United States General Accounting Office

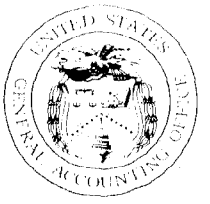
GAO

Report to the Chairman, Subcommittee on Transportation and Related Agencies, Committee on Appropriations, U.S. Senate

December 1989

TRAFFIC CONGESTION

Federal Efforts to Improve Mobility



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GAO

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Washington, D.C. 20548

Program Evaluation and
Methodology Division

B-236101

December 5, 1989

The Honorable Frank R. Lautenberg
Chairman, Subcommittee on Transportation and Related Agencies
Committee on Appropriations
United States Senate

Dear Mr. Chairman:

In response to your letter of May 11, 1989, we are submitting this report entitled Traffic Congestion: Federal Efforts to Improve Mobility. This study reviews Department of Transportation programs aimed at reducing congestion and highlights areas of high and low federal involvement. Our purpose in providing this profile is to assist the Subcommittee as it considers policies for an effective federal role toward improving freeway and roadway mobility. The present report is intended as a companion to our study entitled Traffic Congestion: Trends, Measures, and Effects (GAO/PEMD-90-1).

As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution of it until 30 days from the date of the report. We will then send copies to interested congressional committees and the Department of Transportation, and we will make copies available to others upon request.

If you have any questions or would like additional information, please call me at (202) 275-1854 or Dr. Michael J. Wargo, Director of Program Evaluation in Physical Systems Areas, at (202) 275-3092. Other major contributors to this report are listed in appendix V.

Sincerely yours,

Eleanor Chelimsky
Assistant Comptroller General

Executive Summary

Purpose

Traffic congestion is an escalating transportation problem in this country. An increasing proportion of both rural and urban interstate freeways are operating under crowded conditions. With the reauthorization of the Highway Trust Fund scheduled for the early 1990's, both the Congress and the Department of Transportation (DOT) will have an opportunity to consider changes in the federal role toward improving freeway and roadway mobility.

GAO conducted this review to provide information that could be used when considering the appropriate federal role in maintaining and improving mobility on the nation's freeways and streets. The objective of this report is to present a comprehensive overview of current DOT efforts to reduce traffic congestion. To achieve this objective, the study addressed three questions:

- What activities does DOT presently conduct to assist communities in alleviating traffic congestion?
- What resources does DOT use to support its congestion reduction activities?
- What evaluation efforts are under way to assess the effectiveness of the DOT's congestion reduction activities?

This profile of federal congestion reduction efforts is intended to highlight areas of high and low federal involvement and, more generally, to identify potential areas for transportation policy attention. The study is one of a series of GAO reports on freeway mobility being prepared for the Subcommittee on Transportation and Related Agencies of the Senate Committee on Appropriations.

Background

Federal efforts to assist communities in maintaining mobility on freeways and streets are not orchestrated under one program but, rather, are embedded in a variety of programs and efforts conducted by two agencies within DOT—the Federal Highway Administration (FHWA) and the Urban Mass Transportation Administration (UMTA). FHWA and UMTA are authorized to assist states and metropolitan areas in constructing, reconstructing, and otherwise improving the nation's roadway and transit systems. In carrying out this mandate, FHWA and UMTA conduct programs and activities to help alleviate traffic congestion.

One major policy effort under way to determine future federal transportation strategies is the national transportation policy being developed by DOT. In this plan, the Secretary intends to set forth a policy framework

for meeting the nation's transportation needs well into the 21st century. One component of this plan will be a combination of strategies and guidelines for surface transportation in, around, and between metropolitan areas.

Results in Brief

GAO found that current federal efforts related to traffic congestion could be summarized under three general congestion reduction strategies: road construction and reconstruction, transportation systems management, and advanced technology. The construction and reconstruction strategy involves building new roads or reconstructing existing roads in order to increase their capacity to carry traffic. The transportation systems management strategy includes techniques aimed at either optimizing the use of existing roadway capacity or lowering traffic demand. The advanced technology strategy focuses on efforts aimed at increasing freeway and roadway mobility through the use of computer and other state-of-the-art and emerging technologies. (See pages 13-15.)

DOT conducts a multitude of activities across the three strategies. The predominant FHWA and UMTA activity is providing financial assistance with federal-aid highway or transit funds. These agencies augment their administration of federal aid programs with a variety of planning, technical assistance, and research efforts. While the dispersed nature of federal congestion reduction activities did not permit a precise estimation of federal funds expended, GAO did identify the approximate resources devoted to each strategy in fiscal year 1988. The largest funding levels (about $3.9 billion) were associated with construction and reconstruction. GAO found that evaluations are under way as part of some federal activities but noted gaps in agency approaches to determining the effectiveness of several federal efforts in reducing traffic congestion. (See pages 56-58.)

Principal Findings

Construction and Reconstruction Strategy

FHWA administers five major highway programs for constructing and maintaining the nation's freeways and streets: interstate, interstate 4R (resurfacing, restoration, rehabilitation, and reconstruction), primary, secondary, and urban programs. Funds from these programs can be used by states and metropolitan areas to perform a variety of construction and reconstruction activities. Three activities that can result in

increased road capacity—constructing new routes, reconstructing existing routes, and adding lanes to existing routes—accounted for $3.9 billion of the $7.8 billion in fiscal year 1988 obligations for the five major programs. FHWA monitors and reports on the performance of major U.S. freeways and streets through its Highway Performance Monitoring System. Although FHWA conducts occasional management studies of the federal aid programs, GAO did not find any evaluations or plans to assess the effects of these programs on the congestion problem. (See pages 24-35.)

Transportation Systems Management Strategy

Both FHWA and UMTA promote transportation systems management techniques. FHWA encourages the use of federal-aid highway funds for transportation systems management, while UMTA supports the use of transit formula and discretionary funds for these purposes. State and local governments use these funds to implement many transportation systems management techniques, including computerized traffic signals, carpool and vanpool promotion, and park-and-ride lots. (See pages 36-42.)

From agency information, GAO identified at least $188 million in 1988 funds used for transportation systems management projects, the majority of these funds ($168 million) representing federal-aid highway funds. At least $9 million in 1988 funds were used to sponsor planning, technical assistance, and information dissemination efforts that FHWA and UMTA conducted to encourage the implementation of transportation systems management techniques. Neither FHWA nor UMTA has transportation system management evaluation activities comparable to efforts conducted in the late 1970's and early 1980's, but both agencies are beginning to plan evaluations for some initiatives. (See pages 42-46.)

Advanced Technology Strategy

FHWA has aimed a concentrated High Priority National Program Area effort at examining the use of various advanced technologies. Two specific technologies FHWA is addressing are advanced freeway traffic control systems and advanced motorist information systems. FHWA and UMTA also administer several congressionally requested studies, and FHWA is working with other federal and local groups to develop a more aggressive program for researching and developing advanced technologies. Federal research activities in advanced technology totaled at least $3.5 million for fiscal year 1988, the largest funding source being FHWA's contract program. Although several of the research studies FHWA is conducting or planning include evaluation measures, the program as a whole remains to be evaluated. (See pages 47-55.)

Case Studies

GAO summarized three programs to illustrate federal efforts in greater detail: the Advanced Motorist Information Systems program, the Suburban Mobility Initiative, and the interstate 4R program. (See pages 62-80.)

Recommendation to the Secretary of Transportation

Because of the diffuse nature of current federal efforts, GAO recommends that the Secretary of Transportation set forth guidance in the planned national transportation policy to ensure a coordinated federal strategy toward improving freeway and roadway mobility and that this guidance note the need for appropriate evaluation mechanisms to determine the effectiveness of key federal congestion reduction programs and activities.

To illustrate the importance of a coordinated and evaluated federal approach, GAO suggests several areas for consideration in a future strategy for freeway and roadway mobility. One suggestion is to consider an orchestrated effort for improving mobility on the nation's interstate system. A second suggestion is to consider a more systematic and stable approach toward federal assistance in transportation systems management. And a third suggestion is to determine and evaluate the federal congestion efforts—such as advanced technology development—that warrant scrutiny because of the importance to federal policymaking of knowing whether they are effective.

Agency Comments and GAO Response

DOT concurred with GAO's findings and recommendation. DOT suggested that GAO clarify both the important but limited role of mass transit in reducing congestion and UMTA's intention to use section 3 funds for suburban mobility. GAO has made these suggested changes to the report, along with others included in DOT's helpful technical comments.

Contents

Bibliography

Tables

Figures

Abbreviations

4R	Interstate resurfacing, restoration, rehabilitation, and reconstruction
DOT	Department of Transportation
FHWA	Federal Highway Administration
HPMS	Highway Performance Monitoring System
HPNPA	High Priority National Program Area
HP&R	Highway Planning and Research
NCHRP	National Cooperative Highway Research Program
PATH	Program for Advanced Technology on the Highway
RD&T	Research, development, and technology
SMD	Service and Methods Demonstration Program
TOPICS	Traffic Operations Program to Increase Capacity and Safety
TSM	Transportation systems management
UMTA	Urban Mass Transportation Administration

Introduction

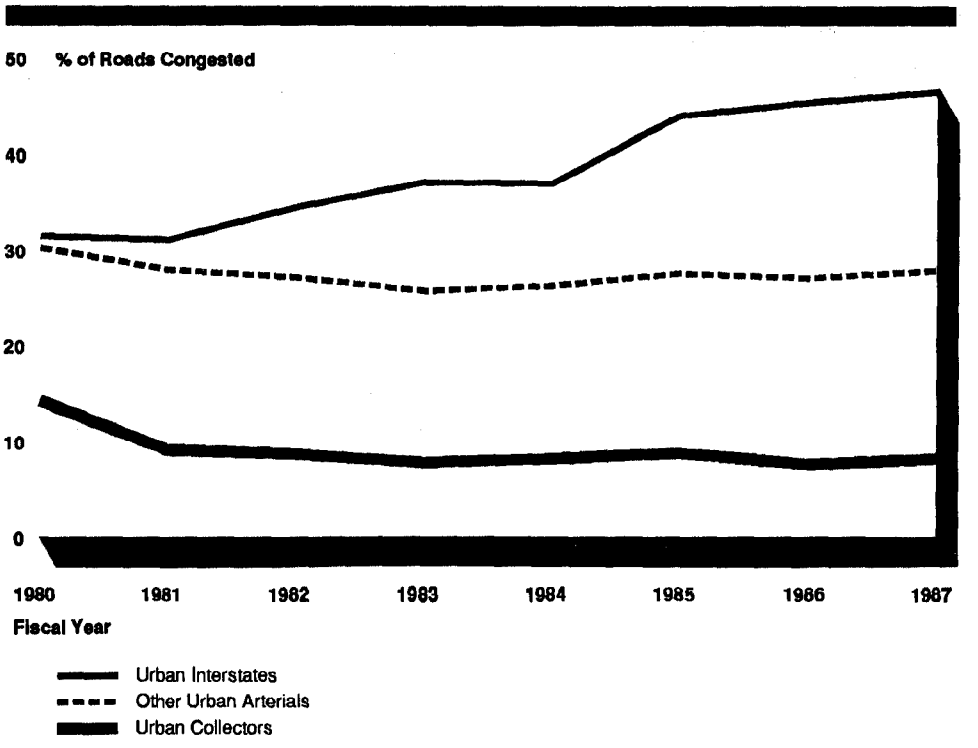
The Congestion Problem

Concern over worsening traffic congestion and expectations for continued traffic growth have become widespread. In a survey of participants from a recent nationwide forum on transportation, 80 percent of the 20,000 respondents noted that traffic congestion was a major problem in their communities.[1] According to the statistics compiled by the Federal Highway Administration (FHWA), empirical data support this concern: between 1985 and 1988, overall traffic delay from congestion grew by 57 percent.

The traffic congestion problem is most pronounced on our nation's major roads and, specifically, on the interstate system. In increasing percentages both urban and rural interstate roads are operating under congested conditions. As shown in figure 1.1, by 1987 almost half (46.4 percent) of all urban interstate roads were congested. During commuting periods, the level of traffic congestion is even higher; 65 percent of peak-hour urban interstate travel was congested during 1987.

[1]Transportation 2020 Program, Beyond Gridlock: The Future of Mobility as the Public Sees It (Washington, D.C.: June 1988).

Figure 1.1: Congestion on Urban U.S. Roads[a]



[a]Roads are considered congested when the ratio of volume to capacity or volume to service flow exceeds .70.

Source: Highway statistics reports for 1980-87 prepared by the Federal Highway Administration, Washington, D.C., 1989.

As documented in another GAO study, several powerful forces have contributed to the traffic congestion problem.[2] These include labor force changes, suburban expansion, growth in private vehicle ownership, increases in truck traffic, and a relative decline in new highway capacity. As a result of these and other forces, peak periods of traffic congestion have increased in duration, and congestion problems have expanded beyond central business districts to surrounding suburban areas.

According to the president of the American Association of State Highway and Transportation Officials, the traffic congestion problem is negatively affecting the nation's productivity:

[2]See U.S. General Accounting Office, Traffic Congestion: Trends, Measures, and Effects, GAO/PEMD-90-1 (Washington, D.C.: forthcoming).

"traffic congestion has become a major problem for workers and businesses, slowing down the delivery of goods and services and the movement of people, impeding the very mobility needed for economic expansion."[3]

Other reports, including an FHWA study as well as public testimony, note that lack of mobility is not only a transportation issue but is also a productivity and pollution issue.[4]

The Changing Federal Role

Federal efforts to assist communities in maintaining mobility on freeways and streets are not orchestrated under one program but, rather, occur through a variety of programs and activities conducted by two agencies within DOT—FHWA and UMTA. FHWA and UMTA have varying authorizations under title 23 and title 49 of the U.S. Code to assist states and metropolitan areas in constructing, reconstructing, and otherwise improving the nation's roadway and transit systems. For part of this assistance, FHWA and UMTA conduct programs and activities to assist in the alleviation of traffic congestion.

With the reauthorization of the Highway Trust Fund scheduled for the early 1990's, both the Congress and the Department of Transportation will have an opportunity to consider changes in the federal role toward improving freeway and roadway mobility. DOT as well as a number of interest groups are assessing this situation and intend to develop their own preferred policy options. Within these efforts, several policy reports have recently been published, and these reports include different provisions for addressing the traffic congestion problem in new or revised federal surface transportation programs.[5]

One major effort presently under way is the national transportation policy being developed by the Secretary of Transportation. In this plan, the Secretary intends to set forth a policy framework for meeting the nation's transportation needs over the next decade and into the 21st

[3]Transportation 2020 Program, Beyond Gridlock, p. 1.

[4]See U.S. Department of Transportation, Federal Highway Administration, "Quantification of Urban Freeway Congestion and Analysis of Remedial Measures," draft, Washington, D.C., July 1986, and Transportation 2020 Program, Beyond Gridlock.

[5]See U.S. Department of Transportation, Federal Highway Administration, America's Challenge for Highway Transportation in the 21st Century (Washington, D.C.: November 1988); American Association of State Highway and Transportation Officials, New Transportation Concepts for a New Century (Washington, D.C.: December 1988); and Institute of Transportation Engineers, A Program for National Mobility and Safety (Washington, D.C.: September 1988)

century. In the development of this plan, transportation needs for several "markets" are being assessed, including urban, suburban, and intercity transportation needs. It is expected that these market needs will form a basis for strategies designed to guide future surface transportation across the nation.[6]

This review was conducted to provide information that could be used when considering the appropriate federal role in an important area of surface transportation policy—maintaining and improving mobility on the nation's freeways and streets. Our intention in this report is to provide an overview of the current federal role in alleviating traffic congestion. By providing a profile of federal efforts, we intend to highlight areas of high and low federal involvement and, more generally, areas for potential transportation policy attention. It should be noted, however, that our report is not a systematic evaluation of the effectiveness of DOT's activities. Rather, it is primarily a descriptive review aimed at generating information to assist congressional and agency policymaking on the traffic congestion problem.

This study is one of a series of reports on freeway mobility being prepared in response to a request by Senator Frank Lautenberg, Chairman of the Subcommittee on Transportation and Related Agencies of the Senate Committee on Appropriations.

Strategies for Reducing Congestion

There are numerous existing and potential techniques for reducing traffic congestion. FHWA has suggested five general strategies for considering these techniques: new construction, reconstruction, supply management, demand management, and advanced technologies.[7] Within these general strategies, a variety of specific techniques can be implemented to reduce congestion. According to FHWA, effective congestion reduction requires the balanced use of a variety of these strategies and techniques rather than relying on any one in particular.

Highway construction and highway reconstruction represent the major capital investment programs for increasing the capacity of our roadways to carry traffic. While the pace of new construction has slowed

[6]See U.S. Department of Transportation, Federal Highway Administration, Moving America: New Directions, New Opportunities, vol. 1, Building the National Transportation Policy (Washington, D.C.: July 1989).

[7]U.S. Department of Transportation, Federal Highway Administration, "Urban and Suburban Highway Congestion: The Future National Highway Program 1991 and Beyond," working paper 10, Washington, D.C., December 1987.

over the past 30 years, critical capacity needs remain in urban areas, according to FHWA. For instance, Phoenix, Arizona, has launched an ambitious $5.8 billion construction program to add 233 freeway miles to its highway system.

With the aging of the nation's highway system, more emphasis is being placed on reconstruction. Highway reconstruction not only allows incorporating improved design and provides needed additional capacity, but it also permits the use of new traffic management techniques for comprehensive congestion reduction. For example, in Houston, Texas, a 70-mile system upgrade is based on the implementation of high-occupancy vehicle lanes to provide travel time savings for carpool, vanpool, and transit riders.

Within the last three decades, greater emphasis has been placed on better management of the existing roadway system. Known as transportation systems management, or TSM, this approach entails both supply management and demand management strategies. Supply management involves low-cost techniques for optimizing the capacity of the freeways to carry traffic. These techniques include freeway widening without reconstruction (for example, adding high occupancy vehicle lanes to existing shoulders), freeway surveillance and control systems, and freeway incident management programs. Applying TSM techniques can greatly improve operational efficiencies and increase roadway capacities, thereby reducing congestion. For example, one study found that at least 4 to 5 minutes of congestion can be eliminated for each minute saved in clearing a freeway incident.[8]

Demand management techniques are aimed at reducing the travel demand, or the number of vehicles operating on the freeways, particularly during commuting periods. Demand management techniques include ridesharing, public transit use, work-hour rescheduling, high-occupancy vehicle lanes, park-and-ride facilities, parking management, zoning laws and traffic ordinances, goods movement restrictions, restricting vehicles, and congestion road pricing.[9] Although some demand management techniques are based on capital (for example, park-and-ride facilities), in general, they tend to focus on changing commuting behavior. A dramatic example of the potential effectiveness of

[8]D. H. Roper, "Manage Traffic—and Get Congestion Relief," presented at the National Conference on Suburban Expressways and Beltways, n.p., June 1986.

[9]Congestion road pricing involves levying a commuter charge so as to provide an incentive for off-peak travel.

demand management techniques occurred during the 1984 Olympics in Los Angeles, where the introduction of several demand management techniques (such as flexitime) resulted in as much as a 35-percent reduction of traffic congestion, even though the freeways were carrying 11 percent more traffic.[10]

Advanced technologies offer techniques for reducing urban congestion in the future through more efficient use of the freeway and roadway system. FHWA considers five specific techniques to be within the general strategy of advanced technologies. These are advanced traffic control systems, advanced motorist information systems, highway navigation and guidance systems, vehicle location and identification systems, and automated highways.

Recently, the use of advanced technologies to develop a "smart" highway system has received attention in the popular media. The smart highway system being tested in Los Angeles involves at least two of these techniques: advanced motorist information systems and advanced traffic control systems. That is, the Los Angeles experiment involves cars equipped with video display screens, two-way communication between the cars (but not the drivers) and traffic control centers, and sensors embedded in the highways to detect traffic densities and vehicle speeds. The goal of a smart system is to reduce congestion through more efficient traffic management, such as routing vehicles onto less congested roads.

Prior Federal Efforts

Construction and Reconstruction

Although the impetus to build "good" roads in the United States began late in the 19th century, federal assistance was really founded in 1916, with the passage of the Federal-Aid Road Act. This act expanded the Office of Road Inquiry, creating the Bureau of Public Roads, which in 1967 became the Federal Highway Administration, a component of the Department of Transportation.

Before 1916, road construction and reconstruction were mainly left to local governments, with little coordination from county to county,

[10]Southern California Association of Governments, Olympics Impact Report: Effectiveness of Demand Management Strategies Implemented During the 1984 Summer Games in Los Angeles (Los Angeles, Calif.: May 1985).

although some states had highway agencies. After 1916, all the states were required to institute highway departments and to designate their systems of main and interconnecting roads.

The cooperative relationship that exists today between the states and the federal government was defined by the 1916 act and made permanent in the Federal Highway Act of 1921. The states have responsibility for the selection, planning, design, and construction of highway improvements, and the federal government reviews and approves the work that is federally financed. About 70 percent of all federal highway funds go to the states for construction, reconstruction, and other road improvements.

Since the 1916 and 1921 highway acts, the Congress has authorized a variety of programs to assist the states in constructing and reconstructing freeways and roads. These include the interstate program, the interstate 4R program, the primary program, the secondary program, and the urban program. The primary program was the first program established in 1916 and 1921, the secondary and interstate programs followed in 1944, and, finally, the urban and the interstate 4R programs began in 1970 and 1981, respectively. Each program was authorized for use on certain designated roads, a classification scheme commonly known as the federal-aid highway system (discussed in greater detail in chapter 2).

Transportation Systems Management

According to FHWA officials, federal efforts to promote TSM were instituted during the late 1960's.[11] In 1968, the Congress funded the first major program aimed at improving highway operations and reducing congestion. The Federal-Aid Highway Act of 1968 established the Traffic Operations Program to Increase Capacity and Safety (TOPICS) to assist urban areas in maximizing the efficiency and safety of their existing urban street networks. TOPICS was funded at $200 million each fiscal year 1970 and 1971 and at $100 million each fiscal year for 1972 and 1973. In this period, a variety of TSM techniques to increase highway efficiency were demonstrated and implemented in metropolitan areas around the country. In the Federal-Aid Highway Act of 1973, the Congress did not authorize specific categorical funds for TOPICS; instead, regular federal-aid highway funds were identified as the source for

[11] According to DOT, the department has a history of research and development in other TSM areas in addition to the major programs covered in this section. These areas include computerized signal control, freeway surveillance and control, and incident management.

continued funding of TSM-related projects. This authorization has been in effect since 1973.

UMTA initiated the Service and Methods Demonstration (SMD) Program in 1974, an effort that agency officials have characterized as totally TSM-related. The objective of the program was to help local areas adopt more cost-effective practices in managing urban transportation systems. The program provided information and technical assistance on urban transportation services, operating practices, and management strategies to assist local governments in finding new and innovative ways to use existing equipment and facilities. However, because of resource limitations, UMTA funded the last SMD project in 1984. In total, UMTA spent about $33 million on SMD projects.

For fiscal year 1981, the Congress appropriated funds for three complementary Department of Transportation programs, as follows:

- Comprehensive Transportation Systems Management Assistance, administered by FHWA ($10 million); this was intended to encourage comprehensive local TSM approaches, especially those that might produce energy savings, and to help coordinate the TSM aspects of the other DOT programs;
- Innovative Techniques and Methods in the Management and Operations of Public Transportation, administered by UMTA ($10 million); this was intended to provide assistance for improvements in the management and operation of public transportation services, including support for TSM activities that complemented and contributed to such improvement;
- Ridesharing Discretionary Grant Program, administered by FHWA ($3 million); this was intended to promote a broad application of innovative ridesharing techniques, with special consideration given to ridesharing efforts that had active employer commitment and involvement.

In 1980, the Department of Transportation also took the following actions to implement TSM activities nationwide: (1) it revised state and urban transportation planning regulations to emphasize the importance being placed on TSM activities, (2) it allowed TSM planning and implementation activities to be eligible under most FHWA and UMTA regular program funding and funding from the National Highway Traffic Safety

Administration, and (3) it began a broad range of TSM training, guidance, and information-sharing programs.[12]

Advanced Technology

Research on advanced technologies began while highway construction and maintenance were the responsibility of the Bureau of Public Roads (the predecessor to the Federal Highway Administration). Since then, several major research efforts have been sponsored by the Bureau of Public Roads and FHWA (and UMTA). Three such efforts were the New Systems Study, the Electronic Route Guidance System project, and the Urban Traffic Control Systems project.

Authorized by the Congress in 1966 and conducted over a 2-year period, the New Systems Study recommended several new technologies, including a "dual mode" system. The dual-mode system entailed vehicles that would travel under automated control on special guideways and under manual control on conventional roadways. FHWA and UMTA sponsored several follow-on studies during the 1970's, but the program never advanced beyond the initial testing phase.

A second project in the history of advanced technologies was a major research and development effort sponsored in the late 1960's by the Bureau of Public Roads and entitled the Electronic Route Guidance System project. It entailed the development of a technically feasible system for electronically providing directions to motorists, based on communication between vehicles and computers placed on the side of the road. The project was ended in 1970, but subsequent projects by Japan and Europe built upon the system.

In the 1970's, FHWA began focusing on the use of advanced technology to improve traffic control systems (for example, traffic signals). FHWA's Urban Traffic Control Systems project and, later, the National Signal Timing Optimization project were designed to test and implement advanced traffic control systems that could increase the efficiency of local streets through such things as better coordination of traffic signals. The project used computers and detectors to adjust traffic signal settings based on traffic patterns. According to DOT, the project also developed the first operational computer traffic simulation model, which was intended to evaluate signal timing plans before they were

[12]A 1983 revision of the FHWA and UMTA joint planning regulations did not include a requirement for a separate TSM element but did specify that the planning process include an analysis of TSM strategies.

implemented. By 1980, the National Signal Timing Optimization project had developed a software program for optimizing the timing of traffic signals (called TRANSYT-7F) and had applied and evaluated the program in 11 cities nationwide.[13]

Objective, Scope, and Methodology

The primary objective of this report is to provide an overview of the current federal role in alleviating traffic congestion. Consequently, the guiding evaluation questions for the assignment were

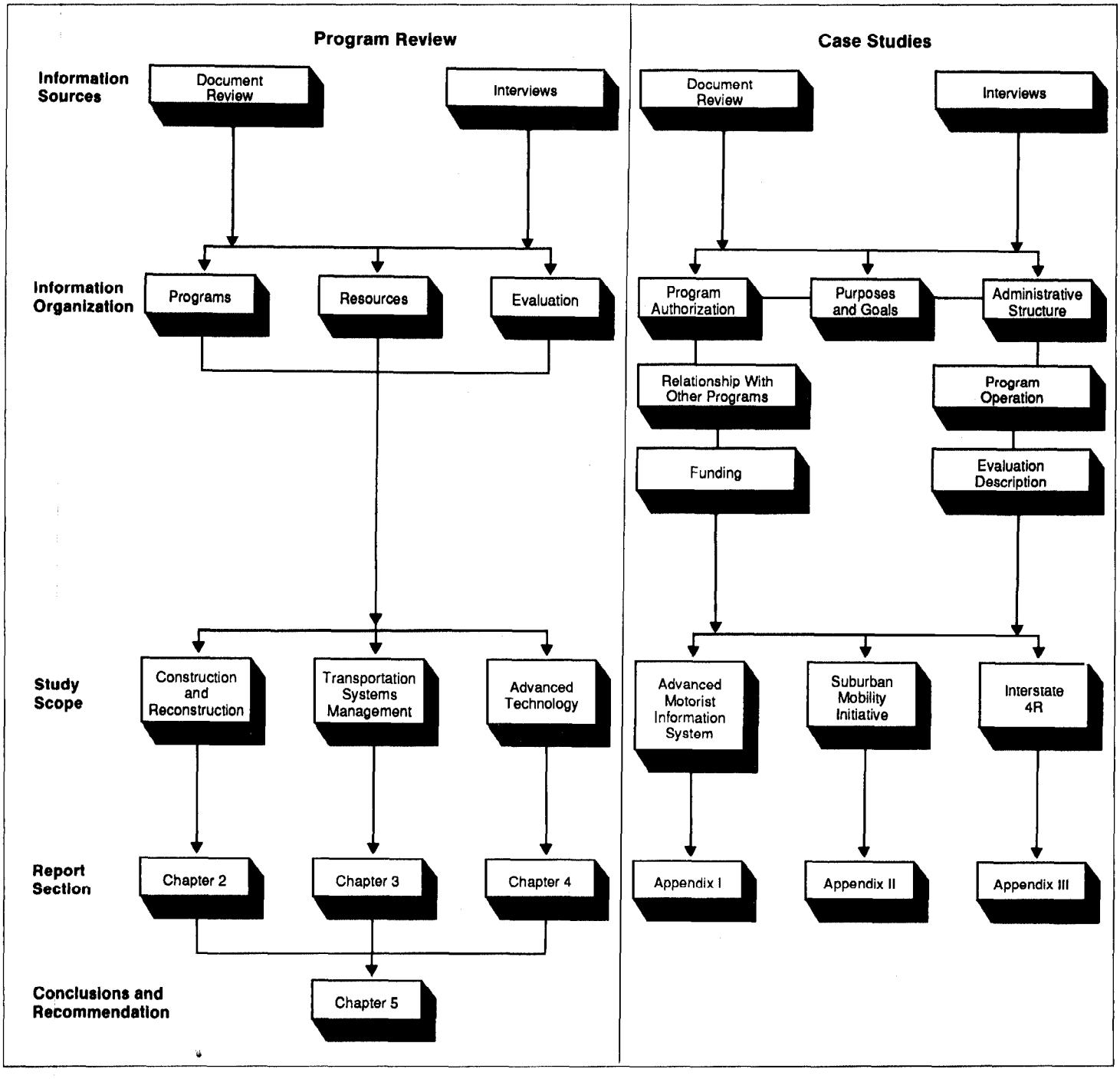
- What activities does DOT presently conduct to assist communities in alleviating traffic congestion?
- What resources does DOT use to support its congestion reduction activities?
- What evaluation efforts are under way to assess the effectiveness of DOT's congestion reduction activities?

The approach taken to answer these questions is summarized in figure 1.2. In terms of the activities reviewed, the study included the programs or related efforts that FHWA or UMTA conducted during fiscal year 1988 in any of three congestion reduction areas: construction and reconstruction, transportation systems management, and advanced technologies.[14] As is specified by the second and third evaluation questions, we also attempted to obtain an overview of the resources devoted to the department's efforts, as well as a description of any associated evaluation activities.

[13]U.S. Department of Transportation, Federal Highway Administration, National Signal Timing Optimization Project: Summary Evaluation Report (Washington, D.C.: 1982).

[14]We have combined FHWA's five strategies into three: construction and reconstruction treated together, demand and supply treated together as transportation systems management, and advanced technologies treated alone.

Figure 1.2: Study Outline



To illustrate federal efforts in greater detail, we decided to profile three programs as case studies. We chose these three programs because they illustrate federal efforts in each of the three major strategies: the interstate 4R program (for the construction and reconstruction strategy), the Suburban Mobility Initiative (for the transportation systems management strategy), and the Advanced Motorist Information Systems research program (for the advanced technology strategy).

The determination of which agency activities to include in the review was based on interviews and other documentation suggesting that a given program or effort supported one of the three major congestion reduction strategies. The selection method for the case studies was judgmental and based on several considerations. These included having a case study for each of the three congestion reduction strategies; adequate documentation to describe the case studies; case studies that represented noteworthy programs within the context of each particular congestion reduction strategy; and case studies that, when taken together, represented a range of the federal efforts aimed toward reducing traffic congestion. The case studies are not representative of all profiled programs, nor were they intended to be. Their function is to deepen and enrich what would otherwise have been a broadbrush review of federal activities.[15]

The study methodology was based upon an information synthesis using data collected through interviews and document review. Data collection guides (and subsequent summaries) were developed for both the general review of federal activities and the three case study profiles. These guides provided outlines for identifying and summarizing federal programs and activities aimed at reducing freeway congestion.

To summarize federal activity in each of the three congestion reduction strategies, we collected information in three areas: federal activities, resources, and evaluations. For the illustrative case studies, the more in-depth information that was obtained was based on a descriptive framework used in previous GAO studies.[16] The elements included in this framework were program authorization, purposes and goals, administrative structure, relationship with other programs, program operation, funding, and evaluation description.

[15]For a more detailed explanation on the use of case studies for illustrative purposes, see U.S. General Accounting Office, Case Study Evaluations, transfer paper 9 (Washington, D.C.: April 1987).

[16]See especially U.S. General Accounting Office, Children's Programs: A Comparative Evaluation Framework and Five Illustrations, GAO/PEMD-88-28BR (Washington, D.C.: August 1988).

The data guides served as a basis for our interviews with agency officials and for our review of agency documentation and related literature. We interviewed officials and obtained documentation from several offices at FHWA and UMTA headquarters, including

- FHWA's Office of Traffic Operations, Office of Planning, Office of Engineering, Office of Fiscal Services, Office of Safety and Traffic Operations Research and Development, and Office of Implementation;
- UMTA's Office of Mobility Enhancement, Office of Planning, Office of Capital and Formula Assistance, and Office of Policy.

Additionally, we contacted FHWA's division administrator for Massachusetts and UMTA's regional administrator (located in Massachusetts) for federal region 1. Our data collection efforts were conducted from October to December 1988.

The results of our information collection and synthesis activities are descriptive findings on federal congestion reduction efforts as well as more detailed findings on the three case studies. These findings are intended both to provide an overview of the strategies that federal programs tend to concentrate on and to identify any gaps in federal efforts.

While the focus of this review is on the federal role in reducing traffic congestion, we recognize that state and local governments have strong roles in decisions that affect congestion, such as local transportation funding as well as land use planning. However, while many transportation decisions are not within the domain of federal transportation policy, we believe the various federal programs can and do influence the overall course of action to improve freeway and roadway mobility. Thus, the federal role described in this report should be considered as one influence, if an important influence, in policy and program directions taken to increase mobility on the nation's freeways and streets.

Our work was performed in accordance with generally accepted government auditing standards. The Department of Transportation provided written comments on a draft of this report. These comments are presented and evaluated in chapter 5 and are included in appendix IV.

The Organization of This Report

Chapters 2, 3, and 4 make up the main body of the report. These chapters present our analyses of federal efforts for each of the three congestion reduction strategies: construction and reconstruction (chapter 2),

transportation systems management (chapter 3), and advanced technology (chapter 4). Case study profiles for each of the strategies are presented as appendixes: Advanced Motorist Information Systems program (appendix I), Suburban Mobility Initiative (appendix II), and the interstate 4R program (appendix III). Finally, chapter 5 concludes the main body of the report and provides a recommendation for the Secretary of Transportation.

Construction and Reconstruction Strategy

As noted in chapter 1, one way of alleviating traffic congestion is by adding capacity through the construction and reconstruction of roads. Since 1916, a variety of federal programs have been created to assist in constructing and maintaining the nation's freeway system. Today, the "federal-aid highway program" constitutes the backbone of federal surface transportation policy, providing assistance to state and local governments through five major programs: the interstate program, the interstate 4R program, the primary program, the secondary program, and the urban program. These five programs had a combined 1988 authorization of over $9.6 billion and have a $48 billion authorization over the 5-year period 1987-91.

This chapter describes the major federal-aid highway programs and their use for construction and reconstruction. Within each program, we have identified three types of road improvement activities that pertain to the construction and reconstruction strategy for reducing congestion: constructing new routes, reconstructing existing routes, and adding lanes to existing routes. For this review, we have analyzed the use of the five major federal-aid highway programs for these three types of road improvements. The analysis also includes a description of program funding levels and current ways of evaluating program performance.

Federal-Aid Highway Program

The federal-aid highway program is a federally assisted, state-administered program that operates through the distribution of federal funds to the states to construct and reconstruct urban and rural highway systems. While the program is administered by FHWA, the states play a primary role in selecting, planning, designing, and constructing highway improvements. The federal government's role is to review and approve work done with the assistance of federal funds. The federal government authorizes funds, and once annual state apportionments have been determined, each FHWA district office has approval authority to obligate the funds within the states. States submit plans for the use of these various funds. These plans must be approved by FHWA prior to the obligation of funds to states.

Federal-Aid Highway System

The basis for federal highway assistance to state and local governments is an administrative system set up by FHWA to classify roads.[1] Each state identifies routes for inclusion in one of four systems.

- The interstate system designation refers to arterial highways that constitute the nation's major transportation network. The interstate system serves national defense, connects principal metropolitan areas, and provides suitable border points with routes to Canada and Mexico.
- The primary system is a system of interconnecting main roads important to interstate, statewide, and regional travel and includes rural arterial routes and their extension into or through urban areas. While the interstate system is technically part of the primary system, for administrative purposes they are considered separate systems.
- The urban system is the designation for urban arterial and collector routes exclusive of urban extensions of the federal-aid primary system.
- The secondary system designates rural collector routes.

Once a road has been assigned to one of these systems, it becomes eligible for federal funding through one or more of the corresponding federal-aid programs described below.

As shown in table 2.1, the overall federal-aid highway system includes the most important U.S. roads, in terms of both the types of roads and number of road miles traveled.[2] Regarding the types of roads, the concentration of the federal-aid system is especially on major roads—that is, the arterials—and to a lesser extent on the collector or local roads. For example, all the interstate miles are included in the federal-aid system, and approximately 97 percent of all other arterials are designated as belonging to either the primary or urban systems. In contrast, while 69 percent of the total road miles in the country are local roads, not one of these is in the federal-aid system.

[1]In addition to the administrative distinction, there is a functional distinction between arterial, collector, and local roads. Arterial roads are routes whose function is mainly to move large numbers of vehicles quickly from one place to another. They are characterized by long-distance travel, high volumes, and high speeds, and generally they are constructed to higher design standards than other routes. At the opposite end are local roads and streets, which as their main function provide access to rural resources and farms, as well as to urban businesses and residences. People usually travel only short distances on local roads and streets, which are characterized by low speeds. Collectors are roads that gather vehicles from the local roads and streets and funnel them to the arterials.

[2]The term "federal-aid highway system" refers to all roads designated part of the interstate, primary, secondary, or urban systems.

Table 2.1: Highway Miles by Federal-Aid Class and Federal-Aid System

	Interstate		Primary		Urban		Secondary		Total		Nonfederal-aid		
System	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**	**All**
Interstate	44,328	100	0	0	0	0	0	0	44,328	5	0	0	44,328
Arterial													
Principal	0	0	111,166	43	25,548	17	0	0	136,714	16	1,878	0	138,592
Minor	0	0	146,954	57	66,302	45	0	0	213,256	25	8,982	0	222,238
Collector	0	0	0	0	56,129	38	398,329	100	454,458	54	352,614	12	807,072
Local	0	0	0	0	0	0	0	0	0	0	2,661,796	88	2,661,796
All	**44,328**	**100**	**258,120**	**100**	**147,979**	**100**	**398,329**	**100**	**848,756**	**100**	**3,025,270**	**100**	**3,874,026**
% travel		21.7		29.0		22.2		8.6		81.5		18.5	

Source: Federal Highway Administration, Highway Statistics 1987 (Washington, D.C.: U.S. Government Printing Office, 1987), p. 181.

The federal-aid system also includes the most-traveled U.S. roads. While the 848,756 miles of interstate, primary, secondary, and urban roads represent only 22 percent of the total 3,874,026 road miles in the country, these federal-aid roads carry approximately 81.5 percent of all travel. Nearly 75 percent of all travel occurs on only three of these road systems—interstate, primary, and urban—even though the total mileage for these systems is only 12 percent of the total for the country.

Federal-Aid Programs

Five major federal-aid highway programs are aimed at providing resources for the construction and reconstruction of roads in the federal-aid system. Each program is geared toward one of the four parts of the federal-aid system and can be used to fund improvements aimed at increasing capacity.[3]

Interstate Program

Since the authorization of the interstate system in 1944, interstate program funds have been used to complete approximately 44,328 miles. Presently, the states' use of interstate program funds continues to be aimed at constructing new routes. In fact, funds are primarily being used to complete the remaining gaps in the system and are being distributed to each state, depending on the remaining cost to complete its interstate roads.[4]

[3]Funds are obligated from the federal-aid program to the equivalent federal-aid system—for example, funds obligated from the interstate program are spent on roads included in the interstate system.

[4]In addition to the funds distributed to the states, approximately $300 million annually is reserved as a discretionary account maintained by FHWA.

The federal share for the use of the interstate funds is 90 percent. That is, for each interstate project undertaken by a state, the federal government pays for 90 percent of the project costs. These costs are paid by FHWA through reimbursement; a state requests obligated funds once the work or portions of it have been completed.

Interstate 4R Program

As the interstate system has neared completion, there has been a growing need to preserve the completed highways. Consequently, a second interstate program was established in 1976. Originally known as the interstate 3R program, and then expanded to the interstate 4R program in 1981, it currently provides for resurfacing, restoring, rehabilitating, and reconstructing the interstate system. The inclusion of the fourth "R"—reconstruction—meant that interstate 4R funds could be used not only for the preservation of existing interstate highways but also for functional improvements such as major widening to allow for additional capacity. (See appendix III for a detailed description of the interstate 4R program.)

The basis for distributing the interstate 4R funds is quite different from that of the interstate program. While funds from the latter program are based on estimated cost to complete the interstate system, interstate 4R funds are apportioned through a formula that is based on extent and use—that is, on interstate lane miles and vehicle miles traveled on the interstate system. The federal match for interstate 4R projects is also 90 percent.

The different apportionment basis of the interstate 4R program vis-a-vis the interstate program provides state governments with additional flexibility for using these funds for reducing congestion. According to the FHWA officials we interviewed, the states can choose annually the routes and the projects to use interstate 4R funds for, in contrast to the interstate program.

Primary Program

The federal-aid primary system includes many of the nation's major highways that are not in the interstate system. In total, the system consists of approximately 258,120 road miles, 111,166 (43 percent) being principal arterials and 146,954 (57 percent) being minor arterials. Of the 138,592 principal arterials in the country, 80 percent are designated primary system roads. There are no collector or local roads in this system.

Primary system funds can be used by the states for both adding new capacity through the construction of new routes and the reconstruction of existing routes. These funds are apportioned to the states on the basis

of a formula that includes such factors as the number of urban and rural inhabitants. The federal contribution for primary system projects is generally 75 percent.

Urban Program

The urban system comprises the streets and roads that serve the nation's metropolitan areas. Only 17 percent of the urban system's 147,979 miles are principal arterial roads. In contrast, 83 percent (122,431 miles) of the system's roads are either minor arterials or collectors.

While the total authorization for the urban program is relatively small (amounting in 1988 to only $750 million of the five major program funds), federal-aid urban funds can be used for a wide variety of congestion reduction techniques. The funds can be used not only for capacity additions through new construction, reconstruction, and lane widening; they can also be used for several TSM techniques, including the purchase of transit vehicles.

As with the other systems, funds for the urban system are apportioned by formula. An added feature of urban system funds is that they can be directly apportioned to metropolitan areas with populations greater than 200,000. The formula for apportioning these funds is based on an area's population. The federal share for projects undertaken with urban system funds is 75 percent.

Secondary Program

The federal-aid secondary system is the rural complement to the urban system: it consists of 398,329 miles of collector roads. All these are rural roads and serve primarily local intracounty travel. Secondary program funds are used for a variety of capacity-increasing activities, including new construction, reconstruction, and major widening. The federal-aid secondary funds are apportioned each year through a formula that includes land area, rural population, and rural and intercity mail delivery route mileage. The federal share for projects that use federal-aid secondary funds is 75 percent.

Other Programs

In addition to the federal-aid highway program, several special purpose and congressionally requested demonstration projects have implications for reducing congestion by adding capacity. These projects are funded either in the authorization acts (such as the Surface Transportation and Uniform Relocation Assistance Act of 1987, Public Law 100-17) or in the annual appropriations bills. For example, the authorization act of 1987 contained 152 demonstration projects, some of which involved the construction and reconstruction of new roadway segments.

Funding

Authorization Levels

Authorization for the current federal-aid highway program is contained in the authorization act of 1987, which authorizes a total of $48 billion in funds for the five major programs over a 5-year period (1987-91), with approximately $9.6 billion for fiscal year 1988. (See table 2.2.) Funding for these five highway programs represents approximately 70 percent of all funds authorized in the act. Moreover, as the highway program funds derive from the Highway Trust Fund (and are apportioned), they can be made available (obligated) without a separate appropriations act.[5]

Table 2.2: Authorizations for Five Major Highway Programs[a]

	1988		1987-91	
Program	**Amount**	**Percent**	**Amount**	**Percent**
Interstate construction	$3,150	32.7	$15,600	32.5
Interstate 4R	2,815	29.2	14,075	29.3
Primary	2,325	24.1	11,625	24.2
Urban	750	7.8	3,750	7.8
Secondary	600	6.2	3,000	6.2
Total	**$9,640**	**100.0**	**$48,050**	**100.0**
Total authorized	$13,737		$68,821	
Five programs as % of total authorizations		70.2		69.8

[a]Authorizations are from the Surface Transportation and Uniform Relocation Assistance Act of 1987. Dollars are in millions.

Funding for three of the five programs—the interstate, the interstate 4R, and the primary—is much more significant than is funding for the two others, the urban and secondary programs. The fiscal year 1988 authorization for the largest, the interstate program, was $3.15 billion, with a total 1987-91 authorization of $15.6 billion. The interstate 4R program is the second largest program of the five, with a 1988 authorization of $2.81 billion. In 1988, with a funding authorization of $2.32 billion, the primary program was third largest. At $750 million and $600 million, respectively, the authorizations for the urban and secondary programs are much lower than the others.

[5]For an overview of the federal highway financing mechanisms, see U.S. Department of Transportation, Federal Highway Administration, Financing Federal-Aid Highways (Washington, D.C.: November 1987).

Capacity Improvement Funding

As noted by our description of the federal-aid highway program, federal-aid funds can be used by the states for a variety of improvements in their road systems. Section 101(a) of title 23 of the U.S. Code includes a definition of the construction activities for which federal funds are generally eligible.[6] This definition encompasses a broad range of activities that include construction, reconstruction, and transportation systems management. The states have considerable discretion in choosing activities to undertake within that definition. FHWA monitors the projects the states undertake and maintains a data base in its fiscal information system that provides information on the types of improvements involved in these projects.

In order to determine how the states actually use federal-aid highway funds, we analyzed the obligations made in fiscal year 1988 for the five major federal-aid programs. From FHWA's information system, we identified seven major categories of road improvement: (1) new construction, (2) reconstruction, (3) major widening, (4) bridge work, (5) restoration, rehabilitation, and resurfacing, (6) safety and transportation systems management, and (7) other.

Our discussion focuses upon three categories of improvement—new construction, reconstruction, and major widening—as these closely relate to adding capacity on freeways and streets and thereby contribute to congestion relief. According to FHWA information, new construction improvements entail adding new routes (new capacity), reconstruction improvements can involve adding lanes (additional capacity), and major widening specifically includes adding lanes. Thus, these three categories provide a focus for considering the actual use of federal-aid funds to reduce traffic congestion through the construction and reconstruction strategy.

According to FHWA's data, total obligations in 1988 for the five major programs were $7.80 billion. (See table 2.3.) The three improvement activities related to capacity improvement—construction, reconstruction, and major widening—accounted for approximately 50 percent of this total, representing about $3.88 billion in obligations.

[6]Besides this section's definition of the use of federal-aid funds for construction, other sections of title 23 specify additional uses. For example, section 142(a) of title 23 provides for the use of urban system funds for the purchase of transit vehicles.

Table 2.3: Obligations for Seven Road Improvement Categories[a]

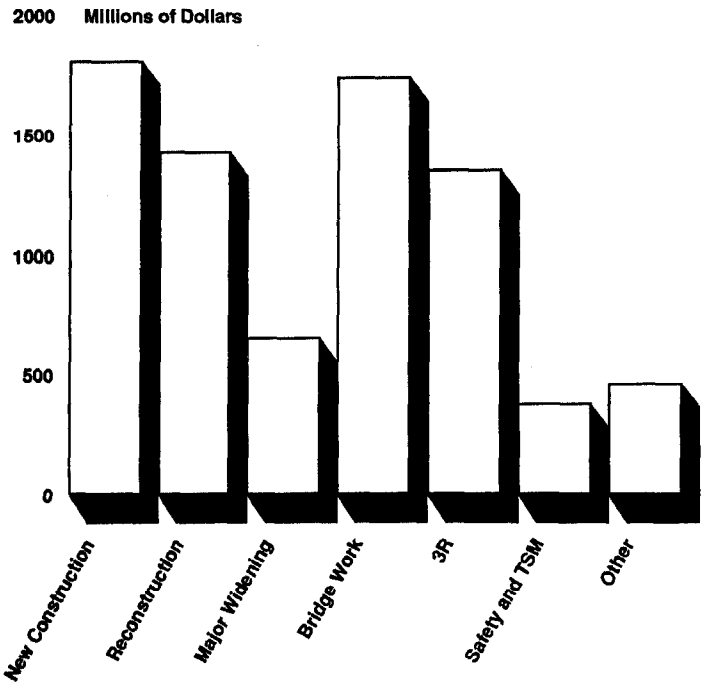
Improvement category	Amount	Percent	Cumulative Amount	Cumulative Percent
New construction	$1,808	23	$1,808	23
Reconstruction	1,424	18	3,232	41
Major widening	647	8	3,879	50
Bridge work	1,737	22	5,616	72
3R	1,352	17	6,968	89
Safety and TSM	375	5	7,343	94
Other	460	6	7,803	100
Total	**$7,803**	**100**		

[a]Data are for fiscal year 1988 and are in millions of dollars.

Source: Office of Fiscal Services, Federal Highway Administration, Washington, D.C., 1988.

Of these three capacity-related improvements, new construction had the highest funding level, with $1.81 billion in obligations. The interstate program accounted for the bulk (76 percent, or $1.37 billion) of new construction obligations. Most of the remaining 1988 projects affecting capacity were in the reconstruction category, which totaled $1.42 billion in obligations. The majority of these funds were obligated from the interstate 4R and primary programs. The interstate 4R program had $462 million (32 percent) and the primary program accounted for $438 million (31 percent) of the total funds obligated for reconstruction improvements. (See figures 2.1 and 2.2.)

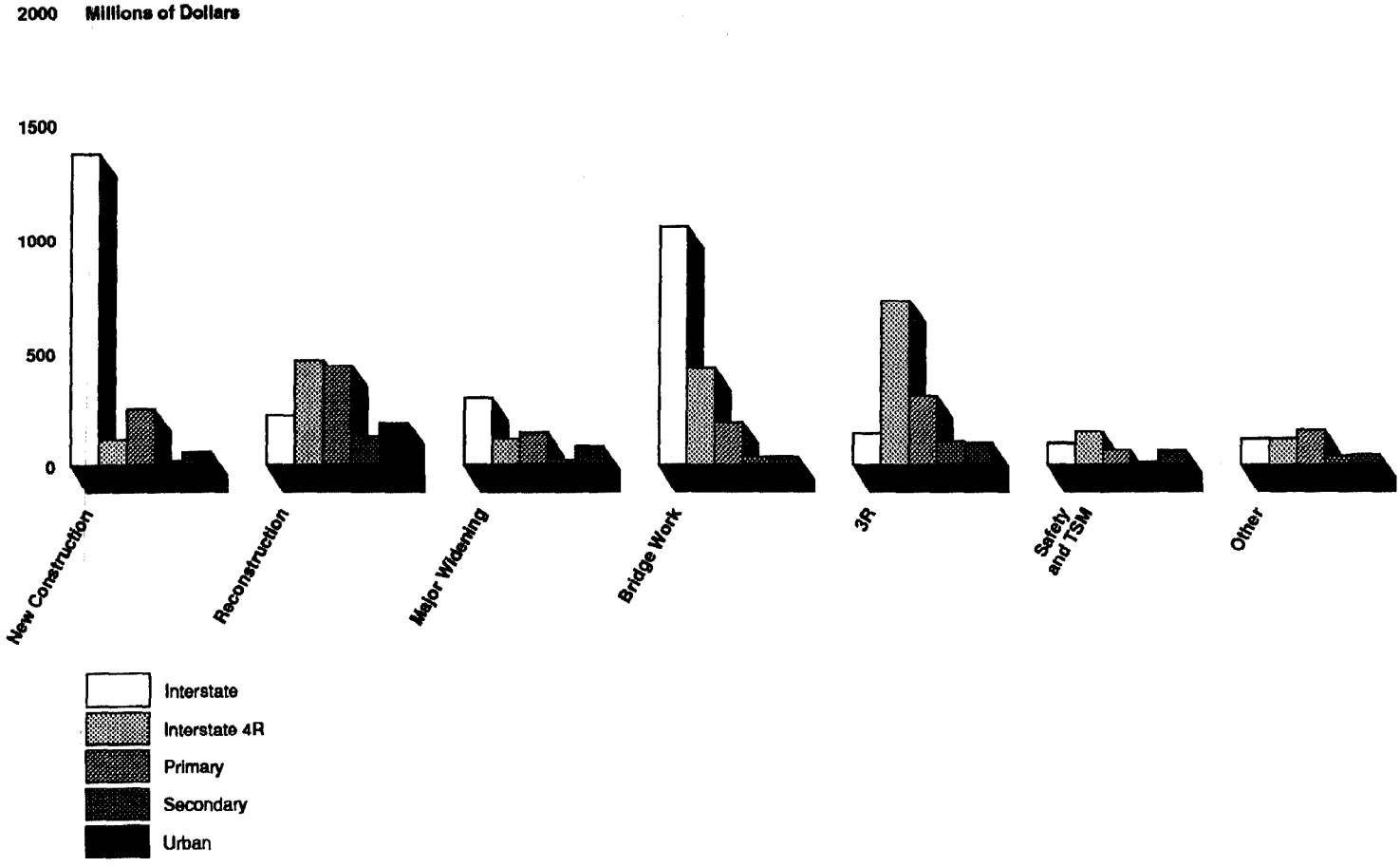
Figure 2.1: Federal-Aid Highway Improvement Obligations[a]



[a]Data are for fiscal year 1988.

Source: Office of Fiscal Services, Federal Highway Administration, Washington, D.C., 1988.

Figure 2.2: Relative Contributions to Federal-Aid Highway Improvements[a]



[a]Data are for fiscal year 1988.
Source: Office of Fiscal Services, Federal Highway Administration, Washington, D.C., 1988.

Major widening had a much lower obligation level ($647 million) for 1988 than the two other types of improvement affecting road capacity. The interstate program accounted for most (46 percent, $296 million) of the funds identified as obligated toward major widening activities in fiscal year 1988.

Because of its lower total funding level, the urban program did not represent the highest source of obligations for any of the seven types of roadway improvement. Nonetheless, we note that—as a percentage of total program obligations—a higher percentage of urban program obligations went for lane widening (14 percent) and for safety and TSM

activities (12 percent) than the corresponding percentage of obligations devoted to these activities by any of the four other federal-aid programs. (As shown in table 2.3, the average obligated in 1988 for major widening was 8 percent, and for safety and TSM, it was 5 percent.)

Evaluation

FHWA actively monitors the performance of the federal-aid highway system through the Highway Performance Monitoring System (HPMS). HPMS is based on data from a statistical sample of about 100,000 highway sections across the country. The data base provides a variety of data that FHWA uses to identify highway conditions, estimate capital investment needs, and measure changes in highway conditions.[7]

Two important reports are based on data from HPMS. The annual Highway Statistics report contains descriptive data on federal-aid system characteristics and performance, including federal-aid system mileage, vehicle miles of travel, growth in traffic volume, and traffic congestion. Regarding the traffic congestion measure, the reported data use a standard measure of congestion that is based on a ratio of actual traffic volume over the maximum "service flow" or capacity of the roadway.[8] (See figure 1.1.)

The HPMS data also provide the basis for the other report on the condition of the nation's highways, the Department of Transportation's biennial report to the Congress. The 1989 report is entitled The Status of the Nation's Highways and Bridges: Conditions and Performance and Highway Bridge Replacement and Rehabilitation Program. It contains information that is less detailed than the corresponding Highway Statistics reports. Both reports are aimed at providing overviews on the performance of the federal-aid highway system and do not analyze or evaluate the effectiveness of FHWA's policies or programs on the system's performance.

We did not find any current evaluations that used the HPMS data base to assess the effectiveness of the federal-aid program in alleviating congestion. One federal official noted that consideration of the construction and reconstruction strategy received limited attention in FHWA's working

[7]Our report entitled Traffic Congestion: Trends, Measures, and Effects contains a review of the use of HPMS to measure and forecast traffic congestion.

[8]Until 1986, service flow (then capacity) was calculated from the 1965 Highway Capacity Manual. Beginning in 1986, new service flow calculations were based on the 1985 Highway Capacity Manual.

paper on traffic congestion because of the lack of quantifiable information.[9] We did identify FHWA work using the data base for forecasting congestion, and we review this study in our accompanying report (GAO/PEMD-90-1).

Although it is not specifically related to congestion reduction, the federal-aid highway program, representing the largest grant program in the Department of Transportation, has been subject to various reviews by DOT's office of the inspector general as well as by GAO.[10] In addition, the FHWA divisional offices have the responsibility for monitoring the progress of projects being funded through federal-aid programs to ensure that work is progressing in compliance with federal regulations and other requirements. FHWA also occasionally does management studies on the federal-aid program. For example, the urban program was reviewed in 1985. The evaluation included an examination of how to streamline the federal-aid urban administrative procedures and how to lower the existing unobligated balances.[11]

[9]See U.S. Department of Transportation, Federal Highway Administration, "Urban and Suburban Highway Congestion: The Future National Highway Program 1991 and Beyond," working paper 10 (Washington, D.C.: December 1987).

[10]See U.S. General Accounting Office, Department of Transportation: Enhancing Policy and Program Effectiveness Through Improved Management, GAO/RCED-87-3 (Washington, D.C.: April 1987), for a review of DOT's grants management process.

[11]See U.S. Department of Transportation, Federal Highway Administration, Review of Federal-Aid Urban System Program (Washington, D.C.: 1985).

Transportation Systems Management Strategy

With the high and increasing costs of road construction and reconstruction, the use of transportation systems management techniques to alleviate traffic congestion has become more salient. These low-cost techniques—such as traffic signal coordination and ridesharing—aim to maximize the use of existing capacity or lower traffic demand on the nation's freeways and streets.

The range of techniques considered under TSM is quite large and is open to interpretation. For example, while demand management techniques such as ridesharing and vanpooling are clearly TSM, others such as constructing park-and-ride lots overlap conceptually with the construction strategy.[1] We use a broad definition of TSM and include activities such as park-and-ride lots. We present first the TSM activities undertaken by FHWA and then those by UMTA. Following this description, we provide an overview of federal funds supporting TSM activities, and, finally, we discuss present evaluation efforts by FHWA and UMTA.

FHWA's TSM Efforts

Federal-Aid Highway Program

FHWA funds TSM applications from the major federal-aid highway programs authorized by the Congress. As discussed in chapter 2, the highway program is a federally assisted, state-administered program. FHWA encourages the states to use these funds for TSM projects but does not require them to do so. As an incentive to use federal-aid funds for TSM, up to 10 percent of a state's federal-aid highway funds can be used without matching state funds for several TSM techniques, including traffic signals, pavement marking and signing improvements, and commuter carpooling and vanpooling projects. Funds from all five major federal highway programs may be used to finance TSM techniques.[2]

[1]The TSM strategy also overlaps conceptually with the advanced technology strategy, as some advanced technologies are aimed at increasing the efficiency of the system to carry traffic (see chapter 4). For the purposes of this review, our delineation of techniques was based on FHWA's working paper on congestion (see U.S. Department of Transportation, Federal Highway Administration, "Urban and Suburban Highway Congestion: The Future National Highway Program 1991 and Beyond," working paper 10, Washington, D.C., December 1987).

[2]The eligibility of various TSM techniques can vary across the programs. For example, primary, secondary, and urban funds can generally be used to fund rideshare promotion programs, while interstate 4R funds can be used only if the program is being conducted in conjunction with an interstate reconstruction project.

Although FHWA encourages the states to apply TSM techniques, its fiscal management information system does not specifically monitor TSM expenditures.[3] However, the system does provide 11 project codes that, according to an FHWA official, represent TSM projects funded by the various federal aid programs. These include traffic signals, fringe (park and ride) parking, computerized traffic signals, surveillance and control systems, computerized (rideshare matching) programs, pedestrian walkways, bicycle facilities, motorist aid systems, automobile restricted zones, carpool facilities, and vanpool acquisitions.

Research, Demonstration, and Technical Assistance

In addition to administering the highway program funds, FHWA officials view their role in TSM as that of providing the states with technical assistance, training, and information on research results, new products, and innovative approaches.

One avenue for disseminating information to the states on TSM techniques is through the technology transfer activities conducted by FHWA's office of implementation. These activities are coordinated within the overall FHWA research and development program. Several of the major research and development areas investigate technologies that directly or indirectly deal with congestion (see chapter 4). However, some of the implementation activities can also be considered dissemination of TSM techniques. These include providing information on incident management, improving traffic control systems and hardware, and disseminating computerized analysis tools. For example, in fiscal year 1988, TSM-related projects approved for technology transfer included a freeway incident management handbook and video, a transportation management strategies workshop, and users' manuals for two traffic simulation packages.

In addition to the technology transfer activities conducted by FHWA's office of implementation, FHWA's office of traffic operations provides technical assistance on TSM techniques. For instance, in fiscal year 1988, FHWA's office of traffic operations

- conducted three courses in ridesharing and three courses in freeway management,
- held three urban mobility and congestion conferences around the country in cooperation with the Institute of Traffic Engineers and UMTA, and

[3]As noted in chapter 2, the one road improvement category that included TSM combined this strategy with safety improvements.

- provided technical assistance to field offices and state and local agencies on various TSM topics, including freeway management, incident management, and traffic management during major reconstruction.

During the spring of 1988, FHWA formed an urban congestion coordinating group, chaired by the agency's associate administrator for safety and operations, to provide advice on traffic congestion issues. The group is made up of the directors from FHWA's offices of planning, highway operations, safety and traffic operations research and development, implementation, and traffic operations. An FHWA official explained that most congestion issues involve these five offices and, therefore, their involvement is crucial in addressing congestion issues.

In cooperation with the urban congestion coordinating group, the office of traffic operations has recently developed an urban and suburban congestion action plan. Under this plan, FHWA requested proposals in June 1988 for demonstration projects in incident management programs and integrated traffic control system techniques. During fiscal year 1989, FHWA planned to demonstrate incident management projects in Minneapolis-St. Paul, Minnesota, and in the metropolitan Washington, D.C., area; an integrated systems project in Anaheim, California; and an incident management and integrated systems project in Seattle, Washington. An FHWA official stated that while FHWA intended to conduct these projects in 1989, final funding arrangements had not been secured and that FHWA was considering using funds from prior categorical programs, as well as from other FHWA offices.

In addition to the planned demonstration projects, FHWA has begun to organize a new research area that would investigate land use issues related to transportation. With an initial study anticipated for fiscal year 1989, FHWA has stated that it intends this area of research to produce information aimed at ensuring the efficiency of future transportation systems though better land use planning.

Transportation Planning Regulations

Although there are no categorical funding authorizations for TSM techniques, a TSM component is included in joint FHWA and UMTA planning regulations. These regulations (23 C.F.R. 450) require that urban transportation planning processes include an "analysis of transportation system management strategies to make more efficient use of existing transportation systems." Fulfilling this requirement is a prerequisite for obtaining federal capital assistance for highways or transit.

TSM planning is financed from FHWA funds authorized for overall metropolitan transportation planning activities. These activities are funded with 0.5 percent of the total federal-aid system funds. The planning funds are apportioned to the states by a formula based on population. The states then allocate the funds to approximately 300 metropolitan planning organizations that are responsible for preparing work programs. These funds may be expended only after the work programs have been approved by FHWA divisional offices.

UMTA's TSM Efforts

As with FHWA, a primary responsibility of UMTA is administering federal aid programs in local communities. The director of UMTA's office of planning explained that UMTA's grant-in-aid programs are oriented toward increasing mobility through public and private transit and are not delineated categorically by specific TSM techniques. According to this official, the role of transit is to provide additional transportation capacity for growth in certain markets and thus mitigate the worsening of congestion.

The limitations of transit in reducing congestion were noted by DOT in its comments on a draft of this report (see appendix IV). According to the department, expansion of transit services and improvements in transit system performance can attract drivers out of their automobiles in the short run, but in the medium to long run, the reduction is often more than offset by growth in auto travel. However, DOT does suggest that transit can have long-term effectiveness in reducing congestion when it is combined with other TSM measures, such as those covered in this chapter.

Discretionary and Formula Programs

Under the Urban Mass Transportation Act of 1964 as amended, the major types of assistance authorized for public transportation systems are discretionary program funds (principally under section 3) and formula program funds (principally under section 9). For the discretionary program, UMTA approved 75 capital grants in fiscal year 1988 in three categories: bus and bus-related (36 grants), rail modernization (33 grants), and new systems (6 grants). Regarding the formula program, 624 grants for capital assistance and operating expenses were approved according to the statutory formula for fiscal year 1988.

According to the chief of UMTA's resource management division in the office of capital and formula assistance, TSM projects are low cost and are most likely to be funded locally or through formula program funds,

which are not specifically identified as TSM funds in the agency's fiscal management system. The chief was, however, able to identify 7 TSM-related projects from the 36 bus and bus-related discretionary program grants awarded during fiscal year 1988. These projects are

- two transit centers in Dallas, Texas;
- a pass system project in San Francisco, California;
- a main street transitway in Akron, Ohio;
- two park-and-ride facilities in Los Angeles, California;
- a high-occupancy vehicle lane in Charlotte, North Carolina;
- a park-and-ride facility in Houston, Texas; and
- an automatic vehicle monitoring system in Baltimore, Maryland.

UMTA has stated its intention to expand the use of section 3 discretionary grants for addressing suburban mobility problems. Beginning in fiscal year 1989, UMTA intends to fund approximately $75 million in section 3 projects for suburban mobility. According to DOT, most of the new projects are to involve constructing either additional parking at existing transit terminals or new transit centers that would facilitate not only transit use but carpools and vanpools as well (see appendix IV).

Suburban Mobility Initiative

In January 1988, UMTA's administrator announced a new program of technical assistance for alleviating traffic congestion. Known as the Suburban Mobility Initiative, its purpose is to help the nation's suburbs solve their growing traffic congestion problems. According to UMTA's director of the office of planning, this initiative can be considered UMTA's principal effort to target funding for TSM techniques. (See appendix II for additional information on the Suburban Mobility Initiative.)

During the course of fiscal year 1988, UMTA hosted 20 1-day seminars around the country to initiate local discussions in areas experiencing high suburban congestion. These seminars were an outreach effort by UMTA to promote the Suburban Mobility Initiative and to bring local officials together for a dialogue on the suburban mobility issue.

As a result of the seminars, UMTA awarded 40 grants in fiscal year 1988 for suburban mobility projects in one of five areas: short-term planning, strategic planning, organizational arrangement demonstrations, employer and developer-supported demonstrations, and contractor support.

In comparison to the nearly $7 million UMTA obligated to the Suburban Mobility Initiative in fiscal year 1988 from various funding sources, the office of mobility enhancement program plan for fiscal year 1989 proposed only $2 million for Suburban Mobility Initiative projects. The director of the office of mobility enhancement noted, however, that he was aggressively pursuing additional funding for this program throughout the fiscal year.

Transportation Planning Regulations

As mentioned earlier, joint FHWA and UMTA regulations require each urban area to have a continuing, cooperative, and comprehensive transportation planning process as a condition for receiving federal capital and operating assistance. The regulations also require that TSM analyses be included in this process. UMTA provides planning funds under section 8 of the Urban Mass Transportation Act of 1964.

UMTA does not dictate how the section 8 funds are to be spent and, consequently, does not prescribe an amount for TSM planning. However, it does identify national emphasis areas that grantees should consider in planning, and it coordinates these areas with FHWA's office of planning. For fiscal year 1988, UMTA emphasized private participation planning, financial planning, and risk management and safety planning; for fiscal year 1989, UMTA included suburban mobility planning as a new national emphasis area.

UMTA apportions 90 percent of the section 8 funds using an administrative formula (based on population), metropolitan planning organizations receiving 80 percent and the states receiving 10 percent. UMTA retains the remaining 10 percent for special studies, which are funded at the discretion of the UMTA Administrator. (The special study fund can be augmented by carryover funds that may be available from prior years.)

According to the director of UMTA's office of planning, special studies may be TSM-oriented. In fiscal year 1988, section 8 special studies funding was used to support the Suburban Mobility Initiative and to fund the following projects, which were identified by the UMTA official as being TSM related:

- a commuter study along Interstate 94 in Michigan,
- a study to link inner-city residents with suburban jobs in Missouri, and
- a planning grant for a downtown transit mall in Erie, Pennsylvania.

Alternatives Analysis

Urban transportation planning includes the analysis of alternative TSM techniques to make more efficient use of existing transportation facilities. According to the chief of UMTA's program analysis and support division of the office of planning, UMTA's policy for new, large rail projects or extensions of existing rail systems requires local applicants to analyze alternatives for their planned projects and to consider less-costly TSM activities. To receive funding, these analyses must show that the benefits of the proposed mass transit investment would exceed the benefits derived from TSM applications. Additionally, UMTA provides technical assistance to states and metropolitan planning organizations for conducting alternative analyses. The director of the office of planning cited an example in which, as a result of the alternative analysis process, a proposed light rail system costing $300 million was rejected in favor of the TSM alternative costing $35 million.

Funding

As should be apparent from the discussion above, no funding total is readily obtainable for federal TSM efforts. This is because TSM embodies a range of activities that are funded through a constellation of programs, many of which do not formally define or monitor funded TSM activities. Nonetheless, in table 3.1, we provide an overview of the federal funds that we identified as supporting TSM.

Table 3.1: Funding for FHWA and UMTA TSM Activities[a]

Program	Amount	Comment
FHWA		
Federal-aid highways	$168,333	Approximate; based on agency project listing
Metropolitan planning	•	Unknown; $47 million available
Contract research	500	For implementation activities; other advanced technology research covered in ch. 4
UMTA		
Section 3 discretionary	11,121	Based on agency project listing; $1.2 billion available
Section 8		
Local studies	•	Unknown; $45 million available
Special studies	3,000	Approximate, based on agency project listing
Section 9 formula	•	Unknown; $2 billion available
Suburban Mobility Initiative	5,330	Excluding section 8 funding
Total	**$188,284**	

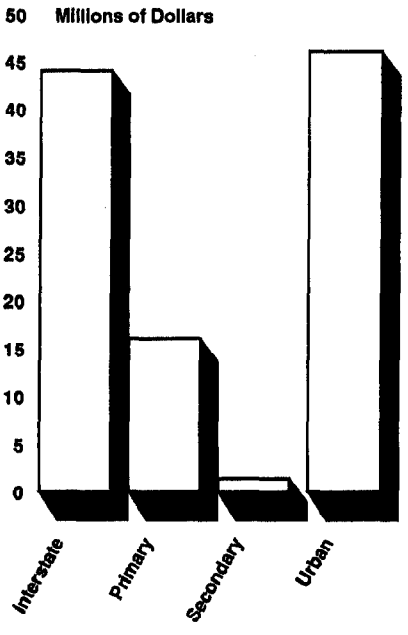
[a]Dollars are for fiscal year 1988 with 000 omitted.

As noted in table 3.1, we identified approximately $188 million in fiscal year 1988 funds used for TSM. This total is undoubtedly a conservative estimate of 1988 funds dedicated for TSM, as it does not include any portion of UMTA's section 9 funds or other FHWA or UMTA planning funds, all of which, according to agency officials, can be and are used for TSM.

The funding profile does, however, provide some indication of the variety and magnitude of federal assistance, including the important role of the federal-aid highway and transit programs in supporting TSM. In particular, we identified about $168 million in federal-aid highway funds obligated during fiscal year 1988 for the 11 TSM-related activities noted at the start of this chapter. Of this amount, approximately $108 million was obligated from the five major federal-aid funds, the remaining $60 million deriving from other special purpose funds.[4] The use of the major federal-aid program funds for these TSM activities is summarized in figure 3.1. According to these data, the largest sources of funding were the urban program (nearly $46 million) and the two interstate programs ($44.1 million).

[4]Numerous special program accounts administered by FHWA can pertain to TSM. For example, any of the demonstration projects from the Surface Transportation and Uniform Relocation Assistance Act of 1987 that pertained to TSM would be included in this total.

Figure 3.1: Federal-Aid Program Funds Obligated for TSM-Related Activities[a]



[a]Data are for fiscal year 1988. The interstate program includes interstate 4R.
Source: Office of Fiscal Services, Federal Highway Administration, Washington, D.C., 1988.

Besides the federal-aid highway program, the discretionary and formula transit programs represent substantial resource pools available to support TSM. The total fiscal year 1988 funding level for the section 3 and section 9 programs was $3.2 billion, the discretionary program (section 3) accounting for $1.2 billion, the formula program (section 9) $2 billion. Of the total amount, available agency information allowed us to identify 7 TSM projects from the discretionary program, and these totaled $11.12 million. This amount is therefore an incomplete estimate of the use of transit funds for TSM.

Similarly, available information did not permit the calculation of 1988 funds that the states use from the FHWA and UMTA planning programs specifically on TSM. Consequently, no such figure is presented in table 3.1, although the total 1988 funding apportionments by both programs are noted. For the FHWA-sponsored metropolitan planning, this total was approximately $47 million, and for UMTA's section 8 program, the total was approximately $45 million.

We did identify several uses of FHWA and UMTA funding totaling approximately $9 million for various technical assistance, demonstration, and

research activities. As mentioned earlier, UMTA retains a percentage of section 8 funds to sponsor special studies; in fiscal year 1988, the agency obligated about $7.6 million. Of this amount, UMTA officials estimated that $3 million was used for TSM-related projects, approximately $1.66 million being for used for Suburban Mobility Initiative projects.

In addition to the section 8 funds, the Suburban Mobility Initiative awarded grants totaling $5.33 million from other discretionary programs.[5] We also identified approximately $500,000 in FHWA contract research funds obligated for the TSM technical assistance activities. We did not estimate the overhead cost to FHWA and UMTA of the staff time spent on recent TSM initiatives, making the total still a conservative estimate.

Evaluation

Federal evaluation of TSM techniques occurred primarily during the late 1970's and early 1980's as part of the various TSM-related programs. For example, UMTA's Service and Methods Demonstration Program sponsored and evaluated over 100 demonstration programs between 1980 and 1984, including 17 evaluations sponsored with FHWA as part of the Rideshare Demonstration Program. As stated in chapter 1, UMTA spent approximately $33 million on such demonstration projects.

Presently, neither FHWA nor UMTA has evaluation programs comparable to the efforts of the Service and Methods Demonstration Program. We identified only one TSM evaluation being conducted by FHWA in fiscal year 1988. Entitled "Evaluation of Demand Management Measures to Relieve Congestion," this project involved reviewing four local demand-management programs to determine the characteristics of such programs and the effect of program activities on traffic congestion. This effort was funded for approximately $65,000 through the office of planning.

For fiscal year 1989, FHWA had several tentative evaluation plans. Four demonstration projects were being conducted as part of the "urban and suburban congestion action plan." According to an FHWA official, local agencies are required to conduct evaluations of these demonstrations. However, FHWA did not provide specific guidance on how these evaluations were to be conducted.

[5]Funding for the Suburban Mobility Initiative is provided through various discretionary funding accounts (sections 4(i), 6, and 8 of the Urban Mass Transportation Act of 1964 as amended).

Regarding UMTA, the agency has not yet determined how to evaluate the 40 grants provided through the Suburban Mobility Initiative. According to the director of the office of mobility enhancement, UMTA has entered into a contract with a consulting firm that will help perform evaluations relating to the Suburban Mobility Initiative. Although the initiative is well under way, the scope of these evaluation activities has not been defined.

Of course, the majority of federal aid for TSM comes from the major federal-aid highway and transit programs, and these programs are subject to general review and monitoring by FHWA and UMTA (see also chapter 2). Although we did not identify any current evaluations specifically looking at the effect of these programs on the use of TSM by local communities, both FHWA and UMTA officials did note that the planning and project selection process for using these funds does, in a general way, provide an a priori form of evaluation for TSM as well as other federally funded projects. That is, these processes are intended to make local communities consider the benefits of proposed projects before they are begun.

According to the study outline, the objective was to develop a framework that local agencies could use when considering alternative approaches to improving the performance of congested corridors.

In the third focal area of this HPNPA—integrated traffic management systems—FHWA is presently conducting an evaluation, funded in 1984, of a major demonstration project in the New York City-Long Island area. Started in 1970 as a joint venture between FHWA and the New York State Department of Transportation, this project is considered to be one of the most comprehensive demonstrations of integrated traffic management. The system integrates a number of traffic control systems aimed at alleviating congestion along a 35-mile corridor running from Manhattan to northern Long Island.

For fiscal year 1989, FHWA intended to initiate new projects pertaining to incident management and integrated traffic management. A project to demonstrate freeway incident management techniques has been planned by FHWA's demonstration projects division. Another effort will entail field demonstrations in incident management and integrated traffic systems.

Advanced Motorist Information Systems

The second HPNPA relating to traffic congestion investigates technologies for providing traffic information to motorists.[3] Entitled Advanced Motorist Information Systems for Improved Traffic Operations, this concentrated research effort was approved as a HPNPA in 1988 (for inclusion in the fiscal year 1989 budget). However, preliminary approval came earlier, and individual research projects have been conducted in this area since fiscal year 1987.

The objective of this HPNPA is to research, develop, and implement information systems—particularly in-vehicle traffic information systems—that can be used by both commuters and traffic engineers to improve the performance of the freeway and roadway system. Unlike previous FHWA research on advances such as electronic variable-message freeway signs, the aim is to develop a technology that allows for active communication between vehicles and a traffic control center. It is expected that if travelers can receive current "real time" traffic congestion information while driving, they will change their routes to avoid the congestion,

[3]Appendix I provides additional illustration of advanced motorist information systems. The case study profile covers several pertinent aspects of FHWA's research program, including a more detailed description of the technologies being investigated and the measures and methods used to assess their potential to alleviate traffic congestion.

thereby maximizing the use of the overall transportation system. Similarly, it is expected that if traffic controllers can be informed of individual vehicle locations and destinations, they can adjust traffic signals and other traffic aids to optimally handle traffic surges.

Within this research effort, FHWA initiated two studies in fiscal year 1988. One was a laboratory-based examination of the use of an information system within automobiles. The technology used in this study was an instrument built into a vehicle that provided the driver with traffic information on a visual screen display similar to a small television or computer screen. Looking at effectiveness as well as safety, the study attempted to evaluate the effects that the use of such an instrument could have on traffic congestion.

In addition to initiating the laboratory study, FHWA has initiated a field study that operationally tests an information and display screen located in automobiles. Called Pathfinder, this study entails the use of computer screens displaying digital maps inside 25 cars in the Los Angeles area. Sensors in the road send electronic signals to a traffic control center. Routing alternatives are in turn displayed on the screens. The study is a preliminary inquiry into some of the problems and opportunities involved in deploying a high-tech motorist information system. It is a cooperative effort between FHWA, the California Department of Transportation, and the General Motors Corporation.

For fiscal year 1989, follow-on studies have been planned in laboratory and field settings. A laboratory study focuses on determining types of guidelines that could be used (for example, by automobile manufacturers) in assessing the performance and safety of proposed vehicular information technologies. A second field study is similar to the Pathfinder study, except that FHWA intends to use another location and, perhaps, different equipment.

Related Research Efforts

FHWA coordinates its research—including HPNPA efforts—with other major highway research. In particular, FHWA coordinates its research activities with both the Highway Planning and Research (HP&R) studies conducted by state highway agencies and National Cooperative Highway Research Program (NCHRP) studies administered by the Transportation Research Board. While not direct federal programs, both the NCHRP and

Advanced Technology Strategy

It was not too many years ago that the automatic turn signal in our automobiles was advanced technology compared to holding an arm out the left window. Today, advanced technology researchers are experimenting with computers, digital maps, and telecommunications, searching for high-tech systems that will manage traffic and keep it flowing. They are looking for ways to integrate the roads we now have with our vehicles into a smoothly running, efficient transportation system. One goal is to make roads so "smart" that they can guide "intelligent" vehicles without direction from the drivers.

Experts agree that we are not likely to see totally automated highways until the 21st century. However, in the not too distant future, roads may "talk" through built-in sensors to a traffic control center that flashes onto an automobile's video screen a map of alternative routes that are less congested. Such electronic navigation systems are already under development by all the major auto companies.

The Department of Transportation is authorized to conduct research on advanced technologies under title 23, section 307, of the U.S. Code, as amended. This section states that "The Secretary is authorized in his discretion to engage in research on all phases of highway construction, modernization, development, design, maintenance, safety, financing, and traffic conditions."

FHWA High Priority Research Efforts

Current federal efforts to alleviate traffic congestion through advanced technologies involve research, development, and implementation activities. They are conducted primarily under FHWA's office of the associate administrator for research, development, and technology (RD&T) and, within this office, the office of safety and traffic operations research and development. The RD&T office of implementation assists with technology transfer of the products once they have been researched and developed, including coordinating training courses with RD&T's National Highway Institute.[1]

To focus FHWA's research efforts on high payoff areas, in 1987 FHWA established High Priority National Program Areas (HPNPAS). These represent concentrated 3-year to 5-year self-initiated research efforts by FHWA and annually account for approximately 70 percent of FHWA's contract and staff research budget. Presently, there are 18 HPNPAS in the four

[1]Once advanced technologies have been developed, FHWA's office of traffic operations is responsible for most deployment activities.

major highway research areas: safety, pavement, structures, and traffic operations. The HPNPA projects pertaining to the use of advanced technologies for alleviating congestion are found in the traffic operations area.

Under this traffic operations category, there were two HPNPAs for fiscal year 1988: Improved Freeway Control Systems for Congestion Reduction and Improved Traffic Analysis Tools. For 1989, two more HPNPAs have been added: Advanced Motorist Information Systems for Improved Traffic Operations and Improved Highway Travel for an Aging Population. Two of the four HPNPAs—Improved Freeway Control Systems and Advanced Motorist Information Systems—directly relate to advanced technology aimed at alleviating congestion.[2]

Improved Freeway Control Systems

According to the documentation we reviewed, the objective of the HPNPA entitled Improved Freeway Control Systems for Congestion Reduction is to provide more efficient and easily understood and applied freeway traffic management for relieving urban freeway congestion. The three major directions of this advanced technology research are (1) the detection and management of freeway incidents such as vehicle accidents, (2) efficient freeway corridor management such as diverting traffic to less-congested corridors, and (3) the integrated operation of freeway traffic management systems, such as integrating the operation of freeway ramp meters with adjacent traffic signal systems.

In fiscal year 1988, FHWA began new projects in the first two of these three areas: incident management and corridor management. For incident management, the agency initiated the development of a handbook and video. The purpose of these materials was to provide "state of the practice" information on managing freeway incidents. Based on previous research by FHWA, this work was aimed at providing up-to-date information on incident management to local areas.

For corridor management, a project entitled Analysis of Complex, Congested Corridor Locations was begun in fiscal year 1988. This study examined congested corridors in four to six case study locations.

[2]The HPNPA aimed at improving traffic analysis tools does have implications for congestion (through improved simulation and signalization tools), but it is not directly aimed at one of the advanced technology techniques included in the scope of our review. Similarly, while the program for the aging could include accidents caused by elderly drivers that in turn create congestion, focusing on this topic is beyond our scope.

HP&R programs have research efforts in advanced technology worth mentioning.[4]

With regard to NCHRP, a series of research assignments dealing with traffic operations aspects of the traffic congestion problem were approved in 1987. According to a Transportation Research Board official, funding was approved for a total of eight studies investigating the use of traffic operations to reduce congestion and improve safety.

The NCHRP studies address a range of issues related to traffic operations and congestion, and one explicitly investigates the role of advanced technologies. Entitled Assessment of Alternative Technologies for Relieving Urban Traffic Congestion, this study examines the potential of various technologies, including automated vehicle control, electronic route guidance, and automatic vehicle identification. The objective of this research project is to identify and assess alternative advanced technologies that could be used to alleviate congestion and then to develop a research and development plan for the most promising technologies.

In addition to the NCHRP work, several HP&R studies the states are conducting are being monitored by FHWA because of their national importance. They include but are not limited to studies in excess of $75,000. Like the NCHRP study, the studies under the traffic operations area cover a range of issues, not just the use of advanced technology.

We did, however, identify one fiscal year 1988 HP&R study that FHWA is coordinating with its improved freeway traffic control HPNPA. Entitled Generation and Assessment of Incident Management Strategies, this study is being conducted by the Washington State Department of Transportation. It investigates the effectiveness of various incident detection and management techniques.

Congressional Requests

FHWA's research into advanced technology includes two projects that are being conducted in response to congressional directives. One project is a direct authorization of funds to support California's Program on Advanced Technology for the Highway (PATH). PATH is a multiyear project being administered jointly by the California Department of Transportation and the Institute for Transportation Studies at the University

[4]The HP&R and NCHRP are not considered direct federal programs, as FHWA is not responsible for determining the research they carry out. However, FHWA does have statutory responsibility for monitoring HP&R studies, and the agency assists in monitoring the NCHRP program.

of California at Berkeley. The objective of the program is to develop electrification, automation, and navigation technologies needed for an automated highway system.

The expected 6-year funding total for the PATH program is $44 million. A variety of funding sources will be used to support the program, $2.91 million being provided by FHWA (over a 3-year period) and $500,000 being provided by UMTA. Funding for the federal portion of this program was included in the Surface Transportation and Uniform Relocation Assistance Act of 1987 (sections 164 and 333).

A second congressional study related to the use of advanced technology to alleviate traffic congestion was requested in the 1989 conference report on the DOT and related agencies appropriations acts. The amendment requested a report on intelligent vehicle-highway system technologies. Scheduled for completion by 1990, it was to report on Japanese, European, and domestic efforts to develop advanced technologies to improve traffic flow and the competitiveness of associated industries. As noted in the congressional language, the study was a response to the intensive research and development programs overseas, in particular the 7-year $700-$800 million "smart" highways PROMETHEUS project begun in Europe. The office of the Secretary of Transportation was responsible for producing the study, although contributions were sought from FHWA, UMTA, the private sector, and academic institutions. For an interim product, DOT published a discussion paper on a possible research agenda for intelligent vehicle highway systems. According to DOT, one aspect of such a system—automated highway and vehicle control—has significant long-term promise for helping ease congestion.

Mobility 2000

To develop a consensus on the research and development needs for advanced technologies, FHWA is assisting in the coordination of a "Mobility 2000" group. According to the chief of FHWA's traffic systems division, the purpose of this group is to bring together representatives from the public sector, the private sector, and the academic community to develop a coordinated research and development agenda.

According to this official, FHWA intends to develop an aggressive research and development program and is looking to coordinate its plans with other research programs. Although the specifics of FHWA's proposal for enhanced research in advanced technology have not been developed, several FHWA officials have indicated that additional federal resources could be requested to support this program over the next several years.

Funding

The primary funding source for FHWA research in the advanced technology strategy is the FHWA contract program. All four of the HPNPA studies initiated during fiscal year 1988 were funded through this program and totaled $2.04 million. (See table 4.1.) In addition to this funding, the direct authorization for the California PATH program ($1.47 million) brought the total direct federal support for the advanced technology strategy to approximately $3.51 million for fiscal year 1988. However, as in the TSM strategy, this estimate is conservative, since it includes neither staff salaries devoted to this strategy nor funding provided from the Highway Trust Fund (through HP&R and NCHRP) for advanced technology research.

Table 4.1: Funding for FHWA and UMTA Advanced Technology[a]

Project	Amount	Funding source
HPNPA		
Advanced Motorist Information (two studies)	$1,250	FHWA contract program
Improved Freeway Traffic Control (two studies)	795	FHWA contract program
PATH		
FHWA	970	[b]
UMTA	500	[b]
Total	**$3,515**	

[a]Funding is for fiscal year 1988 with 000 omitted.

[b]Directly from the Surface Transportation and Uniform Relocation Assistance Act of 1987.

Overall funding for the FHWA contract program has been declining recently: from $20.3 million in fiscal year 1986 to $17.7 million in fiscal year 1988. However, within the contract research budget, funding for the traffic operations category has been growing: from $1.8 million in fiscal year 1986 to $2.6 million in fiscal year 1988.

The two HPNPAs pertaining to traffic congestion—Improved Freeway Control Systems and Advanced Motorist Information Systems—accounted for approximately 79 percent ($2.04 million) of the total traffic operations contract research budget. Among the two HPNPA areas, the elements of the Improved Freeway Traffic Control project are expected to total $795,000, while the contract research projects investigating Advanced Motorist Information Systems are estimated at $1.25 million.

Evaluation

FHWA maintains awareness of developing technologies as part of its research and development process. According to FHWA officials, the agency generally conducts evaluations in the early phases of developing

a technology. Once the problems in the technology are studied and resolved, it is expected that the dissemination and operation of the technology will be successful. Thus, FHWA does not generally conduct formal retrospective evaluations to determine the overall effect of disseminated technologies. According to the chief of the traffic systems division, FHWA does get informal feedback from the field about the success of various technologies.

Correspondingly, with regard to research on advanced technologies to alleviate congestion, evaluations are being conducted or are planned as part of the early developmental or demonstration testing of the various technologies. For example, present and planned research projects in the Advanced Motorist Information Systems HPNPA have laboratory as well as field assessment aspects. As detailed in appendix I, these studies include a range of methods and measures aimed at determining the potential effectiveness of this technology, as well as other implications such as safety. Since the advanced motorist information systems technology is in an early stage of development, the research program does not entail any retrospective evaluations on the effect of this technology on traffic congestion.

Regarding the HPNPA investigating freeway control systems, an evaluation of the performance of the demonstration project in the New York-Long Island area has been under way since fiscal year 1984. This evaluation will include measures on the performance of hardware, improvements in traffic flow, effects on accidents, and the costs and benefits of the system.

While we did not identify any studies being conducted or planned to retrospectively evaluate FHWA efforts to develop and disseminate advanced technologies to alleviate traffic congestion, we did identify one study under way that will prospectively evaluate FHWA's overall role in this area. This is the Intelligent Vehicle-Highway Systems Technologies study being conducted by the office of the Secretary of Transportation in conjunction with FHWA. This study, as requested by the Congress, will contain recommendations for the federal role in researching and developing advanced technologies to improve traffic flow.

In addition to this study, we were apprised of three recent internal management studies examining FHWA's general RD&T process. One study, completed in 1988 by DOT's office of the inspector general, examined the process by which FHWA plans, monitors, and coordinates research activities. A second study, conducted in 1987 by FHWA's office of program

review, assessed RD&T's contract and staff research program. And finally, a third study by the office of program review is currently assessing RD&T's ability to market its products and technologies to local areas, including urban areas.

Conclusions and Recommendation

The purpose of this review has been to provide a comprehensive overview of current federal activities to alleviate traffic congestion. As DOT's efforts for dealing with this growing problem are conducted through a variety of programs within both FHWA and UMTA, this profile highlights a varied pattern of federal activity. While the profile points to the array of federal activities, resources, and evaluations aimed at improving freeway mobility, at the same time it suggests areas for examination as changes in the federal surface transportation role are considered.

This chapter contains the conclusions of our review, with specific regard to the three study questions. As stated in chapter 1, these questions pertain to agency activities (question 1), funding resources (question 2), and evaluations (question 3). From these conclusions and related findings, we provide a recommendation for the Secretary of Transportation.

Conclusions

Agency Activities

We conclude that DOT currently conducts an array of activities across the three congestion reduction strategies: construction and reconstruction, transportation systems management, and advanced technology. The predominant activity is the provision of federal assistance through the federal-aid highway and transit funds, which state and local governments are eligible to use to increase and to better manage the capacity of the federal-aid highway system.

Both FHWA and UMTA augment their provision of federal-aid programs with several planning, technical assistance, and research activities. In particular, the planning and technical assistance are an important way of encouraging communities to use transportation systems management techniques. We did find that, in contrast to earlier, more formal programs to demonstrate, evaluate, and disseminate TSM techniques, current efforts are self-initiated by FHWA and UMTA and depend upon a variety of funding sources. With regard to advanced technologies, we found that FHWA has recently begun a concentrated research program and is planning to pursue an even more aggressive program with the assistance of other private, academic, and local government groups.

Agency Funding Resources

Because the federal resources used to alleviate traffic congestion are often part of larger federal programs, it was not possible to determine

their precise amount. Available data do, however, permit the identification of several major federal funding sources, as well as an approximate indication of the magnitude of assistance for each congestion reduction strategy.

Regarding the construction and reconstruction strategy, we identified approximately $3.88 billion in fiscal year 1988 federal-aid highway funds obligated for construction, reconstruction, and lane-widening, and we noted that the largest funding source for these projects was the interstate and interstate 4R programs. Because the data are imprecise, we consider this only to approximate the amount of federal funds used to reduce congestion through additional capacity. Nonetheless, the data do demonstrate the substantial support of highway programs for adding capacity to the federal-aid system.

We found that federal-aid highway program funds are also an important funding source for the TSM strategy: we identified $168 million in 1988 federal-aid highway funds used for TSM activities. In total, approximately $188 million in TSM funding was identified for fiscal year 1988. However, because several major funding sources used for TSM did not have identifiable TSM components (for example, section 9 transit funds), we consider this total to be a conservative estimate of TSM expenditures.

Regarding advanced technologies, the FHWA contract program provided $2.04 million of the total $3.51 million in 1988 funds. Again, we consider this total to be a conservative estimate, since expenses such as FHWA staff salaries were not included. We also noted that several agency plans could result in proposals for substantial increases above the present funding levels for advanced technology research.

Agency Evaluation

We sought to identify the way FHWA and UMTA evaluate the effectiveness of their congestion reduction efforts. We found some evaluation activities for each of the strategies we reviewed. We noted the extensive data base FHWA uses to monitor the performance of the federal-aid highway system and its potential for measuring congestion. We documented an evaluation assessing the effectiveness of demand management techniques at selected case sites, and, finally, we described the evaluation components of several present and planned advanced technology research projects.

Our review also detected some gaps in the use of evaluation to guide federal programs. The type of gaps varied across the strategies. In the

construction and reconstruction strategy, for example, we did not identify any current federal efforts to examine the use of federal-aid highway funds by local communities to alleviate congestion. In the TSM strategy, we found a lack of front-end evaluation planning as part of the various FHWA and UMTA initiatives. And, with regard to advanced technology, we noted that FHWA does not generally conduct retrospective evaluations of technologies once they are in operation.

Recommendation for the Secretary of Transportation

As evidenced in this review, traffic congestion represents a surface transportation problem that has already engendered a variety of federal activities. While these efforts demonstrate that DOT is addressing the traffic congestion problem through several approaches, the diffuse nature of the federal efforts does raise some concern regarding the extent to which the federal role is being efficiently and effectively executed. Consequently, we recommend that the Secretary of Transportation set forth guidance in the planned national transportation policy to ensure a coordinated federal strategy toward improving freeway and roadway mobility and that this guidance note the need for appropriate evaluation mechanisms to determine the effectiveness of key federal congestion reduction programs and activities.

We think that the national transportation policy being developed represents an important opportunity for the Secretary to recognize the need for a coordinated and evaluated federal strategy for improving mobility, since the policy will, according to the department, provide the framework for setting agency strategies into the next century. In the following sections, we elaborate on some specific areas that we think should be considered for inclusion in any future federal strategy for improving freeway and roadway mobility. The discussion is meant not to be inclusive but, rather, to illustrate our general recommendation on the need for a systematic federal approach.

Coordinated Federal Efforts

As noted in our recommendation, we think it is important to consider a mobility strategy in terms of both the program activities conducted and the evaluations of these efforts with regard to their effectiveness in improving freeway and roadway mobility. One specific program area that we believe merits attention is the interstate system. This system, the mainstay of the nation's highway infrastructure, has the highest levels of congestion but no orchestrated federal approach to alleviating congestion using the various techniques covered in this study. Developing an effective approach for alleviating congestion in this system would

help the surface transportation infrastructure contribute to the nation's productivity and economic competitiveness.

With the high cost of freeway construction, we also think that getting the most out of existing freeway and roadway capacity is an important program area worthy of consideration. Presently, the tentativeness of DOT's TSM initiatives affects the ability of the agencies to plan for and conduct TSM activities. For example, both UMTA's Suburban Mobility Initiative and FHWA's urban congestion action plan depend on a variety of funding sources and, at the beginning of fiscal year 1989, had not received a firm commitment for the funds needed for the year. Consequently, DOT might consider a more systematic and stable means of providing assistance in transportation systems management.

Evaluated Federal Efforts

The gaps in evaluation identified in our review point to areas where critical information on the merit of programs and, consequently, the usefulness of funds, is not being obtained. Further, as we have stated in a recent report on program evaluation, we consider executive branch evaluation activities to be vital in producing information for policy decisions by both the agencies and the Congress.[1]

In this vein, we think that the growing traffic congestion problem necessitates that DOT take an aggressive approach to better understand how it can most effectively use its resources. While federal surface transportation policy is undoubtedly designed to meet a variety of other policy objectives (including infrastructure investment preservation and public safety), our findings point to the need for DOT to consider freeway and roadway mobility as one such objective that warrants the determination of an effective federal approach.

However, given the variety of FHWA and UMTA activities that relate to congestion reduction, it does not seem reasonable to expect that DOT can or should conduct evaluations on every activity. Consequently, we believe that DOT should assign some priorities to the programs—or aspects of major programs—that warrant evaluation scrutiny. Several potential areas for evaluation have been noted in the evaluation gaps cited in this review. These include evaluation information on the effects of federal-aid programs, on the effects of the federal TSM initiatives, and,

[1]U.S. General Accounting Office, Program Evaluation Issues, GAO/OCG-89-8TR (Washington, D.C.: November 1988).

finally, on the potential of advanced technologies to reduce traffic congestion.

Agency Comments and Our Response

The Department of Transportation provided written comments on a draft of our report (see appendix IV). Overall, department officials concurred with our findings and recommendations. They did suggest that we clarify some aspects of the role of transit and UMTA in reducing freeway congestion. According to DOT, there is a widespread misconception that congestion can be reduced by simply expanding transit services. The department stated that transit alone cannot be expected to reduce congestion but, rather, transit services must be implemented in concert with other TSM techniques. According to DOT, what transit can do is provide additional transportation capacity and reliable, high-performance service in certain markets and thus keep congestion from worsening.

We agree with DOT that the role of transit is best viewed as part of an integrated strategy that uses a variety of other congestion reduction means, such as TSM techniques. We think our coverage of transit within the TSM strategy reflects this perspective. Nonetheless, as suggested by the department, we have provided further discussion on this issue in chapter 3.

The department also noted that the use of UMTA section 3 funds for suburban mobility should be clarified in the report. According to DOT, UMTA intends to fund about $75 million on capital projects nationwide under the suburban mobility category. The department suggests that the presentation in chapter 3 be changed to reflect this funding.

We have augmented our discussion of section 3 funding in chapter 3 to note UMTA's intention to allocate additional funds for suburban mobility. From follow-up interviews with UMTA, we determined that the section 3 funds noted in DOT's comments had not been obligated in fiscal year 1988 (in identifying funding, our study focused on fiscal year 1988 obligations). Therefore, we make a distinction between the $11.12 million actually obligated in fiscal year 1988 and the additional $75 million that the department intends to spend beginning in fiscal year 1989.

The department also provided numerous technical comments on our report. We found these comments to be helpful in ensuring the accuracy of our review and, where appropriate, we have incorporated them into the text.

Advanced Motorist Information Systems

Authorization

The official approval for FHWA's Advanced Motorist Information Systems for Improved Traffic Operations project came in spring 1988 when FHWA's research advisory board approved it as one of 18 high-priority areas. According to the chief of FHWA's traffic systems division, an important milestone in the development of this High Priority National Program Area was a 1986 conference on advanced technology for transportation held in California.[1] Beginning with this conference, discussion began for a cooperative FHWA, California Department of Transportation, and General Motors Corporation field demonstration project, later called the Pathfinder project.

Another influence on the genesis of the project is the PROMETHEUS program in Europe. Standing for Program for European Traffic with Highest Efficiency and Unprecedented Safety, PROMETHEUS is an $800 million, 7-year research program begun in 1986 and being sponsored by 19 European countries, 70 research institutes, and 20 automobile manufacturers. The goal of this effort is to develop new technologies for improving transportation efficiency and safety.

Purposes and Goals

The focus of the Advanced Motorist Information Systems, as suggested by the name, is on advanced technologies relating to the provision of in-vehicle information to the driver. The system concepts being developed by research in this area would give vehicles the ability to receive a variety of current "real-time" information on routing, the condition of roads, and safety hazards ahead. In some configurations, it would send speed, location, destination, and other data from a traveling vehicle to traffic controllers. Transportation researchers expect that, at the least, drivers would be able to reroute their trips to avoid congested areas and times. In its more advanced capacities, it is also expected that traffic controllers could use such information to balance traffic demand over the network, thereby reducing congestion.

Information systems already in use in the United States communicate information to motorists, but they are not designed to transmit customized two-way information to and from an individual vehicle. For example, electronic variable-message signs adjacent to the freeway are used to relay recorded, and in some instances "real time," information to motorists. Previous FHWA studies have been aimed at evaluating this technology. The Advanced Motorist Information Systems program is

[1] According to DOT, the advanced motorist information systems project was also influenced by Japanese efforts in this area.

aimed at a new generation of this type of system, one that can use computer and other advanced informational technologies to equip automobiles with an "in-vehicle" or "on-board" ability to both receive and transmit information.

An example of such navigational technology is the navigator developed by ETAK, Inc. The navigator is a self-contained unit that can provide navigational information to the driver on an electronic video screen. The screen pinpoints where the driver is on a map on the screen. The driver can obtain directions by entering intended destinations into the car's computer. When linked to a traffic control center, the navigator can receive from it traffic congestion information and display it on the screen.

FHWA officials told us that FHWA will not develop its own technology for communicating traffic information. Instead, the federally sponsored research is aimed at (1) developing technical and safety guidelines for assessing alternative design systems and (2) assessing the likely feasibility and cost-effectiveness of these systems for improving traffic operations. As stated in the program's documentation, the objective of this research area is

> "to establish on a preliminary basis, the technical feasibility, design guidelines, cost-effectiveness, and practical utility of real-time in-vehicular navigation and motorist information systems when used in congested urban locations."

The research project is viewed by transportation researchers and FHWA officials as one component in a future "smart" highway system that would integrate various advanced technologies. Such a system would use these technologies to allow for two-way communication between those operating the highways and those operating the vehicles, the result being greater operational efficiency and reduced congestion.

Administrative Structure

The project is managed by the FHWA office of the associate administrator for research, development, and technology. As the Advanced Motorist Information Systems is considered to be a traffic operations issue, it is subject to the approval of FHWA's traffic operations research advisory council. Each fiscal year, the advisory committee reviews proposed study plans and makes its recommendations, which are then forwarded—with other research advisory council recommendations—to the FHWA research activities board. This board, which is chaired by the

FHWA executive director, gives final approval for all agency contract research projects in excess of $50,000.

According to DOT, the execution of the Advanced Motorist Information Systems research studies is the sole responsibility of the office of safety and traffic operations research and development. The office of implementation would have responsibility for any implementation activities, and the National Highway Institute would have responsibility for any training associated with the area. Other HPNPAs related to advanced technology have, in fact, had involvement from the office of implementation and the National Highway Institute, but no such activities are planned for this HPNPA, because, according to FHWA officials, the research is presently in an early phase. Consequently, there are no current implementation needs.

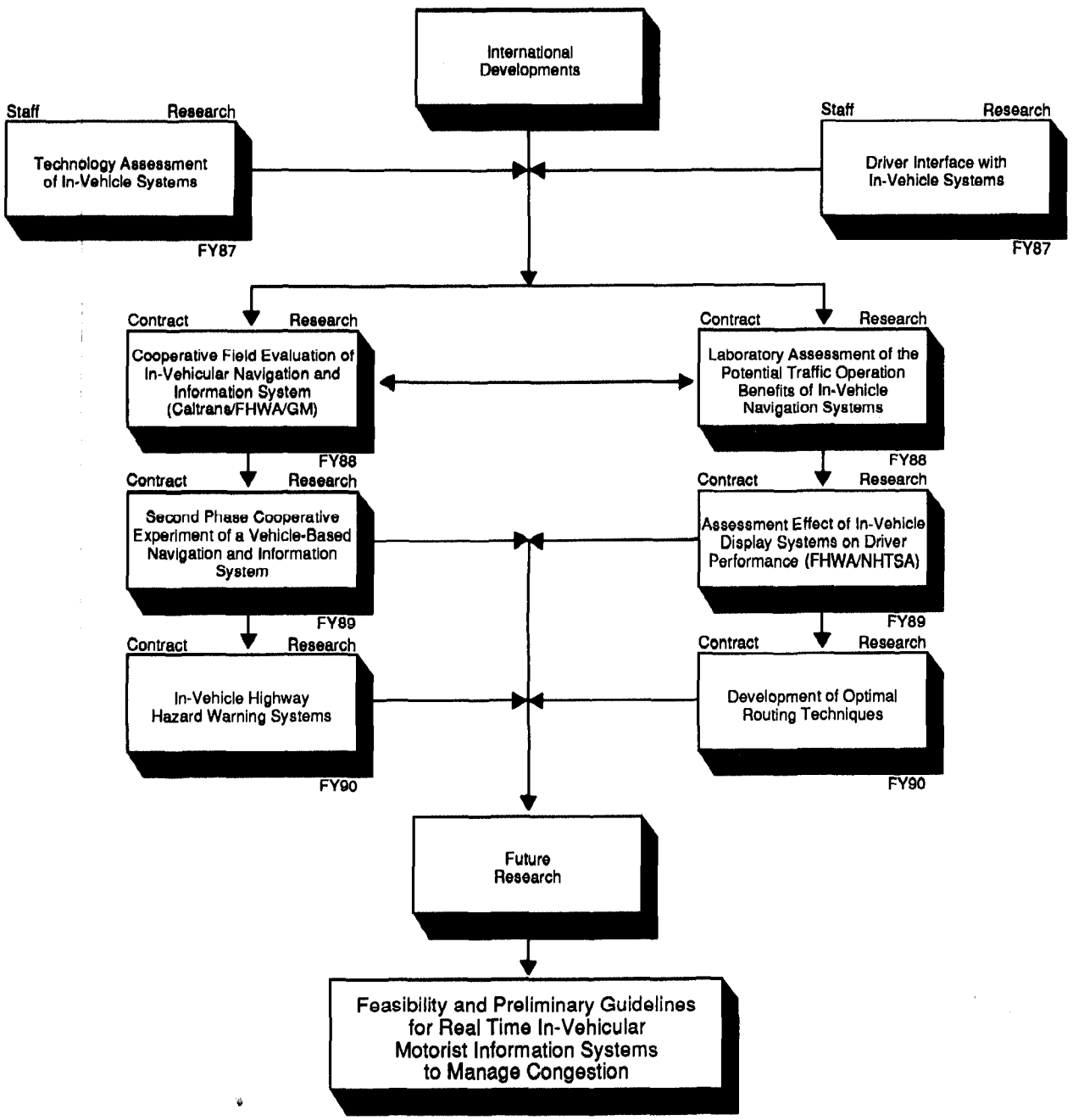
Relationship With Other Programs

The research advisory council for traffic operations provides the primary organizational forum for coordinating the Advanced Motorist Information Systems research among the pertinent offices. Similarly, the research advisory board consists of the associate administrators not only for RD&T but also other divisions, such as policy, engineering, programs development, and safety and operations. Other organizations outside DOT, such as the Transportation Research Board, are not represented on the board (although an annual solicitation is made to outside agencies for research topics).

Program Operation

The Advanced Motorist Information Systems program consists of a series of research projects aimed at investigating different facets of the use of advanced technology to reduce congestion. The studies, most of which are just beginning, involve staff and contract research funds as well as field and laboratory settings. Figure I.1 presents FHWA's scheme for conducting research on Advanced Motorist Information Systems for Improved Traffic Operations.

Figure I.1: Advanced Motorist Information Systems for Improved Traffic Operations



Source: Federal Highway Administration, Washington, D.C., 1988.

Staff Research Studies

In the development of the HPNPA, two preliminary staff studies were started. One study, entitled Assessment of Development of In-Vehicular Navigational and Motorist Information Systems, reviewed evidence and related literature pertaining to in-vehicle navigational and motorist information systems. It found that several early forms of this technology had been successfully implemented and that the cost-benefit ratios for advanced "dynamic" versions (for example, in-vehicle computers) were higher than for "static" systems (such as freeway message signs).

The title of the second staff study, Driver Interface with In-Vehicle Systems, was changed to Investigation of Salient Issues Concerning Driver's Use of On-Board Information Systems. The purpose of this study is to perform a preliminary examination of the operational and safety implications of the different in-vehicle information systems within a simulated (that is, laboratory) environment. For example, the study will compare the effects of visual and auditory information modes on driver performance. In total, data will be obtained from 120 subjects. The study is using FHWA Turner Fairbank Highway Research Center's human factors laboratory.

Contract Research Studies

In addition to the staff studies, two contract research projects were initiated during fiscal year 1988: (1) Laboratory Assessment of the Potential Traffic Operations Benefits of In-Vehicle Navigation and Information Systems and (2) Cooperative Field Evaluation of In-Vehicular Navigation and Information System (Pathfinder).

The first of these studies is, as the title states, a laboratory assessment of the potential operational benefits, including congestion reduction, that could be realized through the use of in-vehicle navigational devices. According to the study plan, the project is intended to be a systematic assessment of both the simulated driver performance and operational benefits of an in-vehicle motorist information system.

The intent of the driver performance experiments will be to gain an understanding of a driver's decisionmaking when there is access to varying types of motorist information systems. These experiments will examine the drivers' route choices under four different in-vehicle technology configurations as well as under a variety of simulated conditions (such as day versus night).

The effect of the use of motorist information systems on traffic congestion will be investigated by employing traffic simulation models. Based

on the driver performance results (obtained from the driver experiments described above), estimated effects on traffic congestion will be simulated under various congestion scenarios as well as under different in-vehicle technology configurations.

The second study, known as the Pathfinder project, is a field study employing in-vehicle motorist information systems in 25 vehicles along a congested corridor in the Los Angeles area. The study is a cooperative effort between FHWA, the California Department of Transportation, and General Motors. FHWA will have the lead responsibility for designing and evaluating the Pathfinder project, including modifying the in-vehicle equipment to enable it to receive and display traffic information and to transmit its location, speed and heading to a control center. California's Department of Transportation will be responsible for managing and operating the field study, while General Motors is responsible for providing the 25 test vehicles.

A contractor was selected for FHWA's portion of the project in September 1988. The project is expected to run over a 2-year period, with a final report due in March 1991.

The test vehicles will be equipped with the ETAK navigator described above. Real-time information will be conveyed to drivers in the test vehicles by enhancing the informational system to display congestion information, time-of-day restrictions, and the like. Since the Santa Monica freeway has been equipped with various traffic monitoring devices controlled by a traffic operations center, two-way communication between the vehicles (but not the drivers) and traffic controllers will be conducted during the field testing.

The purpose of this study is to provide an initial field assessment of the feasibility of using this new technology as a congestion reduction technique. In particular, the study will assess the extent to which the system (1) saves travel time for participating motorists, (2) can be integrated with other traffic information systems, and (3) provides accurate traffic condition information to traffic monitors.

For fiscal year 1989, FHWA has approved funds for two additional contract research studies in the Advanced Motorist Information HPNPA. Similar to the fiscal year 1988 program, one study is laboratory based, while one is field based.

The laboratory study is entitled Assessment Effect of In-Vehicle Display Systems on Driver Performance. The aim is to investigate the types of guidelines that would be required to assess the effectiveness of any given in-vehicle information system on driver performance and safety.

The planned field study is a second implementation of the Pathfinder project and is entitled Second Phase Cooperative Experiment of a Vehicle-Based Navigation and Information System. The goal will be to attempt a demonstration of the in-vehicle motorist information technology in a second setting using other equipment.

Funding

The primary funding sources for research studies on Advanced Motorist Information Systems are FHWA's contract and staff research programs. Funds for these programs are appropriated each year by the Congress as part of FHWA's administrative budget. Both fiscal years 1988 and 1989 studies are funded through the contract research program.

The contract research studies for fiscal year 1988 totaled $1,250,000, representing approximately 50 percent of the total traffic operations research budget. The federal share of the Pathfinder study is approximately $750,000. The total FHWA budget for the Laboratory Assessment of Potential Traffic Operation Benefits of In-Vehicle Systems is $500,000.

The two Advanced Motorist Information Systems studies initiated in fiscal year 1987 were funded as staff studies and totaled $82,000. There were no staff studies in fiscal year 1988.

Evaluation Description

As the Advanced Motorist Information HPNPA consists of a series of related research projects, the evaluation of the technology can be considered within the context of the different study scopes. That is, each of the studies examines different aspects of the system, and in doing so, they include methods and measures that are aimed at evaluating various aspects of the technology.

Table I.1 highlights the types of methods and measures that fiscal years 1987 and 1988 projects have used or plan to use. In fact, for all but one of these studies, the information is based on study plans, not study reports. Therefore, the information should be viewed as tentative and as representative of the fact that FHWA evaluative activities for this technology are just getting under way.

Table I.1: Evaluation Methods and Performance Measures

Study	Method	Measure
Assessment of Development of In-Vehicular Navigational and Motorist Information Systems	Literature review; cost-benefit review	Cost-benefit ratios
Investigation of Salient Issues Concerning Driver's Use of On-Board Information Systems	Laboratory methods using driving simulator	Simulated driver performance
Laboratory Assessment of the Potential Traffic Operations Benefits of In-Vehicle Navigation and Information Systems	Literature review; laboratory assessments; traffic simulation modeling	Driver route choice response; simulated traffic congestion reduction
Cooperative Field Evaluation of In-Vehicular Navigation and Information System (Pathfinder)	Field demonstration	User travel time reduction; accuracy of information sent from vehicles: number of vehicles required for reliable predictions of saturated conditions

With regard to the measures used, the four studies in the project taken together represent a range of measurement approaches. The initial staff study included a review of cost-benefit calculations for the technology, while planned laboratory experiments will measure the simulated performance of drivers as well as simulated traffic congestion reduction. As the field study involves only 25 vehicles, travel time reductions will be measured, but no congestion effect assessment will be considered.

In general, the range of methods of these studies demonstrates that the federal effort related to Advanced Motorist Information Systems is still in the preliminary stage of research and development, as opposed to implementation or diffusion. The studies investigate the technical issues relating to the technology's performance, and only Pathfinder in a preliminary way considers the actual field performance of the technology in the highway system. There are no studies aimed at evaluating dissemination at local sites.

Suburban Mobility Initiative

Authorization

No specific legislative mandate exists for the Suburban Mobility Initiative; however, the Urban Mass Transportation Act of 1964 as amended gives UMTA the authority to have a program of research, development, and demonstrations. UMTA developed the Suburban Mobility Initiative in January 1988 in response to emerging suburban mobility problems and the need for a comprehensive, multimodal approach to solving these problems. UMTA employs existing discretionary funds for the program.

Purposes and Goals

According to UMTA's administrator, UMTA created the Suburban Mobility Initiative to help local communities solve traffic congestion problems, including suburban, intersuburban, and suburban-to-urban congestion. The program provides a forum to identify and discuss suburban mobility problems and provides short-term planning grants to implement transportation systems management projects as well as strategic planning grants to coordinate long-range solutions. The Suburban Mobility Initiative also disseminates information to transportation professionals on successful solutions to suburban mobility problems.

Administrative Structure

The office of mobility enhancement, under UMTA's associate administrator for technical assistance, administers the Suburban Mobility Initiative. The director of the office submits a program plan for the fiscal year to the UMTA administrator; program funds are obligated at the administrator's discretion. The office of mobility enhancement assigns a project manager to each approved project.

According to the director of the office of mobility enhancement, the relationship between the Suburban Mobility Initiative, which is administered by UMTA headquarters, and UMTA's regional offices is currently undefined. The director explained that the regional office work load is approximately 95 percent capital-related and that until more recently, regional offices were not generally involved with noncapital projects. However, he said that UMTA may rely on the regional offices for contact and follow-ups relating to the Suburban Mobility Initiative, which is not capital-intensive.

Relationship With Other Programs

The Suburban Mobility Initiative overlaps elements of other UMTA programs that also touch on suburban mobility issues, including the privatization program of competitive services, the joint financing program associated with transit project development, the entrepreneurial services challenge grant program, and the new university centers program.

The director of the office of mobility enhancement explained that with the exception of the entrepreneurial program, the programs are all administered under the associate administrator for technical assistance; therefore, most coordination is done when the program plans are submitted to the UMTA administrator for approval. He stated that there are some "gray areas" between his office and UMTA's office of policy, which administers the entrepreneurial program and, consequently, these instances require more coordination.

UMTA also coordinates Suburban Mobility Initiative activities with FHWA. In fact, UMTA provided FHWA the schedule of planned 1-day seminars and, consequently, an FHWA representative was present at each seminar to answer questions pertaining to federal-aid highway programs.

Program Operation

During fiscal year 1988, UMTA hosted 20 1-day seminars to initiate a discussion on suburban mobility. The seminars were to provide a marketing effort to promote the Suburban Mobility Initiative and to bring local officials together for a dialogue on the suburban mobility issue. The seminars were held in areas of the country that had significant and varied mobility problems and were attended by major private developers, employers, public and private transit operators, local and state government officials, and public interest groups. As mentioned above, these seminars were coordinated with, and attended by, representatives from FHWA.

According to the director of the office of mobility enhancement, 40 grants were awarded to interested and eligible recipients, based on information from the 1988 seminars and follow-up discussions with major parties in the regions. For example, as a result of the first seminar, held in Seattle, Washington, on February 3, 1988, metropolitan Seattle was awarded a grant for $335,000 to implement and evaluate several demand management strategies, including a downtown Bellevue circulator bus, an ensured-ride-home program, a program to reduce employers' subsidies of commuter parking, and the promotion of greater private sector participation.

The director of UMTA's office of mobility enhancement said that the application process for Suburban Mobility Initiative project grants is not formal. He noted that all the fiscal year 1988 applicants were screened at the seminars or over the telephone prior to their applying for funds. He said approval of projects was based on private and local participation and involvement as well as cash contribution. He said UMTA

expected a 20-percent financial commitment from the grantee or, at a minimum, required in-kind contributions. Additionally, the projects had to generally fit one of the five program elements of the Suburban Mobility Initiative: short-term planning grants, strategic planning grants, organizational arrangement demonstration grants, employer and developer-supported demonstration grants, and contractor support. Table II.1 provides additional information on these elements.

Table II.1: Suburban Mobility Initiative Program Elements

Program element	Description
Short-term planning grants	Helps identify and develop low-cost-high-payoff suburban mobility projects
Strategic planning grants	Helps develop long-term solutions to alleviate future suburban mobility problems
Organizational arrangement demonstration grants	Helps local communities develop new organizational arrangements, such as transportation management associations, in which the public and private sectors share in developing solutions to suburban traffic congestion
Employer and developer-supported demonstration grants	Helps local communities develop and implement programs such as transportation services from the inner city to suburban employment opportunities and plan transit-accessible suburban activity centers
Contractor support	Helps develop and implement seminars, conferences, and special events, perform special studies as needed, evaluate projects, and disseminate information regarding the Suburban Mobility Initiative

The 40 grants awarded in fiscal year 1988 totaled $6,988,816 and included

- 8 short-term planning grants, including a $200,000 grant to the Greater Orlando Chamber of Commerce to sponsor three regional mobility symposiums and evaluate its goals related to land-use planning, right-of-way acquisition, and integrated bus and rail transportation planning;
- 9 strategic planning grants, including a $270,000 grant to the Metropolitan Washington, D.C., Council of Governments to develop land-use and transportation strategies for six counties in the metropolitan Washington, D.C., area;
- 13 organizational arrangement demonstration grants, including a $115,308 grant to the township of New Brunswick, New Jersey, to implement a comprehensive traffic reduction ordinance that requires employers and developers to take steps to reduce peak-period traffic generated by their business activity;
- 6 employer and developer-supported demonstration grants, including a $200,000 grant to the Hillsborough Area Regional Transit Authority to

improve mobility in several suburban activity centers and to provide a reverse-commute service from the inner city of Tampa, Florida;
- 4 contractor support grants, including a $200,000 grant to Dynatrend, Inc., to develop a traffic-reduction manual to assist local agencies in formulating traffic mitigation measures.

Funding

The director of UMTA's office of planning stated that UMTA has no specific appropriation for the Suburban Mobility Initiative; rather, existing discretionary funds are being used to fund it. During fiscal year 1988, UMTA made available approximately $7 million for strategic planning grants, short-term planning grants, employer- and developer-supported demonstration grants, organizational arrangement demonstration grants, and contractor support. These funds were provided through sections 4(i), 6, and 8 of the Urban Mass Transportation Act of 1964 as amended. (See table II.2.)

Table II.2: Funding for the Suburban Mobility Initiative[a]

Activity	Section 4(i)	Section 6	Section 8	Total
Strategic planning	0	$177,280	$1,410,000	**$1,587,280**
Short-term planning	$215,205	604,115	0	**819,320**
Employer-support demonstrations	646,938	52,000	0	**698,938**
Organizational arrangement demonstrations	2,406,308	575,970	0	**2,982,278**
Contractor support	0	651,000	250,000	**901,000**
Total	**$3,268,451**	**$2,060,365**	**$1,660,000**	**$6,988,816**

[a]Data are for fiscal year 1988. Funding is under the Urban Mass Transportation Act of 1964.

In comparison to the nearly $7 million UMTA obligated to the Suburban Mobility Initiative in fiscal year 1988, the office of mobility enhancement program plan for fiscal year 1989 proposed approximately $2 million for Suburban Mobility Initiative projects. The director of the office noted that he would aggressively pursue additional funding for this program throughout the fiscal year as well as toward its end, when other program funds are generally deobligated.

Evaluation Description

UMTA monitors the expenditures of funds obligated for suburban mobility projects. The grantees submit a request for funds to UMTA's accounting division. The accounting staff then prepare required paperwork for reimbursement and forward it to the project manager for certification. From quarterly progress reports submitted by the grantees as well as

periodic telecommunications, the project manager certifies that the project funds were spent. Depending on the availability of travel funds, project managers may or may not make site visits.

UMTA has not determined how it will evaluate the Suburban Mobility Initiative, even though the initiative is well under way. The director of the office of mobility enhancement did note that, in his opinion, it is too early to assess the effect that the Suburban Mobility Initiative will have on reducing congestion. However, UMTA has begun to plan for evaluations by initiating a task order contract with a consultant, although no task orders for evaluation have been executed and designs for producing evaluative information have not yet been specified. Consequently, the extent to which the Suburban Mobility Initiative will produce useful, valid information on reducing congestion is unknown.

Interstate 4R Program

Authorization

The interstate 4R program was established by the Federal-Aid Highway Act of 1981 as an extension of the previous interstate 3R program, which was initiated in 1976 under Public Law 94-280. The interstate 4R program provides funds for resurfacing, restoring, rehabilitating, and reconstructing routes of the interstate system as designated under sections 103 and 139(c) of title 23 of the U.S. Code.

While the majority of interstate 4R funds are apportioned by formula, the program also includes discretionary funds. Initiated in 1982 by Public Law 97-424, the discretionary program was expanded by the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), which established specific dollar set-asides from the regular 4R program funds.

Purposes and Goals

The purpose of the interstate 4R program is to provide assistance to the states in preserving the interstate system through a continual capital replacement program. The interstate system accounts for only 1 percent of all road mileage but carries 21 percent of all vehicle miles of travel. As described in chapter 2, the system is a network of freeways in both urban and rural areas connecting cities of 50,000 or more population.

Interstate system routes are selected by the highway departments of each state, subject to federal approval. The states own and operate the interstate system and are responsible for routine maintenance, such as pothole repairs. Major renovations, however, are funded by the interstate 4R program. The program addresses the construction and reconstruction needs of the system as well as transportation systems management strategies for mitigating traffic congestion. Reconstruction includes, but is not limited to, the addition of travel lanes and the construction and reconstruction of interchanges and overcrossings along existing interstate routes. Interstate 4R funds may also be used for the construction of high-occupancy vehicle lanes, the acquisition of rights-of-way, and the construction of parking facilities for carpools and vanpools.

The interstate 4R discretionary program was designed to allow any state's interstate 4R funds not obligated within the prescribed time period to be made available, at the discretion of the secretary of DOT, to any other state applying for the funds. According to an FHWA official, however, interstate 4R funds have never been left unobligated. Beginning in 1987, a specific sum was set aside annually, before the apportionment of interstate 4R funds, for discretionary purposes.

Administrative Structure

The Federal-Aid Highway Program, including the interstate 4R program, is administered by FHWA in cooperation with state highway departments. FHWA distributes federal-aid highway funds to the states to construct and improve urban and rural highway systems. The states have the authority to decide where to spend the funds, subject to compliance with federal rules and regulations. FHWA is a three-level organization consisting of headquarters, regions, and divisions. The headquarters and regional offices provide guidance to the division offices. There is one division office in each state (and one in Puerto Rico). The division office is the primary contact with the state and local transportation agencies.

Relationship With Other Programs

Federal law permits the transfer of funds among some of the federal-aid highway system programs. A state may transfer from its interstate construction funds to its interstate 4R or federal-aid primary funds. The states are also allowed to transfer any interstate 4R funds in excess of their needs for resurfacing, restoring, rehabilitating, and reconstructing the interstate system to their federal-aid primary funds. Each state can transfer up to 20 percent of its interstate 4R apportionment without having to show that the funds exceed its needs for the interstate 4R program. The federal matching share of transferred funds is 75 percent.

Program Operation

The Federal-Aid Road Act of 1916 defined the federal and state cooperative partnership that remains in effect today. The states select, plan, design, and construct highway improvements; the federal government reviews and approves the work to be done with federal funds.

The interstate 4R funds are apportioned 1 year in advance of the fiscal year for which they are authorized, and the funds remain available for 3 years. When new funds are distributed, the amounts are added to the remaining unobligated balance. Any funds unobligated at the end of 3 years are withdrawn from the state and made available to other states as interstate 4R discretionary allocations.

The interstate 4R program is a reimbursable program; the funds are apportioned to the states by formula as a line of credit. Once a state has obligated the funds, they are protected from lapsing. The obligation commits the federal government to pay the federal share of a project's eligible cost through reimbursement. The federal share for interstate 4R is 90 percent, which may be increased to 95 percent for states with large areas of public lands. The obligation commitment is made when FHWA

approves a state's proposal for the use of its apportioned funds on particular projects.

The FHWA division administrators are authorized to enter into contractual agreements with the states for reimbursement. States submit a 5-year proposed federal-aid construction plan annually to their FHWA division offices. The plan includes all state-proposed projects under the federal-aid highway systems for the 5-year period. The division reviews the plan for compliance with federal regulations and requirements; if the plan is in compliance, the division sends the state a letter of review granting approval. Funds are obligated once a project is actually under way and construction plans have been advertised for contract bids.

Discretionary funds are available in addition to the apportioned funds described above. A state is eligible to receive interstate 4R discretionary funds once it has obligated all its regular interstate 4R apportionment. Also, the state must be able to (1) obligate the discretionary allocation within 1 year of the date funds are made available, (2) apply the funds to a project that is ready to start, and (3) in the case of construction work, begin work within 90 days of obligation. Final funding decisions for the discretionary program are made by the FHWA Administrator, based on recommendations provided by the office of engineering.

Funding

The Surface Transportation and Uniform Relocation Assistance Act of 1987 authorized $2.815 billion to be apportioned for the interstate 4R program during each of the fiscal years 1987 through 1991 out of the Highway Trust Fund. One FHWA official expects the funding for interstate 4R to continue in the future, since the interstate system is expected to need increasing aid to keep the system viable.

Before the authorized funds are allocated, three deductions are made. The first deduction is for FHWA administrative expenses and may not exceed 3.75 percent of authorized funds. It is used for FHWA salaries, travel expenses, supplies, and FHWA-sponsored contract research on highway construction, design, and planning. In fiscal years 1987 and 1988, this deduction was 1.75 percent. The second deduction is to provide financing for urban transportation planning activities as mandated in 23 U.S.C. 134. This planning deduction is 0.5 percent of the authorized funds after the administrative deduction. The third deduction is 0.25 percent of authorized funds before any other deductions are made and is used to finance the Strategic Highway Research Program, which

funds research, development, and technology transfer activities important to the national highway system. In addition, $200 million of interstate 4R funds are set aside annually for interstate 4R discretionary projects.

After the deductions are made, the interstate 4R funds are distributed to the states according to a mandated apportionment formula, which is weighted 55 percent on interstate system lane miles in each state, compared to the total in all states, and 45 percent on vehicle miles traveled on the interstate system, compared to other states. A part of the apportionment may be withheld if a state is in a penalty situation. According to an FHWA official, the majority of the penalty funds withheld from interstate 4R apportionments stem from noncompliance with federal drinking-age requirements. Table III.1 summarizes the deductions from the fiscal year 1988 interstate 4R authorization.

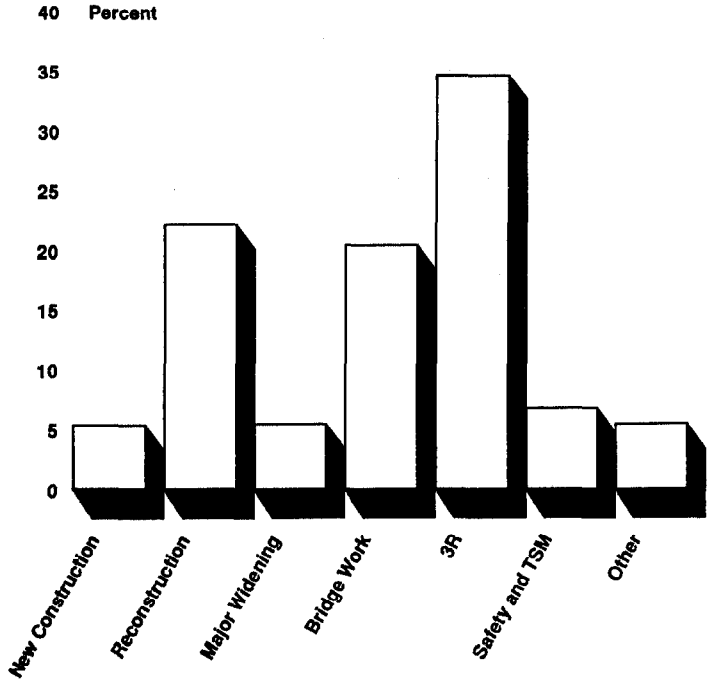
Table III.1: Deductions From Interstate 4R Authorizations[a]

Authorization	Percent	Amount
Administrative	1.75	$49.262
Planning	0.50	13.829
Strategic Highway Research Program	0.25	7.038
Discretionary set-aside		200.000
Penalties		7.159
Total		**$277.288**

[a]Data are for fiscal year 1988, and dollars are in millions.
Source: Office of Fiscal Services, Federal Highway Administration, Washington, D.C., 1988.

In fiscal year 1988, the final apportionment amounted to about $2.538 billion of the $2.815 billion authorization. The state apportionments ranged from a low of $12.7 million to 6 states and Puerto Rico to a high of $246.6 million to California. According to fiscal year 1988 obligation figures, 22 percent of interstate 4R obligated funds were used for reconstruction, 5 percent for new construction, and 5 percent for major widening. (See figure III.1.) In fiscal year 1988, FHWA had $200 million of discretionary funds and received 22 requests totaling nearly $602 million. Table III.2 lists the nine projects that received an allocation of interstate 4R discretionary funds.

Figure III.1: Total Obligated Interstate 4R Improvement Funds[a]



[a]Data are for fiscal year 1988.
Source: Office of Fiscal Services, Federal Highway Administration, Washington, D.C., 1988.

Table III.2: The Allocation of Interstate 4R Discretionary Funds[a]

State	Amount	Project description
Connecticut	$16.891	Resurfacing and related safety work
Illinois	48.955	Bridge rehabilitation
Iowa	20.300	Reconstruction; cement replacement
Maryland	18.79	Upgrading, including lane-widening, adding shoulders, and traffic maintenance
Michigan	27.800	Reconstruction and lane-widening; interchange improvements
Nebraska	16.222	Reconstruction, resurfacing, and bridge reconstruction
New York	12.870	Pavement and shoulder repair; resurfacing and rehabilitation
Pennsylvania	25.901	Drainage improvements; structural overlay; base stabilization; new shoulders
Washington, D.C.	2.362	Bridge deck rehabilitation
Total	**$190.091**	

[a]Data are for fiscal year 1988, and dollars are in millions.

Evaluation Description

FHWA headquarters provides general policy and procedure guidelines for the interstate 4R program and specific technical expertise that is not available at the divisions or regions. According to an FHWA official, the divisions are responsible for monitoring the programs; headquarters officials participate on request and as needed for technical expertise and guidance.

FHWA divisions monitor the projects that use interstate 4R funds to ensure that work is progressing in compliance with federal regulations and other requirements. The monitoring is intended to ensure that decisions on the projects to be funded are made in the public interest and that the projects comply with safety standards as well as air, noise, and water pollution standards.

While project-monitoring is conducted to ensure compliance with these standards, there are no formal evaluation requirements to assess the effect of specific projects on the transportation system performance, including congestion reduction. Similarly, we did not identify any evaluations determining the overall effects of the interstate 4R program on reducing traffic congestion on the interstate system.

Comments From the U.S. Department of Transportation

U.S. Department of Transportation

Assistant Secretary
for Administration

400 Seventh St., S.W.
Washington, D.C. 20590

SEP 27

Ms. Eleanor Chelimsky
Assistant Comptroller General
Program Evaluation and
Methodology Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Ms. Chelimsky:

Enclosed are two copies of the Department of Transportation's comments concerning the U.S. General Accounting Office report entitled "Traffic Congestion: Federal Efforts to Improve Mobility on the Nation's Freeways and Streets."

Thank you for the opportunity to review this report. If you have any questions concerning our reply, please call Bill Wood on 366-5145.

Sincerely,

Jon H. Seymour

Jon H. Seymour

Enclosures

Enclosure

Department of Transportation

Reply to GAO Report of August 10, 1989, on Traffic Congestion: Federal Efforts to Improve Mobility on the Nation's Freeways and Streets.

Summary of GAO Findings and Recommendations

The GAO found that current Federal efforts addressed at or related to traffic congestion could be summarized under three general congestion reduction strategies: road construction and reconstruction, transportation systems management (TSM), and advanced technology. The Department of Transportation (DOT) currently conducts a multitude of activities across the three strategies. The predominant activity by the Federal Highway Administration (FHWA) and the Urban Mass Transportation Administration (UMTA) is the provision of financial assistance using the Federal-aid highway and/or transit funds. These two DOT agencies augment their administration of Federal-aid programs with a variety of planning, technical assistance, and research efforts. While the dispersed nature of Federal congestion reduction activities did not permit a precise estimation of Federal funds expended, GAO did identify the approximate resources devoted to each strategy in Fiscal Year 1988, with the largest funding levels associated with the construction and reconstruction strategy. GAO also found that evaluations are underway as part of some Federal activities, but noted gaps in agency approaches to determining the effectiveness of several Federal efforts in reducing traffic congestion.

The GAO recommends that the Secretary of Transportation set forth guidance in the upcoming National Transportation Policy to assure a coordinated Federal strategy toward improving freeway and roadway mobility, and that this guidance note the need for appropriate evaluation mechanisms to determine the effectiveness of key Federal congestion reduction programs or activities undertaken.

Summary of Department of Transportation Position

Overall, the Department concurs with the report's findings and recommendation. However, we have a number of comments relating to the report's treatment of specific issues including several transit issues.

Transit's potential role in reducing congestion should be defined in the beginning of the report from a broad perspective. As it stands, the report rightly focuses on congestion mitigation actions related to highway supply and demand. However, there is

an extremely widespread belief that the simple expedient of expanding transit services or constructing new fixed guideway systems will somehow reduce congestion from present levels. The notion that transit can be a primary congestion relief mechanism is almost universally held by citizens, local politicians, and the media, yet the report does not address it directly.

Expansion of transit services and improvements in transit system performance can attract drivers from automobiles in the short run, thus reducing congestion for a time. Unfortunately, experience suggests that in the medium to long run, reductions in auto demand due to transit improvements made in the absence of any other actions, are soon more than made up by growth in auto travel. Auto trips absorbed by transit are replaced over time by new trips caused by increased vehicle trip making, changes in origin/destination linkages or by simple growth in population, employment and vehicle ownership. Even where there has been significant clustering of new development around the stations of new rail systems (e.g., Bethesda, Maryland, Walnut Creek, California), auto use invariably goes up because not all of the travel generated by that development actually occurs on the transit system which was its catalyst.

Clearly what transit can do is to provide additional transportation capacity for growth in certain markets and thus mitigate the worsening of congestion. It can also provide a reliable, high performance travel alternative where grade-separated transit facilities (i.e., HOV lanes, rail lines) are provided. What it has proven incapable of doing in the absence of other "TSM" actions is actually lowering, or eliminating congestion over the long run which is the all too prevalent view.

Absolute, long term reductions can only be accomplished if expanded transit services and construction of new facilities are accompanied by dramatic increases in the "price" of auto commuting such as through large increases in parking charges, tolls, the price and availability of gasoline or an absolute reduction of parking capacity. These are the kind of measures that the report does cover quite nicely under the category of "TSM."

We think that these points need to be made absolutely clear in the report. Otherwise, the criticism could be made that the report didn't explicitly address transit as a congestion reduction mechanism, a criticism that could be connected to a call for dramatically increased transit funding as a primary, singular congestion reduction mechanism.

The other point that should be made explicit in the report with reference to UMTA and to transit is that the potential to mitigate increases in congestion is one of the criteria UMTA uses to allocate its Section 3 discretionary capital resource. UMTA's Suburban Mobility Initiative announced in 1988 had more than the planning and technical assistance components covered in the report. In allocating Section 3 discretionary capital funds, UMTA is placing a high priority on projects which are a component in comprehensive programs with demonstrated cost effectiveness in addressing growing congestion. UMTA has announced its intent to fund about $75M in Section 3 capital projects nationwide under the suburban mobility category. Most of these projects are either for the construction of additional parking at existing transit terminals, or for the construction of new transit centers which facilitate not only transit use, but the formation of car and van pools as well. This point should be made in Chapter 3 of the report.

The Department of Transportation is developing a National Transportation Policy to set a framework through which decisions on transportation infrastructures, services, and related needs can be assessed and implemented during the next decade and into the 21st century.

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