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SURFACE TRANSPORTATION

Research Funding, Federal Role, and Emerging Issues





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**Resources, Community, and
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The Honorable John H. Chafee
Chairman
The Honorable Max S. Baucus
Ranking Minority Member
Committee on Environment and
Public Works
United States Senate

The Honorable John W. Warner
Chairman, Subcommittee on
Transportation and Infrastructure
Committee on Environment and
Public Works
United States Senate

In response to your request, this report provides information on (1) the public and private funding for surface transportation research, (2) the transportation community's views on the federal role for such research and the Department of Transportation's ability to fulfill that role, and (3) the issues that the transportation community believes the Congress and the Department should consider during the reauthorization of the Intermodal Surface Transportation Efficiency Act of 1991.

We are sending copies of this report to interested congressional committees and the Secretary of Transportation. We will also make copies available to others upon request.

If you or your staff have any questions, I can be reached at (202) 512-2834. Major contributors to this report are listed in appendix II.

John H. Anderson, Jr.
Director, Transportation and
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Executive Summary

Purpose

Spending on passenger and freight transportation exceeds \$1 trillion annually, representing about 11 percent of the nation's gross domestic product. Decisions about surface transportation research have significant consequences because research provides the knowledge, products, and technologies needed to make transportation more efficient, effective, and safe.

To prepare for reauthorizing the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), the Chairman and Ranking Minority Member, Senate Committee on Environment and Public Works, and the Chairman of that Committee's Subcommittee on Transportation and Infrastructure asked GAO to provide information on the Department of Transportation's surface transportation research programs. This report discusses (1) the public and private funding for surface transportation research, (2) the transportation community's views on the federal role in surface transportation research and the Department's ability to fulfill that role, and (3) the issues that the transportation community believes the Congress and the Department should consider during ISTEA's reauthorization.

Background

ISTEA called for a new direction in surface transportation research, specifying new research initiatives, such as the Intelligent Transportation Systems program, and providing increased funding for research. ISTEA found that despite an annual federal expenditure of more than \$10 billion on surface transportation and its infrastructure, the federal government lacked two key components of an effective research program: (1) a clear vision of the role of federally funded surface transportation research and (2) an integrated framework for the fragmented surface transportation research programs dispersed throughout the government.

Surface transportation and its research spans three distinct modes—highways, mass transit, and railroads. It also includes issues such as safety and the connections between modes. Within the Department, five modal agencies sponsor surface transportation research, which includes basic and applied research, development, demonstration, and technology transfer.

Results in Brief

Since ISTEA's enactment, the federal funding for surface transportation research has reached nearly \$2.9 billion (from fiscal year 1992 through fiscal year 1996). Most of this funding has gone to the Federal Highway

Administration (FHWA), which received \$2.1 billion. Within FHWA, one program, Intelligent Transportation Systems, has received about half of the funding—\$1.01 billion. This program uses research in computer and information technology to improve highway capacity and safety. State spending on surface transportation research has increased but is relatively small compared with the federal investment. Information on industry's total funding for surface transportation research is proprietary and therefore limited.

Representatives of the transportation community—from the federal government, state governments, industry, and academia—agreed that the Department should act as the leader in surface transportation research by funding research, establishing an overall research mission with objectives for accomplishment and priorities for allocating funds, and acting as a focal point for technology transfer. The Department has established councils and committees to coordinate its research, but its modal organization and lack of both a strategic plan and a departmental focal point, as well as congressional directives to initiate or maintain specific research efforts, may limit its leadership. Until these issues are addressed, the Department may not be able to respond to ISTEA's call for an integrated framework for surface transportation research.

According to representatives of the transportation community, federal surface transportation research currently does not adequately address two areas that will grow more important with time. First, it does not adequately focus on the total surface transportation system, giving limited attention to system assessment, policy, and intermodal research. Second, it does not include enough basic, long-term, high-risk research to address complex, persistent problems such as congestion. Federal decisions about the surface transportation research portfolio will be important during the reauthorization of ISTEA's research programs.

Principal Findings

Funding for Highway-Related Research Dominates the Surface Transportation Agenda

From fiscal year 1992 through fiscal year 1996, the Department provided \$2.9 billion for surface transportation research programs. This total represents about 2 percent of the Department's total budget for surface transportation programs. About \$2.1 billion went to FHWA, which allocated nearly half of the funds for the Intelligent Transportation Systems

program's projects. FHWA also supports research on communications technologies, construction practices, and building materials to improve highway safety. The Department's other modal agencies sponsor research on vehicle and driver safety, high-speed ground transportation, mass transit operations and maintenance, and advanced transportation technologies. According to the American Association of State Highway and Transportation Officials, the states increased the federal-aid highway dollars they spent on research from \$53 million in 1989 to \$88 million in 1995. During the same period, they increased their own funding for research from \$33 million to \$76 million. Although information on the private sector's funding is proprietary and therefore limited, the Transportation Research Board reported that highway associations spent about \$21 million on highway research in 1993. Meanwhile, the Association of American Railroads spent \$26 million for rail research in 1994.

Despite Agreement on Federal Role, Limitations Exist

Members of the transportation community generally agreed that the federal government should lead the nation's surface transportation research. They pointed out that federal expenditures on research are important and that the Department has broader interests than other parties: The states generally focus on applied research to solve specific problems; industry funds research to develop new or expanded markets; and universities train future transportation specialists and conduct research that reflects the interests of their funders.

In 1993, the Secretary formed the Coordinating Committee for Transportation Research and Development under the President's National Science and Technology Council, created the position of Director of Technology Deployment within the Office of the Secretary, and established the Research and Technology Steering Committee and Coordinating Council. The Department made these changes to improve the external and internal coordination of its surface transportation research program.

While improving coordination, these actions have not removed the organizational constraints on the Department's development of a more strategic approach to research. Surface transportation research within the Department is focused on improving individual modes of transportation rather than on creating an integrated framework for surface transportation research. Such a framework might establish objectives and strategies for

accomplishing them, including establishing priorities for the use of limited funds.

Unlike the Department of Defense, the Department of Transportation does not have an Assistant Secretary for Research and Development to oversee its research. The Director of Technology Deployment, within the Office of the Secretary, formerly served as a focal point for coordinating research, but that position is now vacant. (On August 21, 1996, however, the Department announced that the Research and Special Programs Administration's Associate Administrator for Research, Technology, and Training would assume the Director's coordinating functions on an interim basis.) Although the Research and Special Programs Administration was established to foster cross-cutting research, it lacks the resources and authority to act as the Department's strategic planner for surface transportation research.

Congressional directives also limit the Department's ability to guide research. For example, officials in one modal agency found that the Congress had specified how the agency was to spend nearly 80 percent of the budget for one of its primary research programs in fiscal year 1996.

The Department is attempting to develop an integrated framework for surface transportation research. Its annual research and development plans are useful inventories of the five modal agencies' research activities. However, the plans cannot be used, as ISTEA directed, to make surface transportation research more strategic, integrated, and focused.

Investment in Emerging Areas and Basic Research Is Not Adequately Addressed

According to public and private transportation officials, the current investment in surface transportation research is inadequate to build knowledge, either in three emerging areas—system assessment, policy research, and intermodal research—or in basic, long-term, high-risk research.

System assessment research seeks a comprehensive understanding of the transportation system's parts and their interrelationships. It also allows for a comprehensive examination of persistent problems, such as congestion, which costs the nation an estimated \$40 billion annually in lost time and wages.

Transportation officials cited policy research as a high priority for the federal government, as well as for state and local governments faced with

complex transportation problems. For example, ISTEA required local planning agencies to conform transportation plans to air quality goals. However, few standard models for assessing the impact of transportation on air quality are available for local agencies to use.

Transportation officials also said that intermodal research—on how people and freight move between highways, mass transit, and rail—is increasingly important. The Transportation Research Board estimates that the Department of Transportation devotes between \$2 million and \$5 million each year to intermodal research. Public and private officials identified institutional barriers and freight movement as intermodal problems requiring further research.

According to transportation officials, the current mix of research projects gives too little emphasis to basic, long-term, high-risk surface transportation research. Because about 80 percent of the projects are applied, short-term, or low-risk, the officials were concerned that quantum leaps—generally credited to basic research—would not occur and users' needs would not be met. For example, surface transportation research that focuses on incremental improvements in asphalt would not deal with fundamental questions, such as whether asphalt for highways will be needed in 20 years.

Recommendation

GAO is making no recommendations in this report.

Agency Comments

GAO provided a draft of this report to the Department of Transportation for its review and comment. GAO met with departmental officials, including the Associate Administrator for Research, Technology, and Training in the Research and Special Programs Administration and officials from the Office of the Secretary, FHWA, the Federal Railroad Administration, the Federal Transit Administration, and the National Highway Traffic Safety Administration. The Department generally concurred with the information presented and the observations made throughout the report. FHWA concurred with the report's findings and conclusions but said that the report gave the impression that the Department's funding is insufficient for basic, long-term, high-risk research. FHWA stated that about 15 percent of its funding for research is focused on basic research. GAO included this information in the report.

Executive Summary

The Department also suggested editorial changes to the report, which were incorporated where appropriate.

Contents

Executive Summary		2
Chapter 1		10
Background	Surface Transportation Research Includes a Wide and Growing Range of Activities	10
	Research Has Improved Surface Transportation	11
	ISTEA Provided New Direction and Funding for Surface Transportation Research	12
	Objectives, Scope, and Methodology	14
Chapter 2		17
Public and Private Funding for Surface Transportation Research	Most of DOT's Surface Transportation Research Budget Has Gone to FHWA	17
	ITS Program Dominates Surface Transportation Research Programs	18
	States, Universities, and Industry Support Surface Transportation Research	21
Chapter 3		23
Progress and Limitations in Moving Toward a More Strategic Role for Surface Transportation Research	DOT Brings a National Perspective to Surface Transportation Research	23
	The Federal Government Provides Leadership	24
	DOT Has Made Progress in Coordinating Research Programs	26
	Organizational Factors Constrain the Establishment of an Agencywide Strategic Plan for Surface Transportation Research	30
	Conclusions	33
Chapter 4		35
Mismatch Between Research Investments and Changing Needs	Emerging Needs Are Not Reflected in the Research Portfolio	35
	Basic, Long-Term, High-Risk Research Is Not Adequately Addressed	37
	Agency Comments	38
Appendixes	Appendix I: Sources Contacted by GAO	40
	Appendix II: Major Contributors to This Report	42

Tables	Table 1.1: Research Activities	11
	Table 2.1: Funding for Surface Transportation Research, Fiscal Years 1992-96	17
	Table 2.2: Research as a Percentage of Modal Agencies' Budgets, Fiscal Year 1996	18
	Table 2.3: Overview of Modal Agencies' Research Programs, Fiscal Year 1996	19

Figures	Figure 1.1: DOT's Research and Development Appropriations, by Organization, in Constant 1992 Dollars, Fiscal Years 1970-92	14
	Figure 2.1: Largest Research Program in Each Modal Agency, Fiscal Year 1996	20
	Figure 3.1: DOT's Surface Transportation Research Organization	28

Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
DOD	Department of Defense
DOT	Department of Transportation
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITS	Intelligent Transportation Systems program
MPO	Metropolitan Planning Organization
NHTSA	National Highway Traffic Safety Administration
NSTC	National Science and Technology Council
RSPA	Research and Special Programs Administration

Background

The nation's transportation system depends increasingly on innovations from research to improve its performance. Improving performance is vital because transportation figures prominently in the nation's economy and quality of life. The nation's expenditures on transportation illustrate its importance—spending on passenger and freight transportation exceeds \$1 trillion annually, constituting about 11 percent of the nation's gross domestic product. U.S. consumers spend more on transportation than on any other item except housing. In addition, governments invest heavily in the nation's transportation system. During 1992, the federal government and state and local governments invested an estimated \$113 billion in transportation.

Decisions about surface transportation research have important consequences because such research provides knowledge, products, and technologies to improve the efficiency, effectiveness, and safety of the nation's transportation system. Decisions about research are assuming more importance as aging highway, transit, and rail systems deteriorate; demands on the transportation system increase; and constraints on resources grow.

Surface Transportation Research Includes a Wide and Growing Range of Activities

Surface transportation research embraces different transportation modes and serves different purposes. Such research spans three distinct modes—highways, mass transit, and railroads. It also encompasses issues such as safety and the connections between modes. Five agencies in the Department conduct surface transportation research: the Federal Highway Administration (FHWA), the Federal Railroad Administration (FRA), the Federal Transit Administration (FTA), the National Highway Traffic Safety Administration (NHTSA), and the Research and Special Programs Administration (RSPA).

Surface transportation research supports several of the Department of Transportation's (DOT) missions, including

- making policy (research informs decisions on transportation issues and policies);
- regulating modes of transportation (research supports regulatory responsibilities for safety compliance with legislative mandates, such as auto safety standards);
- responding to national needs (research identifies means of improving transportation safety and mobility); and

- overseeing operations (research improves technologies for inspecting train wheels and tracks).

Traditionally, research has been viewed as a continuum that begins with basic and applied research and moves toward development, demonstration, and technology transfer. Table 1.1 represents this progression.

Table 1.1 : Research Activities

Activity	Characteristics	Examples
Basic research	Creates new or enhanced knowledge about basic phenomena. No specific expectations for results.	Exploring basic properties of materials used to construct highways, e.g., behavior of recycled concrete.
Applied research	Addresses specific questions; produces knowledge relevant to producing a technology or service.	Discovering more durable, manufacturable materials for highways and railroad track.
Development	Uses research findings to develop practical applications or prototypes.	Producing a prototype of new highway construction materials.
Demonstration	Illustrates operation of new technologies and applications.	Showing how automated reservation, dispatching, and billing systems for transportation geared to the disabled will operate.
Technology transfer/ training	Communicates research and development knowledge and/or products to users in the private and public sectors.	Disseminating research information via the Internet, newsletters, trade journals, bulletins, forums, and seminars.

This traditional linear view of research has been changing. Increasingly, research is seen as a process of continuous feedback involving interactions between activities on the continuum. In addition, opportunities for using new technologies and emerging transportation needs influence research. DOT’s surface transportation research concentrates primarily on applied research, development, demonstration, and technology transfer.

Research Has Improved Surface Transportation

According to public and private officials we consulted, investments in research have provided benefits to surface transportation users and the economy. One expert pointed out that these benefits continue for a long time. DOT officials said that although research produces important results,

its benefits may not be recognized because they are taken for granted. These benefits include crash protection devices, such as seat belts, motorcycle helmets, and car seats for infants and children; programs to reduce alcohol-related deaths; longer-lasting highway surfaces that reduce maintenance costs; and improved roadside safety hardware, such as guardrails and road signs that yield to the force of a collision.

States have realized benefits from their surface transportation research programs. Through a study of drivers' behavior, for example, university researchers for the Ohio Department of Transportation found little to no benefit from using steady-burn lights on barrels in construction zones. (Steady-burn lights are low-wattage yellow electric lamps, which may be used to mark obstructions or hazards.) When the study showed that the lights did not influence drivers' speed or other behavior in construction zones, the state stopped requiring the lights. The Department estimated that this change would save more than \$4 million annually without affecting safety. The Indiana Department of Transportation also benefited from its research programs. Its maintenance engineers, in cooperation with university researchers, developed a computer-aided system for planning efficient routes to remove snow and ice. The Department, which is responsible for more than 30,000 lane-miles of roadway, expected that this system would enable it to eliminate about 120 snow removal routes and save between \$86,000 and \$120,000 per year for each eliminated route.

ISTEA Provided New Direction and Funding for Surface Transportation Research

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) expressed the need for a new direction in surface transportation research, finding that despite an annual federal expenditure of more than \$10 billion on surface transportation and its infrastructure, the federal government lacked two key components for an effective surface transportation research program: (1) a clear vision of the role of federally funded surface transportation research and (2) an integrated framework for the fragmented surface transportation research programs dispersed throughout the government.

In response to these concerns, ISTEA established a framework for changing surface transportation research. Overall, the act underscored the need for a "more active, focused surface transportation research and development program" that would foster cooperation among the federal government, industry, and universities. It called for an integrated national surface transportation research framework that would include "consensus on the goals." The act also stated that the federal role should be to sponsor and

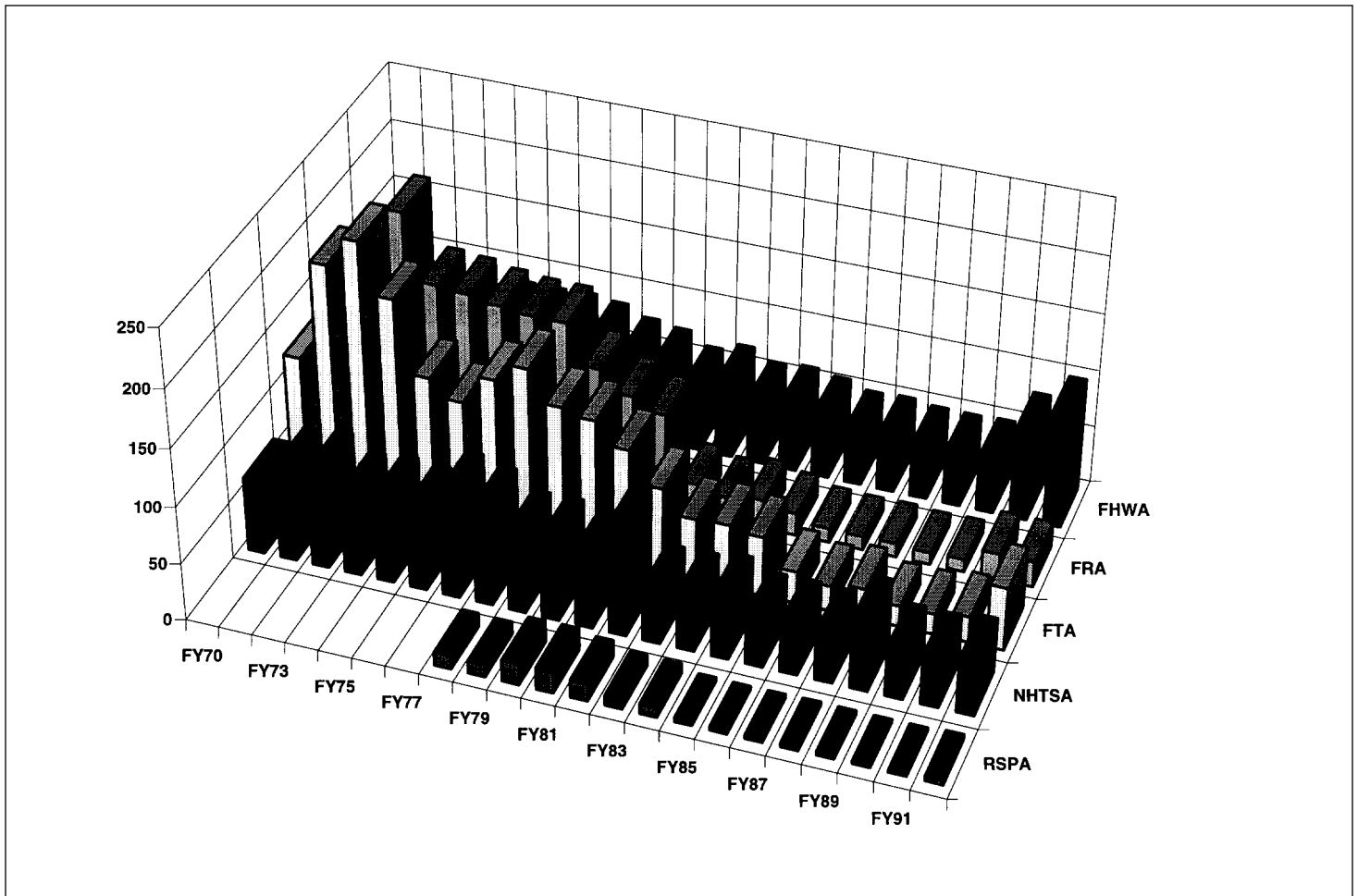
coordinate research and development on new technologies that would provide safer, more convenient, and more affordable future transportation systems.

ISTEA also reflected congressional concerns about the adequacy of the funding for advanced transportation systems, suggesting that too little funding would increase the nation's dependence on foreign technologies and equipment. The act therefore increased the funding for many existing and new research programs, especially for the Intelligent Transportation Systems (ITS) program, which applies numerous electronics, communications, and information-processing technologies to intelligent vehicle-highway systems.

Figure 1.1 shows how the funding for surface transportation research has changed since 1970. From 1970 to 1981, the bulk of the funding supported research on transit and railroad technologies that could revitalize cities and make rail services more productive. According to estimates from the John A. Volpe National Transportation Systems Center (Volpe Center),¹ this research absorbed nearly half of DOT's annual research budget between 1975 and 1981. From 1981 to 1991, the support for rail and transit research declined, as did the total funding for research. Projects sponsored by NHTSA and FHWA were cut less than others because both the Congress and the administration supported these agencies' missions of increasing safety and completing the Interstate highway system. In 1987, the Congress authorized the Strategic Highway Research Program, providing a modest increase in the funding for highway research. In 1991, ISTEA continued to direct funds into highway research via its support for ITS.

¹Located in Cambridge, Massachusetts, the Volpe Center is part of DOT's Research and Special Programs Administration. It provides research, analytic management, and engineering support to DOT, other federal agencies, state and local governments, and private organizations.

Figure 1.1: DOT's Research and Development Appropriations, by Organization, in Constant 1992 Dollars, Fiscal Years 1970-92



Note 1: Nominal dollars were converted to constant dollars using the 1992 Consumer Price Index (1992=100).

Note 2: This figure does not include data for fiscal year 1971.

Source: The Volpe Center.

Objectives, Scope, and Methodology

To prepare for reauthorizing the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), the Chairman and Ranking Minority Member of the Senate Committee on Environment and Public Works and the Chairman of that Committee's Subcommittee on Transportation and Infrastructure asked us to provide information on the Department of

Transportation's surface transportation research programs. This report discusses (1) the public and private funding for surface transportation research, (2) the transportation community's views on the federal role for research and DOT's ability to fulfill that role, and (3) the issues that the transportation community believes the Congress and DOT should consider during ISTEA's reauthorization.

To identify the public and private funding for surface transportation research, we reviewed DOT's research program budgets, three surface transportation research plans, and program and budget information from other sources. In addition, we interviewed officials in FHWA, FRA, FTA, NHTSA, RSPA, and the Office of the Secretary.

To obtain knowledgeable views on the federal role in surface transportation research and DOT's ability to fulfill this role and to identify directions for research, we interviewed DOT officials, representatives of state departments of transportation, university researchers, representatives of transportation organizations and the transportation industry, and other experts with direct knowledge of surface transportation research. Appendix I lists the groups we consulted. In addition, we reviewed documents on research, including a survey of state transportation research staff published in 1995 by the American Association of State Highway and Transportation Officials' (AASHTO) Research Advisory Committee. We also reviewed many public and private analyses of transportation research. We analyzed the proceedings of the Forum on Future Directions in Transportation R&D (Forum),² sponsored in 1995 by the Transportation Research Board and the National Science and Technology Council (NSTC), to identify participants' comments about potential federal roles in surface transportation research. This analysis provided additional support for our findings because approximately 170 representatives from the federal government, state and local governments, industry, universities, private and public interest groups, and transportation users participated in this forum. In addition, we conducted extensive interviews and observed operations at the John A. Volpe National Transportation Systems Center. We performed our review from August 1995 through August 1996 in accordance with generally accepted government auditing standards.

We provided a draft of this report to the Department of Transportation for its review and comment. We met with RSPA's Associate Administrator for Research, Technology, and Training and with officials from the Office of

²Forum on Future Directions in Transportation R&D, Washington, D.C. (Mar. 6-7, 1995).

Chapter 1
Background

the Secretary, FTA, FHWA, FRA, and NHTSA to obtain DOT's comments. DOT generally concurred with the information presented and the observations made throughout the report. DOT provided information to update our report, which we incorporated in chapter 3. DOT also provided additional information on its basic research program, discussed at the end of chapter 4.

Public and Private Funding for Surface Transportation Research

Since ISTEA's enactment in 1991, the federal funding for surface transportation research has totaled nearly \$2.9 billion. DOT's modal agencies have used these funds to support several research programs, but much of the funding has gone to FHWA's ITS program. Although ISTEA required the states to spend more funds on research, the states' support for research is relatively small compared with the federal support. Because data on industry's total funding for surface transportation research is proprietary, this information is limited.

Most of DOT's Surface Transportation Research Budget Has Gone to FHWA

Between fiscal year 1992 and fiscal year 1996, DOT budgeted about \$2.9 billion (in appropriations and contract authority) for surface transportation research—about 2 percent of its total surface transportation budget. Table 2.1 shows how these funds were divided among DOT's surface modal agencies—FHWA, FRA, FTA, NHTSA, and RSPA.

Table 2.1: Funding for Surface Transportation Research, Fiscal Years 1992-96

Dollars in thousands

Agency	Fiscal year					Total
	1992	1993	1994	1995	1996	
FHWA	\$445,916	\$385,385	\$443,020	\$427,966	\$444,357	\$2,146,644
FRA	22,331	25,205	28,565	40,067	48,266	164,434
FTA	94,670	49,881	48,263	51,290	45,914	290,018
NHTSA	43,016	49,401	42,628	56,270	55,290	246,605
RSPA	2,521	2,384	2,739	8,220	7,008	22,872
Total	\$608,454	\$512,256	\$565,215	\$583,813	\$600,835	\$2,870,573

Note: For fiscal years 1992-95, the figures are actual, and for fiscal year 1996, they are enacted.

Through fiscal year 1996, FHWA received 75 percent of the total funding for surface transportation research. Yet FHWA, like the other modal agencies, spent a relatively small percentage of its total budget for research. (See table 2.2.)

**Table 2.2: Research as a Percentage of
Modal Agencies' Budgets, Fiscal Year
1996**

Dollars in millions			
Agency	Research budget	Total budget	Percent
FHWA	\$444	\$19,931	2.23
FRA	48	873	5.53
FTA	46	4,049	1.13
NHTSA	55	277	19.93
RSPA	7	55	12.70
Total	\$601	\$25,186	2.39

Note: Numbers may not add because of rounding.

Source: GAO's analysis of data from DOT.

Although NHTSA devoted a much higher percentage of its budget (20 percent) to surface transportation research than FHWA (2 percent), FHWA budgeted nearly eight times as much (\$444 million) for research as NHTSA (\$55 million). RSPA devoted 13 percent of its budget to surface transportation research, FRA 6 percent, and FTA 1 percent.

ITS Program Dominates Surface Transportation Research Programs

DOT's five modal agencies' surface transportation research programs differ not only in the size of their budgets but also in the focus of their research and in their customers. However, FHWA's ITS program overshadows the other programs, reflecting both the traditional dominance of highways in surface transportation and congressional statutory requirements, which established the ITS program under ISTEA.³

Although the modal administrations set the surface transportation research agenda, their programs, budgets, and customers contrast sharply, as indicated in table 2.3.

³NHTSA and FTA have received about \$10 million a year in appropriations for their ITS programs.

**Chapter 2
Public and Private Funding for Surface
Transportation Research**

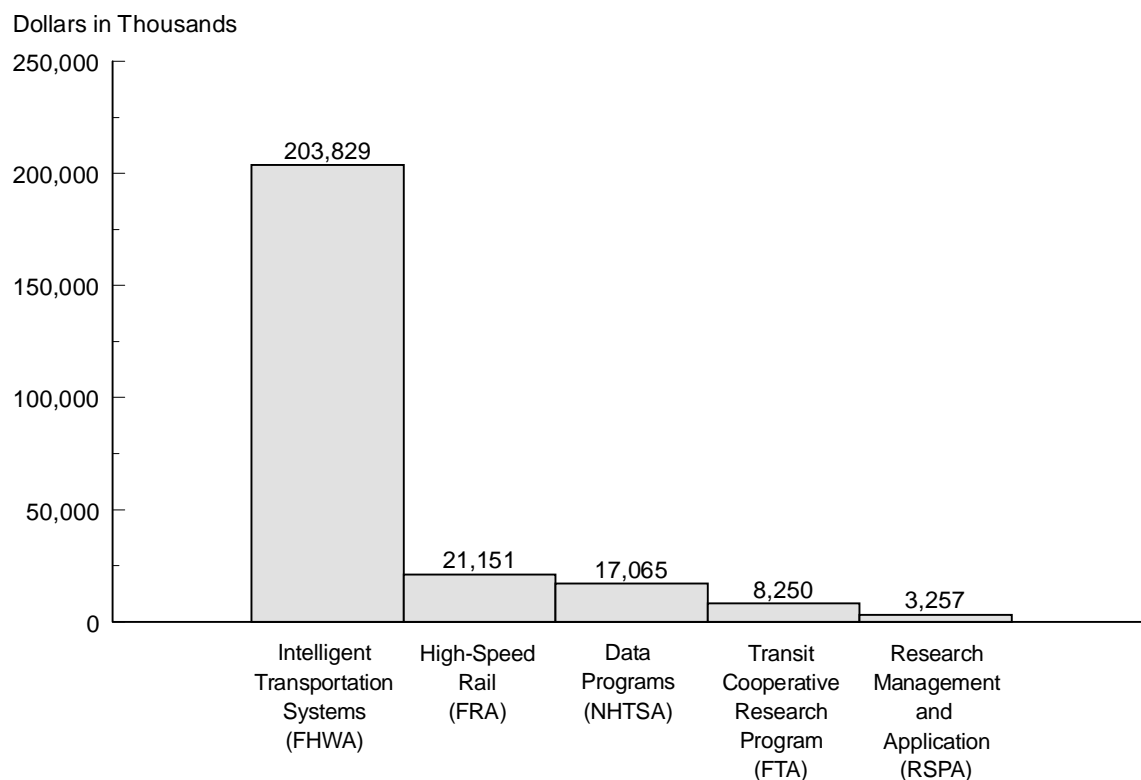
Table 2.3: Overview of Modal Agencies' Research Programs, Fiscal Year 1996

Dollars in millions

Agency	Major research programs	Budget	Customers
FHWA	Intelligent transportation systems (ITS); highway materials, pavements, structures, and rights-of-way; environment; safety; highway designs and facilities for pedestrians/cyclists; advanced research	\$444	Noncommercial and commercial drivers and passengers; state/local transportation and planning agencies; service providers; universities; contractors and consultants
NHTSA	Data programs; crashworthiness, heavy vehicle/driver safety; pedestrian/bicycle safety; traffic safety; ITS crash avoidance; National Advanced Driving Simulator	\$55	NHTSA for rulemaking and resulting interaction with motor vehicle industry; national safety organizations
FRA	High-speed ground transportation; safe equipment, structures, and controls; hazardous materials; human performance factors; technology demonstrations	\$48	Freight, commuter, and passenger railroads; states; industry associations; passengers; FRA (for rulemaking)
FTA	Transit cooperative research program; advanced transit systems; technology development; clean air; financing; mobility for urban/suburban riders; safe equipment and conditions for riders	\$46	State/local transit and planning agencies; riders; transit operators; paratransit; bus manufacturers
RSPA	Building a knowledge base of DOT's research activities and disseminating the results of research; hazardous materials and pipeline safety; technology transfer; Volpe Center; university research program	\$7	DOT's modal administrations; state/regional/local agencies; RSPA (for rulemaking)

As figure 2.1 shows, ITS is FHWA's largest research program. It received \$204 million in fiscal year 1996, or nearly half of FHWA's funding for research. ITS is about four times as large as either FRA's or FTA's research program. ISTEA established ITS and authorized \$659 million for it for fiscal years 1992-97. The appropriations process provided additional funding, bringing the total for fiscal years 1992-96 to \$1.01 billion. The ITS program uses research in computer and information technology to identify ways of improving highway capacity and safety. Much of FHWA's research is designed to benefit state and local governments by developing new materials and techniques.

Figure 2.1: Largest Research Program in Each Modal Agency, Fiscal Year 1996



Source: GAO's analysis of data from DOT.

Through its research, NHTSA develops a scientific basis for its vehicle safety and driver safety programs. The largest portion of its funding—\$17 million in fiscal year 1996—is directed to its data programs. The National Center for Statistics and Analysis is responsible for maintaining large-scale databases that are used to support highway safety, vehicle rulemaking, and safety recall programs. These databases are also the primary source of information on motor vehicle and highway safety for DOT's other modal agencies, especially FHWA, as well as for state and local governments, the automobile and insurance industries, and consumers.

Much of FRA's recent funding for research—\$21 million in fiscal year 1996—has supported work on high-speed ground transportation. The technology deployment portion of FRA's Next Generation High-Speed Rail Development Program supports strategies that FRA believes are essential to the success of high-speed rail in the United States. Through the program, FRA has developed partnerships with suppliers, railroads, and state agencies to make high-speed rail more financially feasible, thereby seeking to encourage states to develop high-speed rail in selected corridors.

FTA's largest research program—\$8 million in fiscal year 1996—is the Transit Cooperative Research Program, an applied research program designed to yield innovative and near-term solutions to transit problems. While sponsored by FTA, the program is carried out under an agreement among FTA, the National Academy of Sciences acting through the Transportation Research Board, and the Transit Development Corporation, an educational and research arm of the American Public Transit Association. The program supports a broad range of research projects and activities to address the immediate and practical needs of transit, as well as to facilitate the transfer of technical information. State and local transit and planning agencies are the program's primary customers.

RSPA's largest research program—\$3 million in fiscal year 1996—is the Research Management and Application Program, whose focus is to develop a database of advanced transportation technology topics and ensure that the results of research and development on these topics are widely available. RSPA's customers include DOT's modal agencies, state and local governments, the transportation community, and academia.

States, Universities, and Industry Support Surface Transportation Research

ISTEA encouraged the states, universities, and the private sector to become more involved in surface transportation research. ISTEA required the states to devote 2 percent of their federal-aid funds to planning and research and to direct at least 25 percent of these funds solely to research, development, and technology transfer. Although DOT does not monitor the states' annual expenditures of federal-aid funds for research, AASHTO reported that between 1989 and 1995 the states increased these expenditures by 66 percent (from \$53 million to \$88 million). ISTEA also encouraged the states to use their federal-aid funds to leverage additional funds from state and other sources. According to AASHTO, between 1989 and 1995 the states increased their own annual funding for research by 130 percent (from

\$33 million to \$76 million). Now that ISTEA requires the states to spend a minimum percentage of their federal-aid funds on research, AASHTO estimated that about 53 percent of the states' fiscal year 1995 funding for transportation research came from the federal government. AASHTO also found that, in keeping with ISTEA's intent, most states have increased their expenditures for research in surface modes other than highways.

ISTEA has continued to involve universities in surface transportation research, bringing five new universities into the University Transportation Center program. These centers, like the original 10 established by the Surface Transportation and Uniform Relocation Assistance Act of 1987, are funded by both FHWA and FTA. ISTEA also authorized \$38 million over 6 years for five additional university research institutes, which receive funding through the Highway Trust Fund. Finally, ISTEA authorized \$18 million over 6 years for the National Transit Institute, which provides training for anyone involved in federal-aid transit work.

Although ISTEA encourages cooperation between the public and private sectors in conducting surface transportation research, the Transportation Research Board has generally found information about the private sector's expenditures for research and development difficult to obtain. The private sector's research is conducted or sponsored primarily by major national industrial and engineering associations. According to the Transportation Research Board, these associations spent about \$21 million on highway research and technology in 1993. Meanwhile, the Association of American Railroads spent \$26 million for rail research in 1994. Except for projects supported by a handful of major companies, research programs sponsored by individual companies are difficult to identify and characterize because they are so numerous and their findings remain proprietary.

Progress and Limitations in Moving Toward a More Strategic Role for Surface Transportation Research

Representatives of five groups of transportation stakeholders—federal, state, university, industry, and other experts—agreed that DOT should lead the nation’s surface transportation research effort and fulfill three principal roles—funding research, establishing a strategic agenda, and acting as a focal point for technology transfer. DOT has established councils and committees to coordinate its research both internally and externally. However, DOT’s modal organizational structure and lack of both a focal point and a strategic plan for surface transportation research, together with congressional directives to initiate or maintain specific research efforts, may limit DOT’s ability to lead. Until these constraints are addressed, the federal government may not be able to respond effectively to ISTEA’s call for an integrated framework for specifying national research goals.

DOT Brings a National Perspective to Surface Transportation Research

DOT’s role as the leader in surface transportation research stems from the Department’s national perspective, which transcends the interests and limitations of nonfederal stakeholders: The states generally focus on applied research that is geared to solving specific transportation problems; industry focuses on research that is often proprietary and geared to developing new or increased markets for selling goods and services; and universities focus on training future transportation specialists and conducting research that reflects the interests of its funders. Although all of these stakeholders advance knowledge, it is unlikely that they could replace the federal government as the focal point for surface transportation research.

The states generally focus their research agendas and dollars on applied research—research that addresses specific questions and is designed to result in the information needed to produce a certain technology or service. According to the Transportation Research Board, highway problems are often of local interest and can best be addressed by state highway departments. For example, the Colorado Department of Transportation has many ongoing projects aimed at predicting where and when avalanches are likely to occur. In 1993, the Colorado Transportation Institute began exploring less costly measures to protect travelers from avalanches. The Institute tested two new monitoring systems that “listen” for sound waves signaling the approach of an avalanche. These advanced systems will allow the state to warn traveling motorists 40 to 60 seconds before an avalanche reaches the roadway.

Private companies also focus on applied research. According to the Transportation Research Board, the private sector's highway research is sponsored by national associations representing industry and the engineering professions or by companies that design and construct highways and supply highway-related products. According to a federal research official, the private sector has few incentives to conduct highway research because its main service—constructing highways and bridges—occurs in a contracting environment in which payment for completing services is based more on adhering to rigid design standards than on finding innovative means of building better highways. The private sector's rail research is supported through the Association of American Railroads, whose researchers confirmed that they focus on applied research that is targeted to improving safety and building better equipment. For example, the association is coordinating research on the effects of 125-ton cars on conventional track structures. In addition, when the private sector conducts research, it often does not share its results with the research community because its findings are proprietary. A Civil Engineering and Research Foundation study noted that the private sector's research is designed to gain a competitive advantage and firms protect the rights to their results.

Finally, universities focus on educating future transportation professionals and spending the funds provided by government agencies or the private sector. Much of the highway research funded by FHWA, the states, and the private sector is performed by universities, especially those with specialized testing facilities and technical experts. However, as some university stakeholders observed, universities do not have the funds to conduct their own research and often shift their research agendas to focus on the areas with the most federal funding. Accordingly, the potential for universities to compensate for reductions in federal funding is limited.

The Federal Government Provides Leadership

Given the specific interests of nonfederal stakeholders, the members of the transportation community with whom we spoke agreed that the federal government should lead the nation's surface transportation research. They said that DOT should fund research, especially research that generates new ideas; establish a strategic agenda; and act as a focal point for technology transfer.

DOT's Role in Funding Research

Representatives of the five groups we interviewed—federal, state, industry, university, and other experts—agreed that DOT should support

surface transportation research. Without federal support, they said, there would be no innovation in the transportation industry—especially in areas of general rather than particular interest, such as social objectives, land use, data collection, and the transportation system as a whole. Federal officials said that the federal government should support research to find solutions to national needs and problems. University representatives emphasized the importance of federal funding because it supports their research.

In addition, according to representatives of the transportation industry, academia, local governments, and state governments who attended the March 1995 Forum on Future Directions in Transportation R&D (Forum),⁴ financial support for research is a federal responsibility. Private-sector participants believed, and state representatives concurred, that the federal government has a responsibility to fund transportation research and share the risk of investing in new technologies whose public acceptance, market acceptance, and technical feasibility are uncertain.

DOT's Role in Establishing a Research Mission and Developing a Strategic Plan

Representatives of the five stakeholder groups agreed that the federal government should establish an overall research mission and provide strategic planning and management to achieve this mission. According to DOT's Surface Transportation Research and Development Plan, DOT, as steward of the nation's transportation system, must lead the effort to set transportation standards and develop a national surface transportation research and development agenda to achieve these standards. A former DOT official noted, for example, that DOT leads the national research and development efforts in safety and regulatory issues because other stakeholders have little or no incentive to support such research. Under DOT's leadership, the use of safety belts increased from 11 percent in 1982 to 68 percent in 1995 and the proportion of traffic fatalities involving alcohol declined from 57 percent in 1982 to 41 percent in 1994. In addition, by focusing on transportation's strategic goals, DOT can develop solutions to intermodal problems. Without a federal strategy, problems such as traffic congestion, which require an intermodal solution, may go unaddressed. Industry representatives discussing the National Science and Technology Council's draft Strategic Implementation Plan for Transportation Research and Development at the Forum also agreed that the federal government has a role in setting standards and sponsoring research.

⁴See footnote 2.

The stakeholders also agreed that DOT should cooperate with others in the transportation community and direct resources toward achieving its research mission and goals. University officials said, for example, that as part of its strategic planning role, DOT must build relationships among the various stakeholders, since the solutions to transportation problems require more than research on building a sturdier road. Transportation officials also stated that DOT should direct resources toward achieving its research mission and goals by coordinating the efforts of other stakeholders. AASHTO indicated in its policy statement on ISTEA's reauthorization that the federal government should coordinate the development of technologies of national interest.⁵

DOT's Role as a Focal Point for Technology Transfer

Finally, representatives from three of the five stakeholder groups—federal, state, and other experts—said that the federal government should act as a clearinghouse for information on surface transportation research and its results and ensure that new technologies are transferred to users. According to a DOT official, the federal government is in a good position to disseminate the results of surface transportation research to many users—states, cities, and the industry. In addition, in its policy statement on ISTEA's reauthorization, AASHTO recommended that DOT continue its ongoing programs to transfer technology to state and local highway agencies and private organizations. According to the policy statement, one such program, the Strategic Highway Research Implementation Program, has produced valuable products, from pavement designs to snow removal technologies. Finally, according to Forum participants, the federal government needs to act as a focal point for gathering and disseminating information on ongoing as well as completed research because other parties are unlikely to perform these tasks.

DOT Has Made Progress in Coordinating Research Programs

To improve the external and internal coordination of DOT's surface transportation research program, the Secretary, in 1993, formed the Coordinating Committee on Transportation Research and Development (Coordinating Committee) under the National Science and Technology Council.⁶ He also created the position of Director of Technology Deployment within the Office of the Secretary and established the

⁵Research: Innovation for Transportation (Dec. 1995), p. 3.

⁶In 1993, President Clinton established the National Science and Technology Council to help coordinate science, space, and technology policies across the federal government. The Council is made up of representatives from the departments of Commerce, Defense, Energy, and Transportation and is housed within the President's Office of Science and Technology Policy.

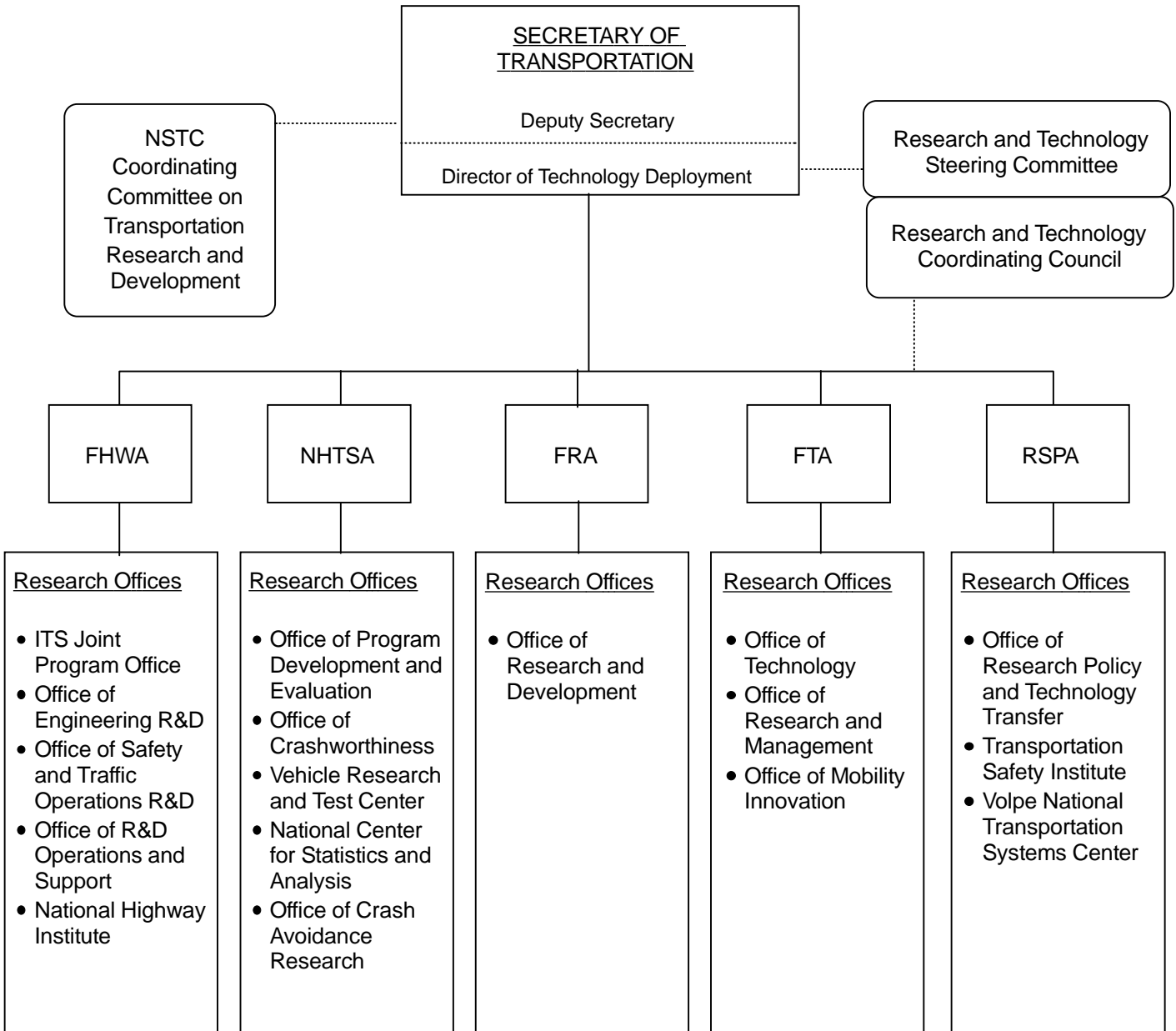
Chapter 3
Progress and Limitations in Moving Toward
a More Strategic Role for Surface
Transportation Research

Research and Technology Steering Committee (Steering Committee) and the Research and Technology Coordinating Council (Coordinating Council) within DOT. These actions have helped to improve the coordination of DOT's research programs.

Figure 3.1 displays the linkages among DOT's research-related committees and councils and other federal departments. At the interdepartmental level, the Coordinating Committee sets federal priorities in transportation research and exchanges information about research programs among the executive branch departments involved in transportation research. The Committee's members represent DOT and the departments of Commerce, Defense, and Energy.

**Chapter 3
 Progress and Limitations in Moving Toward
 a More Strategic Role for Surface
 Transportation Research**

Figure 3.1: DOT's Surface Transportation Research Organization



(Figure notes on next page)

Chapter 3
Progress and Limitations in Moving Toward
a More Strategic Role for Surface
Transportation Research

Note: The Coordinating Committee, the Steering Committee, and the Coordinating Council include representatives all of DOT's modal agencies, not just the surface modes.

Source: GAO's analysis of information from DOT.

DOT has three mechanisms for coordinating research—the Director of Technology Deployment in the Office of the Secretary, the Steering Committee, and the Coordinating Council. The Director of Technology Deployment is responsible for coordinating DOT's transportation research and development programs externally, with those of other federal agencies, and internally, among DOT's modal agencies. The value of this position lies in its day-to-day involvement and interaction with the Secretary and Deputy Secretary, allowing for quick intervention when opportunities arise to emphasize DOT's research. The position also offers modal research directors a focal point for bringing issues to the Secretary. This position increased the visibility of DOT's research programs and emphasized their coordination, but since May 31, 1996, the position has been vacant.

The Steering Committee establishes policies on research and technologies, budget priorities, and strategic plans for the Department, and its members include the administrators of DOT's modal agencies and certain assistant secretaries. The Coordinating Council implements the policies set by the Steering Committee and consists of the associate administrators and office directors associated with DOT's research program.⁷ According to the former Director of Technology Deployment, the Coordinating Council has done more to coordinate research than the Steering Committee. DOT officials indicated that the Steering Committee meets only once or twice a year and its mission has become blurred with that of the National Science and Technology Council's Coordinating Committee. The Coordinating Council, however, meets monthly and its members are committed to furthering DOT's research agenda. According to DOT, the Coordinating Council provides a forum for sharing information about areas of common interest, such as human factors, physical infrastructure, and nondestructive testing.⁸ Furthermore, members of the Coordinating

⁷A Research and Development Coordinating Council was originally created in 1984. However, it was no longer fully functioning in 1993 when DOT reestablished it and created new membership and objectives.

⁸Human factors research involves studying human behavioral issues, such as the impact of fatigue on drivers' performance. Nondestructive testing involves inspecting structures, such as bridges, while leaving the structures themselves intact. It makes use of technologies such as radar and ultrasound.

Council may identify opportunities for further research that researchers themselves have not perceived because they are too close to their work.

Organizational Factors Constrain the Establishment of an Agencywide Strategic Plan for Surface Transportation Research

Several organizational factors limit DOT's ability to develop a strategic approach to, and establish a clear agenda for, surface transportation research across all modes. Most importantly, surface transportation research within DOT is modally focused and lacks a central focal point. An Assistant Secretary for Research and Development might serve as a focal point, but DOT does not have such a position. The Director of Technology Deployment, within the Office of the Secretary, could also act as a focal point. However, as noted, this position remains vacant. Although RSPA was established to foster cross-cutting research, it does not have the resources or the internal clout to function effectively as a strategic planner for surface transportation research. In addition, congressional earmarks limit DOT's ability to guide surface transportation research. DOT's Surface Transportation Research and Development Plan illustrates problems that the Department faces in taking a more strategic approach to changing transportation needs.

DOT's Modal Organization Limits Strategic Planning

Although some coordination of the modal agencies' research agendas occurs through the Steering Committee and the Coordinating Council, surface transportation research is largely a modal initiative. Each modal agency has separate research programs and budgets, congressional authorizing committees, and programmatic and fiscal controls over its research programs.

The modal organization allows each modal agency to focus on its own environment, goals, and users. For example, FHWA's main focus is public roads and highways (publicly owned infrastructure). The primary users of FHWA's research are state and local transportation departments, which look to research to help repair the public infrastructure and find new and better materials for pavements. FRA's focus is the rail industry and its privately owned infrastructure. Users of its research—freight railroads, Amtrak, commuter railroads, and shippers—look to FRA to conduct research that will reduce track failure, equipment failure, and human error.

According to the transportation stakeholders we consulted, DOT's modal organization inhibits centralized decision-making and coordination and works against cross-modal cooperation. Government and university officials and other transportation experts told us that having separate

modal agencies with their own constituencies works against a strategic approach. Each modal agency handles its budget independently and responds to its own constituency. This modal structure makes it difficult for DOT to develop a surface transportation system mission; accommodate the need for types of research—such as intermodal and systems assessment research—that do not have a modal focus; identify and coordinate research that cuts across modes; and evaluate research. Evaluation is particularly difficult because DOT has no single database that provides complete information on its research programs and projects.

DOT Has No Focal Point for Surface Transportation Research

A March 1996 study by the Transportation Research Board stated that when DOT was created, the intent was to have an Assistant Secretary for Research and Development, analogous to the Director of Defense Research and Engineering in the Department of Defense (DOD). Such a position was established when DOT was first created but was abandoned in the late 1970s with the formation of RSPA. DOT attempted to reorganize and consolidate its research program in fiscal year 1996, when it proposed,⁹ in its budget submission, to consolidate the surface modal agencies and their research programs. DOT also proposed to create a new position—an Assistant Secretary for Transportation Technology—and centralize the budgeting and programming for its research under this position. According to DOT, an assistant secretary would be able to look beyond the modal perspective and scrutinize all research programs, thereby improving the coordination of the Department's research agenda. The Congress did not approve either proposal in 1995.

In the absence of an Assistant Secretary for Transportation Technology, DOT's primary focal point for coordinating research is the Director of Technology Deployment in the Office of the Secretary. Although this position does not have the centralized budgeting and programming authority that DOT sought for an Assistant Secretary for Transportation Technology, the former Director encouraged strategic planning and coordination among the modal agencies' research functions. The position has not been filled since it became vacant in May 1996. However, the Deputy Secretary of Transportation announced on August 21, 1996, that RSPA's newly appointed Associate Administrator for Research, Technology, and Training would assume the coordination functions formerly assigned to the Director of Technology Deployment on an interim basis. The

⁹DOT proposed the Unified Transportation Infrastructure Investment Program, which would have reorganized DOT into three administrations, one of which, the Intermodal Transportation Administration, would have incorporated all of the existing surface modal administrations. The program would also have created a new research position and office.

Department has yet to decide whether the position of Director of Technology Deployment will be retained.

Although DOT has made RSPA's Associate Administrator for Research, Technology, and Training responsible for coordinating the Department's research, RSPA does not have the resources or the authority to fill the role of an Assistant Secretary for Transportation Technology. According to RSPA, its mission is to make America's transportation systems more integrated by conducting and fostering cross-cutting research and special programs. In contrast to DOT's operating agencies, which focus on specific sectors of the transportation system, RSPA concentrates on the system as a whole. However, a 1991 study by the National Academy of Public Administration found that RSPA had played only a limited role in research and development policy, in part because its budget is small compared with the modal agencies' research budgets. In addition, RSPA acts in an advisory capacity and has no control over the modal agencies' budgets or policies.

Congressional Directives
Limit DOT's Ability to
Guide Research

The Congress limits DOT's ability to set research priorities by including directives in the modal agencies' appropriations budgets to initiate or maintain specific research efforts. These directives, or earmarks, take a variety of forms, from specifying dollar amounts for particular recipients to suggesting areas of research for consideration. The earmarks also represent different proportions of the agencies' research budgets. For example, FTA calculated that the Congress earmarked 80 percent of one of its primary research programs in fiscal year 1996. A DOT official noted that other agencies, such as FHWA, can better accommodate earmarks because their research budgets are larger and some earmarks are compatible with ongoing research programs. However, FHWA officials stated that without earmarks, the agency would have more latitude to match funds with critical needs. The appropriations committees' conferees recognized that earmarking funds may be detrimental to meeting research programs' goals when they stated in the fiscal year 1996 conference report on DOT's appropriations that they would seriously consider discontinuing their earmarking of the ITS program in fiscal year 1997.

DOT's Research Plans Do
Not Reflect a Strategic
Approach

DOT is attempting to develop a strategic surface transportation plan with clear goals and objectives for the federal role. The plans that the Department has issued to date are useful inventories of the five modal agencies' research activities, but they cannot be used as ISTEA directed—to

make surface transportation research more strategic, integrated, and focused.

ISTEA required the Secretary of Transportation to develop an integrated national surface transportation research and development plan focusing on urban, suburban, and rural areas in the next decade. This plan was to include both strategic and nonstrategic elements. On the one hand, ISTEA placed the plan in a strategic framework, linking it to DOT's efforts to develop transportation technologies and maintain long-term advanced research for next-generation surface transportation systems. On the other hand, ISTEA required the plan to include descriptions of the Department's surface transportation research programs, including their funding, milestones, preliminary cost estimates, work scopes, personnel requirements, estimated costs, and goals over a 3-year period.

ISTEA required the first plan to be submitted by January 15, 1993, and updated annually thereafter. RSPA's Volpe Center prepared the initial plan and the two updates that DOT has submitted to the Congress since 1993. The first two plans, submitted in 1993 and 1995, responded primarily to ISTEA's requirement for descriptive information. These plans, according to DOT officials, provided the Department with the first inventory of its major modal surface transportation research programs. However, both the Secretary and the Congress asked RSPA to give the third plan a more strategic and intermodal focus.

The third plan, submitted in August 1996, tries to take a more strategic approach to research by projecting the modal agencies' research needs and programs into the future. However, strategic questions posed by ISTEA, such as what surface transportation research should provide to meet users' needs in the future, receive limited attention. As a former DOT official observed, the third plan moves in a more strategic direction, but it is far from being a strategic plan. A DOT official involved in preparing the 1996 research plan noted his difficulty in encouraging the modal agencies to take a long-term view when their research budgets consist of mandates and earmarks limiting their discretion.

Conclusions

Transportation stakeholders generally agree that the federal government should remain a leader in surface transportation research, serving as the primary source of funds, developing a strategic plan, and acting as a focal point for technology transfer. The role of strategic planner is particularly important because it gives DOT the opportunity to define the best uses for

Chapter 3
Progress and Limitations in Moving Toward
a More Strategic Role for Surface
Transportation Research

the nation's limited research dollars. However, without a focal point for surface transportation research at the departmental level, DOT will have difficulty assuming the leadership role envisioned by stakeholders and achieving the strategic goals set forth in ISTEA.

Mismatch Between Research Investments and Changing Needs

As surface transportation problems become more complex in the next decade, transportation experts contend that the current surface transportation research portfolio must change to prepare the nation for a transportation system whose present use is expected to double by 2030. As the Congress considers the successor to ISTEA, federal decisions about the surface transportation research portfolio may determine whether new knowledge and technologies will be available to address future transportation problems.

According to public and private transportation officials, federal surface transportation research currently neglects two areas that will grow more important. First, it does not address the total surface transportation system, giving limited attention to system assessment, policy, and intermodal research. Second, it does not include enough basic, long-term, high-risk research to respond to complex, persistent problems. Targeting funds to changing priorities will be important when reauthorizing ISTEA's research programs.

Emerging Needs Are Not Reflected in the Research Portfolio

Industry participants in a Forum session stressed that transportation providers and their customers plan business activities on the basis of a safe, efficient, and productive transportation system, rather than on what each mode of transportation can offer. As a result, private and public transportation officials expressed concern that the current surface transportation research portfolio was weighted toward current, modal problems rather than emerging system problems. Public and private officials viewed the current research efforts as inadequate to build knowledge in three areas: system assessment, policy research, and intermodal research.

System Assessment Research

Transportation officials stated that understanding how the nation's complex surface transportation system functions—system assessment research—is vital to making transportation more efficient and effective for users. System assessment uses analytic tools to measure, monitor, and model systems and people's performance in them. According to Forum participants, system assessment applies models and simulations, cost-benefit analyses, and risk assessment to understanding how vehicles, the physical infrastructure, and the nonmaterial infrastructure (policies, regulations, laws, and institutions that govern transportation) interrelate. For example, a university official noted that system assessment would allow persistent problems that are not improving—particularly

congestion—to be examined on a larger scale. The Texas Transportation Institute estimated that congestion costs the nation \$40 billion annually in lost time and fuel.

DOT officials noted that system assessment’s broad focus and attention to the interrelationships among the individual components of a national system make it an appropriate area for federal research. However, DOT officials stated that research in this area is limited and funding is difficult to obtain. A federal research manager explained that it is difficult to put system assessment into research language and get funding because funders do not see a tangible product. As a result, a DOT official stated that the inability to look at issues as part of systems has constrained DOT’s ability to manage research.

Research on Transportation Policy

Public and private officials stated that research to support transportation policy decisions should be a high priority in the federal research portfolio. These officials noted that although the federal government and state and local governments face increasingly complex transportation problems, policy research to resolve these problems is not a high priority. A university researcher added that without reliable research, decisions risk depending on conventional wisdom—which can be wrong. As a result, scarce funds may be spent inefficiently to deal with spurious cause-and-effect relationships. For example, a university researcher noted that local government initiatives to restrict downtown traffic have been made with little information about their payoffs.

According to federal and university officials, policy research may be least available to local transportation groups, such as the Metropolitan Planning Organizations (MPO) that received new decision-making responsibilities under ISTEA. For example, MPOs are required to conform their transportation plans to air quality goals. However, a federal official observed that standard models are not available for the MPOs to use in identifying the effects of transportation on air quality.

Intermodal Research

Public and private transportation officials stated that intermodal research—how people and freight move between highways, mass transit and rail—should be an important part of the federal research portfolio. Intermodal research is important because it affects the nation’s productivity and competitiveness by focusing on the efficient movement of people and freight from one mode to another. Although intermodal

research is viewed as important, a recent report by the Transportation Research Board noted that the Department spent only about \$2 million to \$5 million on intermodal research in fiscal year 1995.

Public and private officials said that additional research is needed in two intermodal areas: overcoming institutional barriers and improving the movement of freight. Representatives of local governments participating in the Forum identified institutional research as one of three research priorities for them. They explained that public and private institutions involved in transportation often have conflicting interests that can constrain intermodal planning, funding, and decision-making. For example, implementing ITS will require institutional cooperation among local and state governments and private industry. Both state and local Forum participants called for more research to identify models that would reduce local institutional barriers to intermodal transportation planning.

Public and private officials stated that research on how freight moves between rail, truck, and sea is also needed. To date, research has focused principally on how people, rather than freight, move between modes. Additional intermodal research is needed to determine how to transport the nation's huge volume of freight without major tie-ups. University researchers noted that the problem is significant because fewer goods are shipped to local markets than to regional, national, and international markets.

Basic, Long-Term, High-Risk Research Is Not Adequately Addressed

Public and private officials pointed out that current and future research payoffs require a federal research portfolio that includes a mix of basic and applied, short- and long-term, low- and high-risk research. They emphasized that basic, long-term, high-risk research is important to provide fundamental knowledge that is the "seed corn" for developing future technologies and information.

The National Research Council and other experts noted that major advances in technology come from basic research. They cited the Global Positioning System—rapidly becoming crucial to ITS—to show that decades of basic research in diverse areas converged to create new technology that is paying off. University researchers also cited two examples of basic, long-term research that have benefited surface transportation. First, behavioral demand modeling began as an esoteric study, but in 15 years it has altered methods of predicting the market's responses to changes in transportation pricing. Second, mathematical

logistics, funded by the National Science Foundation as long-term research, has become crucial to the transportation industry and the nation's competitiveness. U.S. automakers have used mathematical logistics to operate a just-in-time inventory system and help recover their competitive position.

Despite the need for a research mix, transportation experts said, the current surface transportation research portfolio has too little basic, long-term, high-risk research. Public and private officials viewed the portfolio as weighted heavily toward applied, short-term, low-risk research. Because about 80 percent of the portfolio's research projects are applied, short-term, or low-risk, a transportation official was concerned that quantum leaps—generally credited to basic research—would not occur and users' needs would not be met. A university official stated, for example, that surface transportation research is focusing on incremental improvements in asphalt rather than on fundamental questions, such as whether asphalt for highways will be needed in 20 years.

In 1995, the National Research Council reported to the Congress¹⁰ that balancing the surface transportation research portfolio with more basic, long-term research would require a long-term commitment from the United States. However, public and private officials noted that the United States has difficulty sustaining long-term research—unlike Japan and Germany—and tends to lose interest after a few years. A university researcher whose department moved from transit to paratransit research to follow federal funds characterized surface transportation research as a highly fashion-conscious field where the tendency is to move from one area to another before solutions are found.

Agency Comments

In commenting on a draft of this report, FHWA officials said that the report gave the impression that the Department funds insufficient basic, long-term, high-risk research. They believe, however, that their agency's program includes a significant amount of this type of research. According to FHWA, its research program has a 15-50-35 split—that is, about 15 percent of the funding is directed to exploratory or long-term research projects, which are likely to be completed in 10 years or more; 50 percent is directed to applied research projects, which are likely to be completed within 2 to 5 years; and 35 percent is directed to refining and delivering the products of research to the transportation community. They cited two ITS

¹⁰Committee on Criteria for Federal Support of Research and Development, Allocating Federal Funds for Science and Technology (1995).

projects—the Crash Avoidance Research Program and the Automated Highway Systems Program—as examples of exploratory, long-term research.

Our purpose was not to evaluate the Department’s commitment to basic, long-term, high-risk research but to convey the views of five groups of transportation stakeholders—federal, state, university, industry, and other experts. According to these stakeholders, the current surface transportation research portfolio includes too little basic, long-term, high-risk research.

Sources Contacted by GAO

To obtain information for this study, GAO interviewed two or more officials from each of the following groups:

U.S. Department of Transportation

Office of the Secretary
Federal Highway Administration
Federal Railroad Administration
Federal Transit Administration
National Highway Traffic Safety Administration
Research and Special Programs Administration
Bureau of Transportation Statistics
Volpe National Transportation Systems Center

Other Federal Agencies

National Transportation Safety Board
National Science Foundation

State Governments

American Association of State Highway and Transportation Officials

Industry

Association of American Railroads
American Trucking Associations
General Motors/Research Institute
Arthur D. Little, Inc.

Transportation Organizations

Transportation Research Board

Public Interest Groups

The Surface Transportation Policy Project

Experts

Michael Bolton, former Director of the Capital Metro Transportation Authority
Thomas D. Larson, Transportation Consultant and Former FHWA Administrator
Samuel K. Skinner, President of Commonwealth Edison and former Secretary of Transportation

Universities

Northwestern University—McCormick School of Engineering and the
Infrastructure Technology Institute
DePaul University—The Chaddick Institute
University of Illinois/Chicago—Urban Transportation Center
University of California—University Transportation Center
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