement. In addition to requirements for environmental assessments or environmental impact statements, in metropolitan regions that have significant air quality problems, transportation plans and programs must conform to the State Air Quality Plans, which outline strategies for reaching compliance with air quality standards established by the U.S. Environmental Protection Agency (EPA).[14] To meet these standards, states and MPOs in these designated regions must identify transportation projects that will help reduce motor vehicle emissions.

Title VI of the Civil Rights Act of 1964 prohibits discrimination on the basis of race, color, or national origin in programs and activities that receive federal financial assistance. To comply with Title VI, DOT issued regulations requiring recipients of federal transportation funds to provide assurances of compliance, periodic compliance reports, and access to relevant information about compliance. The regulations require that each MPO state that its planning process is in compliance with Title VI, as well

[13]See 40 C.F.R. 1502.23 dealing with Environmental Impact Statements and Cost-Benefit Analysis.

[14]The Clean Air Act of 1990 and Title 23 of the U. S. Code both require that transportation and air quality planning be integrated in areas designated by EPA as air quality nonattainment or maintenance areas. Nonattainment areas are geographic areas that do not meet the federal air quality standards, and maintenance areas are areas that formerly violated but currently meet the federal air quality standards.

as other statutory requirements. Both Title VI and NEPA require involvement and input from the public, interest groups, resource agencies, and local governments throughout the transportation planning and project development process.

Transportation Planners Generally Have Discretion in Selecting Analytical Tools

Other than the NEPA requirements for environmental analyses, federal requirements give states and MPOs considerable flexibility in selecting specific analytical tools and elements used to evaluate projects and make investment decisions. For most surface transportation projects, current planning regulations require only that states (in coordination with MPOs) establish a process to conduct data analyses and evaluate alternatives for transit and highway projects. In defining the factors to be included in such an analysis, the requirements specify in general terms that states should consider identified social, economic, energy, and environmental effects of transportation decisions. Federal planning requirements also state that the metropolitan planning process should consider the cost-effectiveness and financing of alternative investments to meet transportation demand, support efficient transportation system performance, and consider the related impacts on social and economic development, housing, and employment goals. However, the requirements do not provide guidance to the states and MPOs on the types of analyses that are required or how they are to be prepared.

An exception to this approach applies to major transit system projects eligible for capital investment grants and loans under FTA's New Starts program. Under this program, FTA identifies and funds fixed guideway transit projects, including heavy, light, and commuter rail, ferry, and certain bus projects (such as bus rapid transit). In contrast to other FHWA and FTA programs where funds are distributed through statutory formulas, funding commitments for the New Starts program are made for specific projects, and projects are evaluated at various stages in the development process. For New Starts projects, federal requirements are more specific in terms of the types of data to be collected, the criteria for conducting an analysis, and the factors involved in evaluating a proposed project. For example, to be considered for possible New Starts funding, local project sponsors must prepare an alternatives analysis on the

benefits, costs, and impacts of alternative strategies to address a transportation problem in a given corridor.[15]

While FHWA and FTA guidance does provide some technical assistance on the use of various analytical tools and models, neither FHWA nor FTA advocates the use of any particular set of analytical tools, except for the New Starts program. In addition, according to a 1999 National Cooperative Highway Research Program report, decision-makers are often uncertain about the appropriate use of analytic tools, including their usefulness, reliability, and data requirements.[16] Furthermore, FHWA officials note that there currently is no minimum set of elements that are required to be included in an analytical model. In fact, FHWA officials point out the difficulty of establishing a consensus on modeling standards, especially since the use of tools or models varies from one region to the next. As a result, states and MPOs have largely been responsible for identifying and performing their own analyses during the planning process.

Benefit-Cost Analysis Is a Method for Evaluating Alternatives and Improving Transportation Infrastructure Decision-Making

Although the federal framework does not require the use of any particular tool, federal guidance advocates using benefit-cost analysis to evaluate investments. Benefit-cost analysis facilitates sound transportation investment decisions by integrating the effects of a potential alternative into a common monetary measure for comparison with other alternatives. In assessing the relative benefits and costs of each alternative, the analyst attempts to integrate social, economic, energy, and environmental impacts, in accordance with federal guidance, directly into the benefit-cost analysis. Research and best practices indicate that key steps of the analysis include defining the project objectives, identifying all reasonable alternatives, and systematically evaluating and comparing the projected effects of each alternative. Upon completion of the analysis, the decision-maker can derive useful information about the trade-offs among alternatives and identify the alternative that results in the greatest estimated net social benefit to society. Researchers acknowledge several practical challenges of benefit-cost analysis, such as difficulties in

[15]FTA proposes New Starts projects to the Congress for funding on an annual basis, based on an evaluation of their technical merits, including mobility improvements and cost effectiveness, and the stability of the local financial commitment.

[16]Transportation Research Board, *Guidance on Using Existing Economic Analysis Tools for Evaluating Transportation Investments*, prepared for the National Cooperative Highway Research Program, NCHRP 2-19 (2) (Washington, D.C.: October 1999).

quantifying some benefits and costs and defining the scope of the project. However, major transportation groups, such as DOT and the National Research Council's Transportation Research Board (TRB), continue to work on guidance and provide resources to improve and simplify benefit-cost analysis and other analytic tools for practitioners.

Federal Guidance Supports the Use of Benefit-Cost Analysis

While federal planning regulations for transportation generally do not require the use of specific analytical models, several federal sources have identified benefit-cost analysis as a useful tool to help decision-makers determine trade-offs between alternatives and identify projects with the greatest estimated net social benefits. For example, Executive Order 12893 states that expected benefits and costs should be quantified and monetized to the maximum extent practicable when evaluating federal infrastructure investments in the areas of transportation, water resources, energy and environmental protection.[17] Moreover, guidance from OMB on the planning of federal capital assets suggests that the selection of alternatives should be based on a systematic analysis of expected benefits and costs.[18] DOT encourages and provides guidance on the use of benefit-cost analyses in decision-making for transportation planning.[19] In addition, in the past, we have encouraged the use of benefit-cost analysis in other areas such as freight transportation.[20]

[17]Executive Order 12893, *Principles for Federal Infrastructure Investments* (Washington, D.C.: Jan. 26, 1994).

[18]See Office of Management and Budget, *Capital Programming Guide, Supplement to Office of Management and Budget Circular A-11, Part 3: Planning, Budgeting and Acquisition of Capital Assets* (Washington, D.C.: July 1997).

[19]For example, see FHWA Toolbox for Regional Policy Analysis, FHWA Economic Analysis Primer.

[20]See U.S. General Accounting Office, *Freight Transportation: Strategies Needed to Address Planning and Financing Limitations*, GAO-04-165 (Washington, D.C.: Dec. 19, 2003).

Benefit-Cost Analysis Integrates Multiple Effects Using a Systematic Approach to Evaluate Alternatives

Unlike most other types of analysis, benefit-cost analysis allows analysts to integrate multiple effects into a common monetary measure for assessment of a wide variety of alternatives. As discussed earlier in this report, federal guidelines encourage decision-makers to consider the potential social, environmental, and safety effects of transportation projects. Many tools and methods exist to analyze these effects separately, including models that forecast travel demand, emissions measurement tools, and other types of analyses. (See app. II for a comparison of benefit-cost analysis to other economic analyses.) However, benefit-cost analysis integrates and monetizes the quantifiable benefits and costs of each alternative, including the results of some of these other models. Therefore, benefit-cost analysis provides a more thorough assessment of the alternatives than an analysis of any single impact area.

Benefit-cost analysis is a systematic approach to evaluating alternative investments that attempts to quantify and monetize benefits and costs accruing to society from an investment. This analysis examines the immediate effects of the investment on the people using the investment and the effects that accrue to nonusers as a result of the investment. Examples of effects on users of transportation investments are reduced travel time and improved safety for drivers and transit passengers. An example of an effect on a nonuser is a change in pollution levels. From research and guidance on transportation investment analysis and our own previous work, we identified 10 steps that an analyst should perform for sound benefit-cost analysis, as shown in table 3.[21] (See app. III for a detailed discussion of each of the key elements of the analysis.)

[21]See U.S. General Accounting Office, *Consumer Product Safety Commission: Better Data Needed to Help Identify and Analyze Potential Hazards*, GAO-HEHS-97-147 (Washington, D.C.: Sept. 29, 1997).

Table 3: Key Elements for Benefit-Cost Analysis

Key elements
• Define project objectives; • Establish the base case for comparison; • Identify alternative projects; • Define a time frame for analysis; • Identify impacts of alternatives; • Quantify and monetize impacts as benefits and costs to the extent possible; • Discount benefits and costs to present values; • Compare benefits and costs of each project, using a common monetary measure; • Assess the sensitivity of the analysis to changes in assumptions and forecasted inputs; and • Identify the alternative that results in the estimated greatest net social benefit.

Source: GAO Analysis of economic literature and federal guidance documents.

Benefit-Cost Analysis Can Yield Valuable Information for Decision-Makers

In addition to assigning a single monetary value to each potential project, benefit-cost analysis provides decision-makers with valuable information for comparing investment alternatives. Specifically, benefit-cost analysis informs decision-makers about the relative merit of alternatives by systematically assessing and placing monetary value on the favorable and unfavorable effects of various investment options. That is, researchers state that benefit-cost analysis can help decision-makers better understand the implications of each alternative and make trade-offs between investment options more transparent. This process encourages objective analysis and can expose possible biases in decision-making.

The systematic process of benefit-cost analysis also helps decision-makers because it organizes information about the alternatives and converts dissimilar values, such as hours of travel time and number of accidents, to a comparable dollar measure. Researchers highlight benefit-cost analysis as a useful organizational tool because it aggregates key information relevant to the investment decision in a meaningful way. In addition, benefit-cost analysis offers a comparison of the benefits and costs that might accrue over time—including projected future operating costs and benefits to society that might not materialize immediately—and converts them to values in a single time period for more accurate comparison. In commenting on a draft of this report, FHWA noted that the discipline of going through the steps of benefit-cost analysis also could disclose important, timely information for public officials, planners, designers, and

the public, even if the data and methods used in the analysis are imperfect. Such timely information can facilitate decision-making.

During our site visit to Chicago, railroad officials noted the value of benefit-cost analysis in a practical application. The Chicago Regional Environmental and Transportation Efficiency project (CREATE) is a $1.5 billion plan that includes more than 70 infrastructure improvement projects to increase the efficiency and reliability of freight and passenger rail service, reduce highway congestion, and provide safety and environmental benefits in the Chicago area.[22] Benefit-cost analysis was key in the decision to proceed with this public-private partnership, according to several railroad executives. Project sponsors used an extensive model of the Chicago regional railroad network to help determine the effects of various upgrades to the network. The model showed the extent to which CREATE would resolve freight rail congestion problems—rather than merely pushing them to another location in the regional railroad network. Using the results of this model, benefit-cost analysis was critical in identifying the highest return on investment for individual project segments across the Chicago rail system and helping to illustrate public and private benefits. Benefit-cost analysis also helped provide a calculation of the level of benefits that private railroads would receive from the project, thus providing an estimate of the level of financial contribution that the railroads should make.

While the results of benefit-cost analysis aid decision-makers in selecting between alternatives, guidance on benefit-cost analysis advises decision-makers to augment the results of the analysis by considering other factors when weighing investment alternatives. Such other factors, like public participation and equitable distribution of benefits, are those that cannot be quantified or incorporated directly into the analysis due to practical challenges of benefit-cost analysis or limitations of the underlying information.

Benefit-Cost Analysis Has Practical Challenges

Although guidance from many federal agencies encourages the use of benefit-cost analysis as a useful tool for assessing the potential effects of transportation projects, such analysis has several practical challenges. One

[22]Chicago's rail system is the nation's largest freight hub, and the region also handles 73 million railroad passenger trips annually. Major bottlenecks have developed as a result of the region's need to move 1,200 trains each day.

challenge is that while benefit-cost analysis evaluates the net benefits of projects, it does not usually consider the distribution of benefits across locations or populations or other equity concerns that may exist with transportation investment projects.[23] Moreover, the outcome of benefit-cost analysis is a net value and therefore inherently eliminates any distinction between groups of citizens to whom benefits accrue. By summing the individual gains and losses to determine the effect on society as a whole, benefit-cost analysis assumes that each individual's gains or losses should be valued equally with any other individual's gains or losses.[24] For example, FHWA guidance notes that benefit-cost results might disproportionately rank projects in urban areas over those in rural areas because of the higher level of benefits urban projects may generate.

Another practical challenge of benefit-cost analysis is monetizing some impacts of transportation improvements, such as reductions in emissions, travel time saved, and increased safety and reductions in fatalities. Although agency guidance exists, researchers do not always agree on the appropriate methods and assumptions for valuing these effects. For example, a report by the National Cooperative Highway Research Program (NCHRP) cites several outstanding issues in placing economic value on the time people spend traveling, such as (1) the fraction of the wage rate that should be used for work-related travel and personal travel, (2) whether to apply the same time value for very short periods of time saved as for longer periods, and (3) how to account for variation of travel time.[25] Furthermore, debate surrounds the appropriate value of saving one statistical life through an improvement in safety; some advocates assert that human life is priceless and cannot be measured in monetary terms, while some researchers state that monetizing the impact of a reduction in fatalities leads to more complete analysis.[26] In commenting on a draft of this report, FHWA said that although there is some debate about the

[23]Analysts could address these distributional problems within benefit-cost analysis by mathematically weighting the benefits and costs to a disadvantaged group differently than the benefits and costs to other segments of the population. However, in practice, it is very difficult to determine appropriate weights and equitably assign them to different population groups.

[24]GAO-HEHS-97-147.

[25]Transportation Research Board, *Assessing the Social and Economic Effects of Transportation Projects*, NCHRP B25-19 (Washington, D.C.: February 2001).

[26]For additional discussion on this topic, see OMB, *Economic Analysis of Federal Regulations Under Executive Order 12866* (Washington, D.C.: Jan. 11, 1996).

monetary value of some impacts of transportation improvements, there is also much about the valuation of impacts that economists can agree on. For example, FHWA noted that monetary values available in agency guidance can be assigned to the performance measures—such as travel time saved—that are already calculated by regional models in order to aid the evaluation of proposed transportation projects.

Another challenge of implementing benefit-cost analysis is properly scoping the alternatives to analyze. Benefit-cost analysis is typically practiced as a way to compare one project against one or more individual projects rather than evaluating a system of projects. FHWA guidance cautions against evaluating a project that is actually a combination of two or more independent projects because an inefficient project might be hidden in the aggregate result. If multiple projects are aggregated and the net benefits of the group of projects are calculated, the result might indicate that the group of projects results in greater total benefits than the total costs incurred. However, one or more of the individual projects might not result in benefits greater than its costs if it were analyzed separately. Other research shows that analyzing each project independently and selecting projects without regard to the interrelation of the project outcomes can lead to selection of a combination of projects that do not maximize net benefits to society.[27] In other words, one project, such as traffic signal coordination, might complement another project, such as a dedicated bus lane. In such a case, independent assessment of each project would not reveal the full benefits of implementing both projects. According to FHWA, in cases where projects are significantly interrelated, but not dependent on each other to produce net benefits to society, the effects of one project on another (e.g., changes in traffic) should be included in the analysis.

Finally, because benefit-cost analysis integrates the effects of many different impact areas, it carries with it the challenges of forecasting and measuring the effects in those areas. For example, travel demand models forecast future use of the transportation system; therefore, their outputs become inputs to benefit-cost analysis. According to a TRB report, though travel demand models have been commonly used for 4 decades, few universally accepted guidelines or standards of practice exist for these

[27]Hof, John G. and Douglas B. Rideout, "Limitations of the With and Without Principle in Benefit-Cost Analysis," *Public Finance Quarterly* (17, 2) April 1989, pp. 216-226; and Cohn, Elchanan, "Benefit-Cost Analysis: A Pedagogical Note," *Public Finance Review* (31, 5) September 2002, pp. 534-549.

models or their application.[28] Practitioners' views on appropriate methods vary because each organization conducting analysis tailors the forecasting approach to its region's characteristics, available data, and the preferences and knowledge of the staff doing the analysis. The resulting uncertainty over the best approach to forecasting is an important challenge because such uncertainty can lead to imprecise or inaccurate inputs, which can severely affect the outcome of the analysis. For example, research on an emissions model highlights uncertainties in the data used to estimate reductions in vehicle emissions from congestion mitigation and concludes that these uncertainties lead to large uncertainties in the model outputs.[29]

Research Studies Are Available to Improve Benefit-Cost Analysis and Other Analytic Tools

Several major transportation organizations—TRB, FHWA, FTA, the Association of Metropolitan Planning Organizations, the American Association of State Highway and Transportation Officials (AASHTO), and the American Public Transportation Association (APTA)—conduct research to help MPOs address some of the practical challenges of implementing benefit-cost analysis, as well as other analytic tools. For example, FHWA has developed a "Toolbox for Regional Policy Analysis" that offers guidance on a variety of techniques, including benefit-cost analysis, that MPOs can use to evaluate investment alternatives. MPOs also may adopt best practices developed by other MPOs or use consultants to assist with analysis and modeling. Initiatives such as the Transportation Planning Capacity Building Program—sponsored by FHWA and FTA—offer peer exchanges, roundtables, and workshops to facilitate such information sharing. In addition, many studies that are relevant to analysis and decision-making come from two major applied, user-oriented research programs—the NCHRP, which focuses on highway research and the Transit Cooperative Research Program (TCRP).[30] In both programs, practitioners and other potential users of research results are involved in identifying their research needs, participating in selecting projects, and

[28]Transportation Research Board, *First Report of the Transportation Research Board's Committee for Review of Travel Demand Modeling by the Metropolitan Washington Council of Governments*, (Washington, D.C.: Sept. 8, 2003).

[29]Committee to Review EPA's Mobile Source Emissions Factor (MOBILE) Model, *Modeling Mobile-Source Emissions*, (Washington, D.C.: 2000).

[30]TRB administers both programs. State transportation departments that are AASHTO members have sponsored NCHRP in cooperation with FHWA since 1962 and make about $30 million available annually to sponsor its projects. FTA provides about $8 million annually and has worked with APTA's nonprofit education and research organization since 1992 to sponsor TCRP research.

helping guide projects. When research is complete, TRB publishes and widely disseminates the research findings.

Several experts have indicated that while transportation researchers have devoted considerable attention to developing detailed guidance on analysis and modeling, they anticipate an increasing emphasis on this issue. They emphasized that TRB is likely to lead a major analysis to review and improve the state of the practice in modeling transportation impacts, benefit-cost analysis, and other tools.

Many Other Factors Shape Transportation Investment Choices

While transportation decision-makers consider analyses, such as benefit-cost analyses, in investing resources to meet transportation needs, analyses often do not have a decisive impact on the final investment choices made by states and MPOs. According to transportation research, planning officials, and our prior work, other factors play a greater role in shaping decisions. For example, the federal funding structure for surface transportation and federal program incentives tend to focus decision-makers' attention on highway and transit projects and stakeholders rather than on railroads or other freight concerns. Moreover, there are relatively few instances in which decisions involve trade-offs among the various transportation modes to meet passenger and freight mobility needs, according to local planning officials. Decision-makers also are required to seek public input and involve a wide range of public and private stakeholders in reaching a consensus on investments. Ensuring that investment choices will maintain the existing infrastructure or improve its operation, rather than expand the transportation system's capacity, also appears to be an important priority for decision-makers. Finally, decision-makers are recognizing the importance of longer, multistate transportation corridors and the special challenges that they pose for investment decisions.

Analysis Assists, but Does Not Drive, Many Transportation Decisions

MPOs, especially in major metropolitan areas, produce a substantial amount of analysis and modeling, according to transportation experts we interviewed. The results of such analyses can be a factor in transportation investment decision-making. For example, as noted previously in this report, transportation decision-makers in Chicago stated that the results of benefit-cost analysis had factored into their decision to implement the CREATE project. However, such analyses do not appear to play a decisive

role in many investment decisions, although they may help rule out bad investments and point out serious problems.[31] For example, planners in Los Angeles noted that the projects selected for the TIP were not necessarily the ones with the highest benefit-cost ratios, although their analysis showed that every project in the plan did generate more benefits than costs. In addition to the limitations of benefit-cost analysis we discussed previously in this report, decision-makers may not be relying upon analyses, in part, due to various concerns about the usefulness and reliability of the analyses, according to the transportation research literature and our interviews with experts and officials in Chicago, Los Angeles, and San Francisco.

State DOTs and MPOs have expressed uncertainty about the usefulness of analytical tools in guiding their transportation planning and decision-making. For example, states and MPOs view existing analytical tools as having limited usefulness in comparing investment alternatives among transportation modes and between passenger and freight investments. TRB's applied research programs are trying to address this need through development of specific tools to help in making multimodal trade-offs. In addition, understanding how and when to use analysis is challenging for decision-makers.[32] During our site visits, we found few instances in which investment decisions involved direct cross-modal trade-offs, such as railroad versus highway. According to a NCHRP survey published in 2001,[33] 88 percent of state DOT respondents and 85 percent of MPO respondents reported that more useful guidelines—such as a guidebook for agency use in applying methods and analytic techniques—was either badly needed or would help to enhance the agency's ability to evaluate the social and economic effects of transportation system changes. Accordingly, the study concluded that decision-makers need to be able to better select when, how, and why to use particular analytic tools in investment decisions.

[31]For example, financial analysis and air quality conformity analysis might reveal concerns that would play an important role in some investment decisions.

[32]Transportation Research Board, *Guidance on Using Existing Economic Analysis Tools for Evaluating Transportation Investments,* NCHRP 2-19 (2), (Washington, D.C.: October 1999).

[33]Transportation Research Board, *Assessing the Social and Economic Effects of Transportation Projects,* NCHRP B25-19, (Washington, D.C.: February 2001).

There are also concerns about data used in the analyses. Insufficient state and local data—particularly freight-related data—limits the quality and amount of analysis and modeling, according to NCHRP research and our December 2003 report.[34] The lack of metropolitan level data, which is needed to analyze investment alternatives, has been a continuing concern in transportation research. For example, data needed to identify heavily traveled highways and freight bottlenecks, and to develop and evaluate alternative solutions for addressing such congestion (e.g., comparing the benefits of improving highway operations to the benefits of adding new road capacity), is not always available. Furthermore, data needed to apply a specific analytic tool may not be available or funds may not be sufficient to acquire or collect needed data. Compounding the problem, existing modeling software cannot always successfully accommodate the data limitations to yield results that are credible and usable. In the NCHRP survey of state DOTs and MPOs published in 2001, 82 percent of state DOT respondents and 97 percent of MPO respondents reported that better data to analyze social and economic effects either were needed badly or would help enhance the agency's ability to evaluate the social and economic effects of transportation system changes.

Freight data pose special challenges because shifting product mix, trade patterns, and consumer demands make freight a fast-changing area. The U.S. Bureau of Transportation Statistics reported in 2003 that there is a consensus that existing freight data often are too outdated to capture current freight status, many data elements are missing, and data often cannot be compared across modes.[35] TRB and we have made recommendations to improve freight data. TRB recommended that resources be focused on developing a national freight data program that targets the needs of transportation analysts and planners.[36] We recommended in our December 2003[37] report that DOT facilitate the collection of freight-relevant data, which would allow state and local planners to develop and use better evaluation methods such as demand forecasts, modal diversion forecasts, and estimates of the impacts of

[34]GAO-04-165.

[35]U.S. Department of Transportation/Bureau of Transportation Statistics, *Transportation Statistics Annual Report 2003* (Washington, D.C.: October 2003).

[36]Transportation Research Board, *Letter Report on the Freight Analysis Framework* (Washington, D.C.: Feb. 9, 2004).

[37]GAO-04-165.

investments on congestion and pollution, thus providing a better basis for making transportation investment choices. FHWA has developed a Freight Analysis Framework (FAF) designed to estimate the flows of commodities and related freight transportation among states, substate regions, and major international gateways. The FAF also forecasts changes in the flows due to changes in economic conditions, transportation facilities, or other factors. FHWA is currently working to improve the FAF by improving the accuracy of freight flows, updating sources used in the model, and possibly incorporating new data sources and forecasting methods.

Other considerations affect decision-makers use of analyses, such as how competently the analyses are interpreted and how well analyses are communicated, according to a transportation researcher. TRB and we have expressed a concern about impending shortages of skilled transportation professionals with expertise to choose and use analytic tools and communicate their results. Timing also can have an impact on the use of analysis. A local official observed that analyses that come later in the decision-making process may be viewed as the most relevant because they reflect the most current information available as projects are being considered.

Concerns also have been raised about the ability of MPOs to produce and disseminate quality analyses that aid investment decision-making, given their broad scope of responsibilities and current funding levels. A recent study of metropolitan decision-making in transportation[38] concluded that although MPOs have been given new planning responsibilities in areas such as environmental justice, job access, freight planning, and systems operations, highway program funding for metropolitan planning has not increased. DOT officials also told us that local budget constraints complicate the ability of MPOs to deliver quality data analysis because analysis is usually the first thing to be cut. During our Chicago site visit, a transportation consultant expressed concern that the MPO for that area is very thinly funded for the work that it is being asked to perform.

[38]Bruce Katz, Robert Puentes, and Scott Bernstein, The Brookings Institution Series on Transportation Reform, *Improving Metropolitan Decision Making in Transportation: Greater Funding and Devolution for Greater Accountability*, (Washington, D.C.: October 2003).

Federal Financing Structure and Other Factors Limit Intermodal Investment Decision-Making

In evaluating and deciding on investments, the structure of federal funding and the lack of freight stakeholder involvement are important factors that focus decision-making principally on highways and transit and on stakeholders associated with these modes. In addition, during our site visits, we found few instances where investment decisions considered direct trade-offs between modes or between passenger and freight issues.

ISTEA, TEA-21, and federal planning guidance all emphasize the goal of establishing a system wide, intermodal approach to addressing transportation needs. However, the reality of the federal funding structure—which directs most surface transportation spending to highways and transit, rather than railroad infrastructure—plays an important role in shaping MPO investment choices. In fiscal year 2001, for example, federal transportation grants to state and local governments totaled about $27.8 billion for highway programs, $7.0 billion for transit programs, and $37 million for railroad programs. The federal financial support for highways and transit systems comes mainly from federal highway user fees (i.e., fuel taxes deposited into the Highway Trust Fund), with the revenue generated from these fees generally targeted for highway or transit projects. While most federal funding sources and programs are linked to highway or transit uses, some funding flexibility between highway and transit is allowed under programs such as the National Highway System, Surface Transportation Program (STP), and Congestion Mitigation and Air Quality Improvement (CMAQ) programs. Federal programs provide limited support for investment in railroad infrastructure, with railroad investments largely financed by the private sector.

In addition to the federal transportation grants to state and local governments discussed above, the federal government also provides some support to Amtrak for intercity passenger rail service. For example, in fiscal year 2003, the federal government appropriated about $1 billion to Amtrak to cover operating and capital expenses. However, the role of the federal government in providing financial support to Amtrak is currently under review amid concerns about the corporation's financial viability and discussions about the future direction of federal policy toward intercity rail service.[39] Regarding freight rail projects, the private sector owns,

[39]The Amtrak Reform and Accountability Act of 1997 prohibited Amtrak from using federal funds for operating expenses, except an amount equal to excess Railroad Retirement Tax Act payments, after 2002. However, Congress specifically appropriated funds for Amtrak to cover operating expenses in fiscal year 2003 (see the Consolidated Appropriations Resolution, 2003, P.L. 108-7).

operates, and provides almost all of the financing for freight railroads, with the public sector providing the supporting infrastructure—such as highways, ports, and intermodal facilities. Innovations in ISTEA and TEA-21 allowed states more flexibility to use federal funds for freight projects, established public-private partnerships, and allowed the expenditure of federal aid on nonhighway freight projects in certain circumstances.[40]

A number of concerns have been raised about the availability of funding for railroad infrastructure, particularly for intermodal investments that could improve freight mobility. For example, AASHTO has reported that, although the railroad industry's return on investment has improved, it still is below the cost of capital, a factor that might adversely affect future railroad infrastructure investment levels.[41] In addition, we reported in December 2003 that access to funding sources for freight railroads—such as the National Corridor Planning and Development Program and the Coordinated Border Infrastructure Program—has been limited because, according to FHWA, these programs are oversubscribed and much of the funding for these programs has been allocated to congressionally designated projects.[42] In addition, National Corridor Planning and Development Program funds may not be used for improvements on railroads' heavy-use "mainline" tracks. Furthermore, given the intermodal nature of freight projects, the overall lack of flexibility for using federal transportation funding across modes limits the availability of funding for improving railroad and freight infrastructure. For example, the eligibility criteria under the Transportation Infrastructure Finance and Innovation Act do not allow assistance to privately owned facilities, such as privately owned rail infrastructure. Local planning officials we interviewed expressed concerns that limited public funding for freight railroad investments might limit regional options for addressing infrastructure requirements. For example, one local planning official told us that the lack of flexible funding limited that city's ability to address freight-related problems. A regional planning official noted that while CMAQ money has

[40]Federal programs that can support railroad-related infrastructure that meet eligibility requirements include the Transportation Infrastructure Finance and Innovation Act, Railroad Rehabilitation and Improvement Financing, and the Rail-Highway Grade Crossing Program.

[41]American Association of State Highway and Transportation Officials, *Transportation: Invest in America: Freight-Rail Bottom Line Report* (Washington, D.C.: 2002).

[42]GAO-04-165.

some flexibility, the federal funding structure narrows the ability to make optimal intermodal choices.

Our December 2003 report[43] on freight transportation pointed to another concern about freight decision-making—that state and local transportation planning and financing is not well suited to addressing freight improvement projects. At the local level, planning is oriented to projects that clearly produce public benefits, such as passenger-oriented projects. While freight projects also may produce public benefits by reducing freight congestion, they often can have difficulty securing public funds because they may generate substantial private sector benefits. For example, in California, local planning officials told us that State Transportation Improvement Program (STIP) funds could not be used for freight railroad improvements unless there were distinct benefits for passenger movement. Unlike passenger projects, it may be more difficult to identify clear-cut public benefits associated with freight railroad projects and balance them with private benefits. In California, local planning officials said they consider railroad improvements to be at a disadvantage in public referenda on transportation improvements because public support for freight and railroads is lacking. Chicago officials acknowledged that the lack of federal funds for freight projects limits the region's investment options and local governments' interest in spending their own funds on freight projects, such as the CREATE project. Finally, railroad industry investment criteria are not always aligned with the goals of the states and MPOs. While freight railroad industry investments may meet the internal industry tests of providing revenues, profits, and financial feasibility, they may not deal adequately with national transportation concerns, such as improving mobility, reducing nationally significant chokepoints, and enhancing system capacity.

Several other considerations limit freight stakeholder involvement in local investment decisions—potentially affecting the MPOs' ability to take a system wide, intermodal approach to addressing transportation needs. Although MPOs are required to consider freight needs, reflecting the concerns of freight stakeholders—such as freight railroads—in decision-making has proven challenging. For example, the Chicago region has been particularly active in involving freight railroads in the MPO's Intermodal Advisory Task Force. But a railroad official, who described the railroad companies' interaction with the MPO, nevertheless saw the need to modify

[43] GAO-04-165.

the long-standing, local decision-making process so that freight railroads have a clearer role in investment decisions. Railroad officials in Chicago also cited the unfamiliarity of planners and decision-makers with freight operations as an obstacle to freight investments. They noted that many local officials and transportation agencies do not have a clear understanding of how freight operates, including the complexities of a consumer goods distribution system that typically starts in Asia or other areas of the world. However, several Chicago officials believed that the CREATE project may help change this situation by providing a plan to improve freight rail efficiency and freight rail's interface with passenger transportation, and by giving freight more visibility with local officials.

The freight industry may face other challenges in participating in transportation decision-making. For example, freight railroad companies operate in many states—each with numerous MPOs in their borders. A railroad executive noted that if all MPOs were serious about freight issues, companies could not handle the demands on their resources to participate. The freight industry also has long-standing concerns about working with the public sector. A railroad official we interviewed said that federal rail regulation left a lingering legacy of industry distrust of the government. In addition, freight railroads have long made their own investment decisions and supplied their own capital—with no public sector influence. As private entities that own most of the nation's railroad infrastructure, freight railroads typically have not worked with the public sector because of concern about requirements and regulations that are tied to federal funds, unless a proposed infrastructure project will yield financial returns for the company. In addition, the lengthy planning and construction time associated with public infrastructure projects does not match the shorter planning and investment horizons of private companies.

In addition to the focus on highways and transit over railroad investment choices, during our site visits we also found that cross-modal comparisons play a limited role in transportation investment decisions. We found limited instances in which investment decisions involved direct trade-offs in choices between modes or users—such as railroad versus highway or passenger versus freight. Officials in Chicago indicated that railroad and highway investments, and passenger and freight projects, rarely are in direct competition—perhaps because railroads and highways often serve different needs or markets. An official in Los Angeles commented that planners there avoid making modal comparisons because they view them as comparing "apples to oranges." In Chicago, an official described only a few situations that posed modal choices and trade-offs for decision-

makers, for example, deciding between a transit alternative versus adding lanes to an existing tollway.

Several researchers told us that whether planners and decision-makers make cross-modal and passenger-freight comparisons may be a moot point because local conditions, such as the physical environment often dictate modal choices. For example, metropolitan areas that are adjacent to a seaport may have few choices about whether to use highways or railroads to move products to and from the port. Space constraints and existing infrastructure, as well as the characteristics of freight (i.e., ports that handle bulk commodities such as coal or grain usually use railroads, while ports that handle computers usually use trucks), foreclose choices. Overall, moving freight usually offers fewer transportation choices than moving passengers, an expert noted. In addition, the demographic or other characteristics of specific transportation markets—such as a growing area with many transit commuters—also may determine modal choice.

Public Input and Other Political Considerations Shape Investment Decisions

Metropolitan decision-making is designed to be a collaborative process that involves the public and its diverse concerns in identifying actions to improve transportation system performance. MPOs are required to seek public comment and have clear federal guidance on involving the public—it is integral to their mission and one of their core functions. Moreover, the definition of the public is wide ranging—virtually all private and public individuals and organized groups that are potentially affected by transportation decisions in a given area.[44] Federal regulations also state that MPOs must cooperate with the state and local transportation providers such as transit agencies, airport authorities, maritime operators, rail-freight operators, Amtrak, port operators, and others. MPOs are directed to provide the public with meaningful opportunities to provide input on transportation decisions and are expected to consider public input on the full range of financial, social, economic, and environmental consequences of their investment alternatives.

Public participation can introduce considerations such as quality of life and other issues that are difficult to quantify in making transportation choices. It also puts decision-makers in the position of balancing different

[44]FHWA, FTA, AASHTO, APTA, The Association of Metropolitan Planning Organizations, *The Metropolitan Transportation Planning Process: Key Issues* (Washington, D.C.: November 2001).

public agendas about funding and values, according to a transportation researcher. Funding conflicts may arise between modes or from concerns about spreading benefits across the metropolitan area. Value conflicts may result from public concern about a potential project's impacts on a neighborhood or the environment.

As we observed in our site visits, public participation can play an influential role in transportation investment decisions. In California, public views often are expressed in county-level ballot box initiatives on the sales taxes and municipal bonds that finance transportation projects. Whether voters approve these initiatives is a significant factor in the investment decision-making process because of the growing prominence of local sales taxes in funding transportation projects. Local sales taxes have surpassed user fees as the primary source of funding for new transportation project construction in California because fuel tax revenues have not kept pace with travel volume and systems costs. The need for voter support may result in a greater number of transportation investment proposals that clearly identify public benefits for local constituents. In Chicago, an official noted that when an expressway extension with a High Occupancy Vehicle lane was proposed, attendees at public meetings opposed the project and endorsed additional mass transit service instead.

Besides public input, other political considerations also shape investment decisions. The metropolitan planning process emphasizes the importance of achieving stakeholder agreement on the set of projects that constitute the MPO's plan. One researcher said that achieving consensus often is difficult—especially with regard to completing large-scale projects—even when decision-makers are like-minded professionals. Arriving at a consensus puts a premium on how well local elected and appointed officials negotiate and build coalitions to obtain support for projects. Several researchers noted that this need for consensus may elevate the importance of certain political considerations—such as ensuring a rough equity in use of local and state funds for the distribution of transportation projects throughout a metropolitan area—in selecting projects for funding.

In addition, state and metropolitan transportation politics may make some organizations, such as state DOTs, large units of local government such as cities and counties, or large transit agencies more influential in planning and project selection than others. This uneven influence may mean that a project's priority can be determined by which agency sponsors the project. Our site visits also suggest that the relative influence of decision-makers varies across locations. For example, officials in Chicago described the Illinois DOT as having strong influence on metropolitan planning.

Furthermore, a recent study indicated that federal and state agency decisions can be very important in determining the scope and composition of key decisions in the Chicago area. By contrast, officials in Los Angeles and San Francisco described local planning agencies, especially county-level Congestion Management Agencies, as most influential.

Finally, state decisions to distribute funds across the state may shape investment decisions. For example, California state law requires that 75 percent of State Transportation Improvement Program funds be directly allocated to counties, who work through the county Congestion Management Agencies. However, according to CALTRANS officials, the total funding allocated to the counties is first divided between the counties of northern and southern California, with the 13 southern counties receiving 60 percent of the funds and the balance of California counties receiving 40 percent of the funds. Thus, while modal choices are primarily made at the regional or county level, the choices are constrained by state funding splits, according to CALTRANS officials.

Investments to Preserve Existing Infrastructure Are a Priority

Due to infrastructure and space concerns, and time lags associated with new construction projects, state and regional transportation decision-makers are increasingly giving priority to highway investments that preserve, enhance, and maintain the existing infrastructure over investments in new construction. According to FHWA data, of the $64.6 billion spent nationally in 2000 on highway capital improvements, 52 percent ($33.6 billion) of all funds were spent on system preservation, 40 percent ($25.9 billion) on new roads and expansion of existing roads, and 8 percent ($5.1 billion) on the installation of system enhancements, such as safety enhancements.[45] The amount spent on system preservation rose from 45 percent of capital improvements nationally in 1993 to 52 percent

[45]Capital expenditures on highways include those for (1) system preservation, which includes capital improvements on existing roads and bridges, intended to preserve the existing infrastructure, but does not include routine maintenance; (2) system enhancements, which are traffic operations improvements, such as the installation of intelligent transportation systems (ITS) and environmental enhancements; and (3) system expansion, which includes construction of new roads and bridges, as well as additional lanes on roads. Noncapital expenditures are for maintenance and operations of highways, including functions necessary for day-to-day operations, such as keeping roads free of obstacles, performing pavement and shoulder maintenance, operating ITS, and performing incident management (the quick removal of incapacitated vehicles from the highway) to improve safety and traffic flow.

in 2000.[46] In addition to the money spent on system preservation, all levels of government spent $24.2 billion on routine maintenance in 2000.

In our site visits, we found that system preservation and operations and maintenance activities were high priorities for local transportation officials. For example, in Chicago, planners told us that in the space-constrained Chicago area, the primary strategy has been to periodically rebuild existing infrastructure rather than build new infrastructure. In California, both the Southern California Association of Governments (SCAG) and the Metropolitan Transportation Commission in Northern California spend approximately 80 percent of their regional budgets on maintenance and operations. SCAG officials pointed out that regions such as Los Angeles and San Francisco tend to focus less on capital improvements due to capacity and infrastructure limitations. Some situations offer few alternatives for expansion from the onset. Infrastructure that is old and inadequate, such as underpasses or tunnels with insufficient clearance, often has limited expansion potential.[47] Further complicating new construction is the limited supply of available land. Densely populated urban areas, where space is at a premium, offer few alternatives for expansion due to geographic constraints on the surrounding development.[48] In addition, land-use planning and zoning issues can be highly contested in a space constrained real estate market. Capacity constraints and costs of new construction are forcing decision-makers to look at alternate solutions and place a premium on maintaining and improving the existing transportation system.[49]

System preservation and maintenance and operations improvements are also preferred because they offer quicker remedies than new capital projects, which can take almost 20 years to plan and build. A key reason for the length of time to complete projects is the set of federal and state requirements, which include clean air, water quality, historical preservation, New Starts reporting, and public input requirements that

[46]FHWA and FTA, *Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance Report, 2002 Report to Congress* (Washington, D.C.: 2002).

[47]GAO-04-165.

[48]GAO-04-165.

[49]American Society of Civil Engineers, *Statement of American Society of Civil Engineers Before the Banking, Housing and Urban Affairs Committee, U.S. Senate* (Washington, D.C.: Oct. 8, 2002).

were discussed earlier.[50] However, the length of time for project development is also influenced by the diffusion of authority over transportation decisions and the resulting complexity of the decision-making process. Changes in local priorities, lack of local matching funds, and locally driven changes in project scope are often associated with project longevity. Requirements for benefit-cost and other economic analyses could extend the length of time for project development. One local planning official noted that the long lag time for new projects acts as a disincentive for planners and officials when considering capacity expansion projects. Transportation decision-makers operate in an environment where they must consider preexisting factors and needs when making transportation investment decisions.

Planning for Longer Transportation Corridors Presents Additional Challenges and Opportunities

Finally, corridors that extend across multiple state and local boundaries pose challenges for intermodal transportation decision-making due to coordination and cross-jurisdictional issues. A majority of investment decisions are made at the state and local levels, with local planners tending to focus on local and regional planning needs, as opposed to larger corridor needs. Getting the cooperation of and coordinating with multiple agencies, communities, and transportation modes—each with its own priorities—makes the planning and implementation of multistate and multiregion projects difficult.[51] Further complicating this type of planning is the variety of approaches used by the local and regional agencies in analyzing projects. The type of transportation modeling used in one location may not be available or used in another.

Particularly problematic are interstate corridors that do not provide clear-cut benefits for all states that the proposed corridor crosses, but require that the costs be borne by all states involved. Although state DOTs work to address freight mobility challenges on a statewide basis, many corridors cross state boundaries; and unless states are part of a multistate coalition, states may not address projects that involve multijurisdictional corridors.[52]

[50]U.S. General Accounting Office, *Highway Infrastructure: Preliminary Information on the Timely Completion of Highway Construction Projects*, GAO-02-1067T (Washington, D.C.: Sept. 19, 2002).

[51]C.F.R. 450.310 requires "planning agreements" between the state and MPOs, between MPOs in the same metropolitan area, and between MPOs and designated air quality agencies.

[52]GAO-04-165.

For example, an Illinois transportation official explained that developing high-speed rail service to the east of Illinois is contingent on whether other states will share the costs. To date, only one other state has been willing to contribute. Similarly, freight infrastructure needs may involve projects along a freight corridor that cuts across the jurisdictions of several transportation-planning agencies and, in some cases, states.

For the most part, planning for longer multistate corridors is conducted by ad hoc state coalitions. In the past, the impetus for creating such multistate coalitions has come from state departments of transportation, and the federal government's role in making these interstate decisions is limited. Generally these ad hoc groups do not receive federal funding. However two groups, the Interstate 95 Corridor Coalition and the Chicago-Gary-Milwaukee Coalition, did receive funding in TEA-21. The Interstate 95 Corridor Coalition, which runs from Maine to Florida, was initially created to examine ITS systems along the corridor but has now widened its focus to include intermodal issues. The coalition developed a railroad operations study for the region, which identified deteriorating transportation system performance in the mid-Atlantic region, noted that all modes of transportation needed to be improved to deal with the situation, and suggested that railroads could play a larger role in meeting the region's transportation needs.[53] Studies such as this one illustrate the opportunities for these multistate coalitions to analyze problems in a larger corridor.

Other such state groupings exist. For example, state DOTs along Interstate 10 have organized an I-10 partnership to conduct research on managing freight movement along the corridor running from California to Florida. The I-10 partnership group developed a transportation planning study based on vehicle volume, traffic flow, and alternative scenario testing for freight movement. Rather than focusing on one particular mode, the study included highways, railroads, and barges in its analysis of freight traffic, and explicitly attempted to be mode neutral. While the partnership study projected the effects of different possible infrastructure improvements along the corridor, individual states are ultimately responsible for deciding whether to implement the study's findings.

[53]Cambridge Systematics Inc., Parsons Brinkerhoff Quade and Douglas, Inc., and the I-95 Corridor Coalition, *Mid-Atlantic Rail Operations Study* (Mid-Atlantic: April 2002).

In contrast to these multistate groupings, planning for intrastate projects fits more easily into the framework of state planning. For example, in the case of passenger rail corridor development in California, intrastate passenger rail is funded primarily by the state DOT and the localities and operated by state and local joint powers authorities. In some cases, Amtrak serves as the operator for these state-supported routes. Some of these routes are Amtrak's most heavily traveled outside the Northeast Corridor, including the Capitol Route in Northern California, the San Joaquin Route in Central California, and the Pacific Surfliner Route in Southern California. Planning for proposed routes, such as high-speed and passenger railroad, is facilitated when the route remains within a single state because such projects fit readily into the existing state planning framework. However, many of the corridors that would benefit from such projects involve more than one state.

Concluding Observations

ISTEA and TEA-21 both articulated a goal of moving from a traditional focus on single transportation modes to a more efficient, integrated system that draws upon each mode to enhance passenger and freight mobility. These key pieces of legislation also provided MPOs and states discretion in selecting projects to address local needs and conditions. In exchange, MPOs and states are expected to follow federal planning and program requirements to reflect the national public interest in their decisions. The approach for investment planning and decision-making that emerged from ISTEA and TEA-21 provides guidance on a systematic process for making transportation investment choices and a host of factors to consider, while generally allowing MPOs and states considerable discretion in choosing the analytical methods and tools that will be used to evaluate and select projects.

Our work has shown that while much analysis is done by states and MPOs, the results of those analyses do not appear to play a decisive role in many investment decisions, except to rule out the most problematic projects. Instead, other factors play a major role in shaping investment choices, including the federal government's funding structure that provides incentives for investing in highway or transit projects rather than railroad infrastructure or intermodal projects, public or political support for certain projects, and the practical realities of simply preserving the existing infrastructure. In addition, the data and other limitations associated with using analytical tools, such as benefit-cost analysis, may discourage their use by decision-makers. DOT, TRB, and other major transportation organizations are doing research to improve analytical tools and methods and to help states and MPOs use them to better evaluate

investment alternatives. In a prior report, we also encouraged the use of benefit-cost analysis in freight transportation decision-making and recommended that DOT facilitate the collection of freight data that would allow state and local planners to develop better methods for evaluating investments. It is possible that overcoming the challenges of using analytical tools would make them more attractive to decision-makers, thus leading to improved investment decision-making.

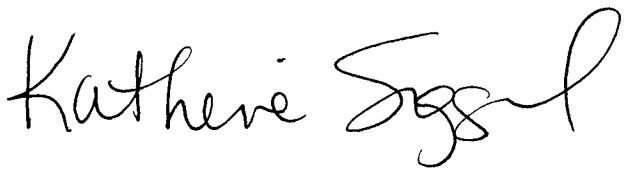
Agency Comments and Our Evaluation

We provided copies of this report to the Department of Transportation for its review and comment. The department generally agreed with the report's content and said that the report provided a useful overview of the literature and practice involving transportation investment decisions. The department also provided technical comments, which we incorporated into this report as appropriate.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies of this report to congressional committees with responsibilities for surface transportation programs; DOT officials, including the Secretary of Transportation and the administrators of FHWA, Federal Railroad Administration, and FTA; and the President of Amtrak. We will make copies available to others on request. This report will also be available on our home page at no charge at http://www.gao.gov.

If you have any questions about this report, please contact me at siggerudk@gao.gov or by telephone at (202) 512-2834. GAO contacts and acknowledgments are listed in appendix IV.

Sincerely Yours,



Katherine Siggerud
Director, Physical Infrastructure Issues

Appendix I: Scope and Methodology

Our scope of work included reviewing the processes that decision-makers at all levels of government use to analyze and select surface transportation infrastructure investments. Our overall approach was to review and synthesize federal requirements, Department of Transportation (DOT) guidance, and the economics literature and transportation planning studies; interview federal transportation officials, national association representatives, and transportation experts to obtain their perspectives; and conduct site visits in three major metropolitan regions to understand how investment decisions are actually made in those regions.

To identify the key federal requirements for planning and transportation infrastructure decision-making, we reviewed federal laws and regulations relating to the metropolitan and state planning and funding process, as well as federal guidance provided by the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) to states and Metropolitan Planning Organizations (MPO) on the transportation planning process. We interviewed transportation officials in the following U.S. DOT offices: Federal Railroad Administration, FHWA, FTA, and the Office of Intermodalism. We also interviewed national stakeholders including Amtrak, the Association of American Railroads, the Association of Metropolitan Planning Organizations, the American Public Transportation Association, and the American Association of State Highway and Transportation Officials. To get regional perspectives on the federal requirements and guidance for transportation planning, we interviewed state and regional transportation officials in California and Illinois.

To identify how benefit-cost analysis facilitates sound transportation investment decisions, we reviewed the economics literature, academic research, and transportation planning studies containing evaluations of various economic analytical tools, with an emphasis on benefit-cost analysis. A GAO economist read and reviewed these studies, which we identified by searching economics literature databases and consulting with researchers in the field, and found their methodology and economic reasoning to be sound and sufficiently reliable for our purposes. We interviewed researchers and consultants from the National Research Council's Transportation Research Board (TRB), DOT, university research centers, national transportation organizations, and selected state DOTs to get their perspective on these analytical tools, the general applicability of benefit-cost analysis, and the feasibility of cross-modal comparisons. In addition, we reviewed our previous studies that had key findings relating to the use of analytical tools in investment decision-making and consulted

with our Chief Economist regarding the value of benefit-cost analysis and its challenges.

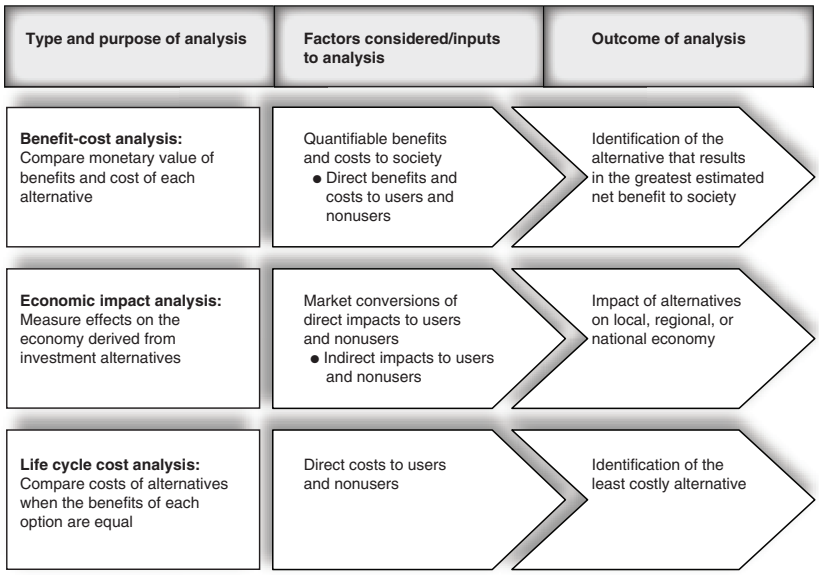
To identify other factors transportation decision-makers consider in evaluating and deciding on investments, we interviewed federal transportation officials and the other national stakeholders identified above. We interviewed transportation researchers from the TRB and, based on their input and that of federal transportation officials, interviewed additional researchers from university research centers—and other think tanks—as well as representatives from civic and private sector organizations who are knowledgeable about transportation investment issues. We also conducted site visits in three major metropolitan regions: Chicago, IL; Los Angeles, CA; and San Francisco, CA. These sites are major centers of passenger and freight traffic and contain a wide variety of planning agencies, transportation issues, and modes. During our site visits, we conducted semistructured interviews with officials from state, regional and local transportation planning agencies, including state departments of transportation, MPOs, city or county transportation planning agencies, and organizations involved in railroad investment issues. From these interviews, we obtained information on each region's planning and decision-making processes, the factors that drove decision-making in that region, the extent to which analytical tools were used, and other issues affecting the planning and decision-making processes. In addition, we also analyzed planning documents and analytical tools used by these regional decision-makers. The information collected and analyzed from our site visits was intended to illustrate how investment decisions were made in those areas.

To ensure the reliability of information presented in this report, we relied to a large extent on studies from the economics and transportation literature that were reviewed by peers prior to publication. A GAO economist reviewed these studies and found them methodologically sound. We also corroborated much of the testimonial information provided during our three site visits by obtaining documentation of investment decision-making processes and results, although we did not test the reliability of specific data contained in reports prepared by officials from those three sites. Additionally, we obtained statistics presented in the introduction of this report about passenger and freight travel growth from DOT; because this information is included as background only, we did not assess its reliability. We conducted our work from September 2003 through June 2004 in accordance with generally accepted government accounting standards.

Appendix II: Summary of Three Types of Economic Analyses for Comparing Investment Alternatives

While benefit-cost analysis aims to monetize and compare all direct benefits and costs to identify the alternative that results in the greatest net social benefit, other types of analysis consider different types of impacts to yield different criteria for comparison. Two common types of analysis are economic impact analysis and cost-effectiveness analysis. Figure 2 illustrates the differences between benefit-cost analysis, economic impact analysis and life-cycle cost analysis, a special case of cost effectiveness analysis.

Figure 2. Comparison of Three Types of Economic Analyses



Source: GAO analysis of economic literature and guidance documents.

Economic impact analysis assesses how some direct benefits and costs of investment alternatives convert to indirect effects on the local, regional, or national economy or on a particular sector of the economy.[1] Examples of indirect impacts are changes in wages and employment, purchases of goods and services, land use, and changes in property values. These impacts result from increased or decreased levels of economic activity caused by the investment and can accrue within or outside of the immediate area of the investment. Economic impact analysis often

[1]The use of the terms "direct" and "indirect" to classify types of benefits and costs is common in transportation economics literature but might not apply generally to economic analysis in other fields.

includes a number of factors other than those that meet the stricter criteria for inclusion in a benefit-cost analysis. As a result, advocates or opponents of a project can use this type of analysis to illustrate implications of an investment other than the estimated net social benefit.

However, economic impact analysis is not an appropriate technique for identifying which alternative provides society with the greatest net benefit because often the values of benefits to society are counted twice in different forms in this analysis. Guidance from both TRB and FHWA states that the net direct user benefits included in benefit-cost analysis have the same monetary value as the net indirect benefits and caution that the two are not additive when analyzing an investment for economic efficiency. In other words, indirect impacts are not included in benefit-cost analysis because economists generally agree that they are market transformations of direct benefits. Thus, while economic impact analysis can provide interesting information for policy makers regarding the effects of potential investments on the local, regional, or national economy as well as on specific industries, researchers state that economic impact analysis can be considered complementary to, but different from benefit-cost analysis.

Cost-effectiveness analysis is similar to, but less comprehensive than, benefit-cost analysis. This type of analysis attempts to systematically quantify the costs of alternatives. However, cost-effectiveness analysis does not attempt to quantify the benefits of alternatives. Rather, it assumes that each alternative results in achieving the same stream of benefits. Thus, cost-effectiveness analysis identifies the lowest cost option for achieving a given level of benefits rather than identification of the alternative that achieves the greatest benefit per dollar of cost to society.

Life-cycle cost analysis, essentially a subset of benefit-cost analysis, is a specific example of cost-effectiveness analysis. Life-cycle cost analysis involves several of the same steps included in benefit-cost analysis, but excludes any assessment of benefits because each of the alternatives compared is expected to result in the same level of benefits. The key elements of life-cycle cost analysis are identifying alternatives, defining a time frame for analysis, identifying and quantifying the costs of each alternative, discounting costs to present values, assessing the sensitivity of the analysis to changes in assumptions, and identifying the alternative that results in the lowest cost over the life-cycle of the project. When identifying and quantifying the costs of each alternative for transportation

projects, best practices indicate that analysts should consider construction, rehabilitation, and maintenance costs as well as costs to users associated with work zones during construction and maintenance.[2] Like benefit-cost analysis, these user costs include travel time costs, costs associated with crashes, and vehicle operating costs.

[2]See appendix III for a description of best practices for the other steps, as the procedures for these are consistent with their parallel steps in benefit-cost analysis.

Appendix III: Overview of Benefit-Cost Analysis

From our review of research and best practices on transportation investment analysis, we identified 10 elements integral to sound benefit-cost analysis. Analysts include these steps to ensure a thorough evaluation of the social benefits and costs of investment alternatives and to systematically assess the trade-offs between investment alternatives. Using benefit-cost analysis, as described below, analysts determine the project that will result in the greatest benefit to society for a given level of cost.

Analysts first should identify the project objectives to ensure a clear understanding of the desired outcome and to aid in determining appropriate alternative projects to be considered. Reports from TRB and FHWA identify several possible surface transportation project objectives including addressing an existing congestion problem, investing to accommodate expected future demand, generating economic development, improving safety in an area, or increasing mobility for disadvantaged citizens. Identifying the intended outcome at the outset leads to analysis focused on alternative projects that can achieve the stated objectives. For example, if the primary objective were to ease congestion, adding a highway lane or new transit option might be reasonable alternatives to consider; however, if the objective were to improve safety in an area, perhaps other alternatives would be more appropriate. Federal Aviation Administration (FAA) guidance on benefit-cost analysis cautions that the analyst should be careful not to identify the objective in a way that prejudges the alternatives for achieving the objective. For example, an objective stated as construction to address an existing congestion problem ignores the possibility of nonbuild alternatives that might improve the use of the existing system.

Establishing a realistic base case provides a reference point against which the incremental benefits and costs of alternatives will be measured. According to FAA guidance, the base case is the best course of action that would be pursued in the absence of a major initiative to meet the investment objectives identified.[1] In other words, the base case should represent existing infrastructure, including improvements that are already planned, as well as on-going maintenance. FHWA guidance states that the base case should be realistically defined including, for example, allowances for changes in traffic patterns with congestion. Failure to allow

[1]The base case is sometimes referred to as the "do nothing" or "no-build" scenario; however, a more accurate name is the "do minimal" alternative.

for such changes in the base case can lead to overly pessimistic assessments of the base case in comparison to alternatives.

Given the project objectives and the base case, analysts should identify the investment alternatives capable of achieving the stated objectives to define the scope of the analysis. In generating the list of possible alternatives, analysts should consider options across different transportation modes. For example, alternatives for a congested metropolitan route could include adding a lane to the existing highway, providing new or better bus service, or building a light rail line. Moreover, passenger alternatives for a congested intercity corridor could include high-speed rail, new or expanded air travel, or a new or expanded highway. In addition to evaluating multiple modes, low-cost noncapital intensive alternatives should be considered. These alternatives include Intelligent Transportation Systems (ITS) and demand management approaches. ITS solutions are designed to enhance the safety, efficiency, and effectiveness of the transportation network and are relatively low-cost options for maximizing the capacity of the existing infrastructure.[2] ITS solutions include coordinating traffic signals to improve traffic flow, improving emergency management responses to crashes, and using electronic driver alert boards to notify drivers of congested routes. Similarly, demand management alternatives can relieve congestion without major infrastructure investments. Demand management alternatives are ways of reducing the number of vehicles traveling on a congested route during the most congested times or peak periods. Demand management alternatives encourage drivers to drive during less congested times, or on less congested routes, or to ride together in carpools or vanpools. Charging single occupancy vehicles a toll during congested times on congested routes, providing free or discounted convenient parking for persons riding in carpools or vanpools, and subsidizing transit usage are possible demand management alternatives.[3] Finally, both passenger and freight options for addressing congestion should be considered. Our past work on freight transportation shows that truck use significantly affects highway congestion. For example, officials at the Ports of Los Angeles and Long Beach estimate that truck traffic accounts for about 30 to 60 percent of the total traffic on two particularly

[2]U.S. General Accounting Office, *Surface and Maritime Transportation: Developing Strategies for Enhancing Mobility*, GAO-02-775 (Washington, D.C.: Aug. 30, 2002).

[3]GAO-02-775.

congested major highways, which serve as connectors to the two ports.[4] Moreover, independent studies report that shifting greater amounts of freight from highways to rail could relieve highway congestion.[5]

Following the identification of alternative projects, analysts should list the relevant impacts of each alternative to ensure that all aspects of a project are considered in the analysis. As previously stated, benefit-cost analysis considers all direct user impacts and externalities, but it does not consider indirect impacts because these are transfers of direct impacts and their inclusion would constitute double counting. Transportation economics research and government agency guidance we reviewed identified the following list of direct user impacts that should be considered for transportation investment decisions: construction, operations and maintenance costs; travel time savings and construction travel time cost; vehicle operating costs; safety improvements; and environmental impacts, such as noise pollution and air pollution. Tolls, fares, or any other user fees should not be included as impacts of the projects, because these are payments made by consumers to receive the benefits already counted in the list above.

After identifying the user impacts for each alternative, the analyst must define a single time frame or life cycle for all alternatives over which the benefits and costs will be compared. This element of the analysis is necessary for equal comparison of projects with differing expected future streams of benefits and costs from current investment. Typically, a region constructing major infrastructure investments incurs a majority of the costs of the project within the first years of the life cycle and reaps the majority of the benefits later in the life cycle of the project; therefore, the analyst should choose a time frame that allows for the measurement of benefits and costs expected to materialize throughout the useful life of the investment.

The impacts of each alternative should be quantified and monetized as benefits and costs to the greatest extent possible to enable the analyst to compare the value of each project to the alternatives. In addition to

[4]GAO-04-165.

[5]American Association of State Highway and Transportation Officials, *Transportation Invest in America: Freight-Rail Bottom Line Report* (Washington, D.C.) and Brown, Thomas R. and Anthony B. Hatch, *Rail Intermodal: On the Fast Track* http://www.tomorrowsrailroads.org/industry/railstudies.cfm.

compiling the obviously quantitative impacts, like construction and operations costs, the analyst must quantify other identified impacts of alternatives, like emissions reduction. The analyst must then convert those values to dollars so the impacts are expressed in common units. Forecasting tools and benefit-cost analysis models facilitate the process of quantifying and monetizing benefits and costs. Forecasting tools predict future behavior of system users, like travel demand and ridership, for the investment alternatives. Values from the forecasts are used as inputs into a larger model that quantifies and monetizes direct user impacts and quantifiable externalities. Therefore, the accuracy of the forecasts directly affects the accuracy of the analysis. Several widely accessible models of highly varying complexities measure and quantify predicted benefits and costs.[6] These models rely on some assumptions, but also require users to enter location and project specific data to generate estimates, which are used to assess the overall net benefit of alternatives. Therefore, the outcome of the analysis depends, in part, on the quality of the model used for calculations of benefits and costs.

After monetizing the direct user benefits and costs, the analyst converts all values to present dollar values to allow an accurate comparison of projects with different levels of future benefits and costs. The dollar values of the benefits and costs of each alternative cannot simply be summed over the life of the project to calculate the total. Benefits and costs incurred in the future have lower values than those incurred in the present because, in the case of benefits, the benefits cannot be enjoyed now and, in the case of costs, the resources do not need to be expended now. In other words, benefits and costs are worth more if they are experienced sooner because of the time value of money. Therefore, analysts must convert future values into their present equivalents to compare benefits and costs expected in the future with benefits and costs incurred in the present. This conversion requires the use of a discount rate, which represents the interest rate that could be earned on alternative uses of the resources. Researchers explain that the discount rate can have a strong influence on the outcome of the analysis and note that higher discount rates tend to favor short-term projects and lower rates favor long-term projects. Thus, analysts should use care in choosing a discount rate that will not bias the outcome of the analysis and will accurately account for

[6]For a listing and evaluation of some models, see National Cooperative Highway Research Program, *Guidance on Using Existing Economic Analysis Tools for Evaluating Transportation Investments* (Washington, D.C.: October 1999).

the benefits and costs expected in the future. Office of Management and Budget (OMB) provides guidance on choosing appropriate discount rates for different types of investments.[7]

After all benefits and costs have been discounted to present values, the analyst should evaluate the benefits and costs of each project using a common measure to allow for comparison across different alternatives. Net present value and benefit-cost ratio are two useful measures for project comparison. Net present value is the discounted sum of all benefits less the discounted sum of all costs associated with an alternative and is generally the preferred measure. If the net present value is positive, then the project is economically efficient in that the gainers from the project could potentially compensate those who incur costs and still benefit from the project. That is, the benefits throughout the life cycle of the project exceed the costs incurred in the same time frame. A benefit-cost ratio is the discounted sum of benefits divided by the discounted sum of costs. If the benefit-cost ratio is greater than one, benefits outweigh costs and the project is economically efficient. In essence, the benefit-cost ratio indicates whether $1 invested in one project earns a higher rate of return than $1 invested in a different project. Researchers and government agency guidance caution analysts to assign costs and benefits consistently when calculating benefit-cost ratios because inconsistency can result in incorrect comparisons between alternatives. For example, if maintenance costs are included in the cost component, the denominator of the fraction, for one project, but are netted out of the benefits, the numerator of the fraction, for a different project, the two benefit-cost ratios will not be comparable.

Due to the inherent uncertainty in calculating the inputs to benefit-cost analysis, a critical element of investment analysis is assessing the sensitivity of the analysis to changes in the assumptions and forecasts. In addition, uncertainty can also affect the economically suggested choice of the project resulting in the greatest net benefit to society. Several methods, which vary in their complexity, exist for conducting sensitivity analysis including simple sensitivity analysis and Monte Carlo simulation. Simple sensitivity analysis involves recalculating the net present values or benefit-cost ratios after adjusting uncertain inputs to reflect alternative values, as well as the expected value typically used in the original analysis.

[7]OMB, *Circular A-94 Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* (Washington, D.C.: 2002).

Using this approach, the analyst can determine whether or not the alternative would still be economically efficient if the actual values were different from their predicted values. For example, transportation researchers widely accept that ridership forecasts for transit projects can be very uncertain. An analyst using simple sensitivity analysis can determine if the net present value of a transit alternative would still be positive even, if ridership in the future were lower than predicted.

Monte Carlo simulation or probabilistic-based risk assessment is a more comprehensive and preferred approach to sensitivity analysis. With Monte Carlo simulation, the analyst assesses the probability distribution of each uncertain input and recalculates the benefit-cost analysis multiple times while drawing values that fall within the probability distribution for each of the uncertain inputs. The results are examined in the context of their probability distribution covering all potential outcomes of the analysis as well as reporting the average or other values. This approach allows the analyst to judge alternatives not only on their average net present value, given multiple possible input value combinations, but also on the likelihood that the project will achieve outcomes such as a positive net present value.

Real options analysis incorporates uncertainty directly into benefit-cost valuation. It acknowledges and internalizes both the cost of making irreversible investments under uncertain conditions and the value of option-creating actions.[8] This type of analysis incorporates timing of the decision as a factor rather than assuming investments are now or never decisions that cannot be delayed. In addition, real options analysis recognizes that a cost is associated with making decisions when the information that decision-makers use as a basis for the decision is uncertain and may change in the future. The analysis attempts to quantify the inherent opportunity cost of making an investment decision. In other words, real options analysis accounts for the lost opportunity to make a different decision at a later time when more or better information is

[8]Option-creating actions are steps that decision-makers can take to improve the information available for making a decision, including resolving uncertainty, enabling flexibility, and uncovering new and relevant information. For example, if existing levels of demand do not support a light rail line for a planned new highway corridor but planners expect that such demand might materialize in the future, an option-creating action would be to build the highway compatible with the possibility of constructing a light rail line in the median. Brand, Daniel, Shomik Raj Mehndiratta and Thomas E. Parody, "Options Approach to Risk Analysis in Transportation Planning," *Transportation Research Record 1706*, Paper No. 00-1075.

available. For an investment to be advisable under real options analysis, the net present value of the investment must exceed the value of keeping the investment option alive until more certain information is available.

While the real options approach is becoming more common in private sector investment decision-making, research suggests that this approach is not widely used in the public sector. Researchers have highlighted several ways that public sector transportation investment decision-makers could use real options analysis. First, decision-makers can use incremental planning and staged implementation of phases of projects to maintain the option to defer a decision and wait for new information or to terminate a partially-completed project if new information reveals that the investment is no longer beneficial to society. Decision-makers can also actively create flexible options by taking steps like acquiring a right-of-way but not building until more is known about the potential project, including demand conditions, potential costs, and expected benefits of alternatives. Finally, planners can use options to take incremental actions that increase learning. One study uses the case of San Diego's conversion of a high-occupancy vehicle (HOV) lane to a high-occupancy toll (HOT) lane as an example of taking incremental action that increases learning. By using existing infrastructure and adding a pricing component, decision-makers tested users' reactions to optional congestion pricing before implementing a congestion-pricing model that would affect all drivers.

Finally, after the analysis has been completed and the results have been checked for sensitivity to uncertain inputs, analysts should use the results of the analysis to compare alternatives and identify the project that results in the greatest estimated net social benefit. As stated above, any project that has a positive net present value or benefit-cost ratio greater than one is expected to provide net benefits to society. However, transportation decision-makers have budget constraints and typically cannot implement all projects resulting in net benefits. Rather, they must rank alternatives and identify the best project that can be implemented given the budget constraint. In general, projects with higher net present values or benefit-cost ratios should be chosen over projects with lower net present values or benefit-cost ratios. If projects are not mutually exclusive, then a combination of projects, the total cost of which does not exceed the budget constraint, might lead to the greatest net social benefit. In this case, the decision-maker should examine all feasible combinations of projects, sum the net present values for each combination, and identify the combination that yields the highest total net present value. In addition, according to Executive Order 12893, OMB guidance, and our past research, in the likely event that not all benefits and costs could be

quantified and monetized when developing the benefit-cost analysis, the decision-maker should consider the nonquantifiable factors in addition to the numeric results of the analysis when evaluating alternatives.

Appendix IV: GAO Contacts and Staff Acknowledgments

GAO Contacts

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