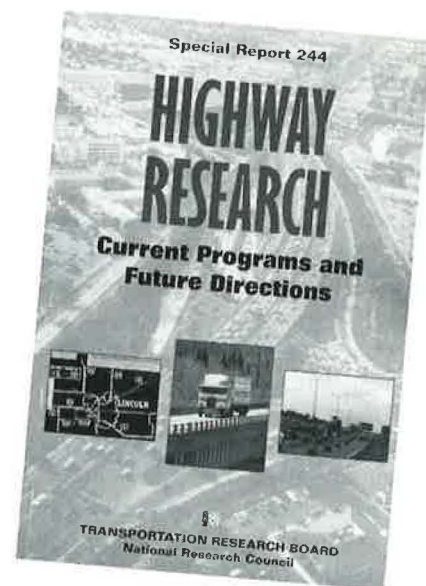


HIGHWAY RESEARCH

Current Programs and Future Directions



TRB Special Report 244—*Highway Research: Current Programs and Future Directions* is available from the Transportation Research Board.

The Research and Technology Coordinating Committee (RTCC), organized by the Transportation Research Board in 1991, provides the Federal Highway Administration with an ongoing independent assessment of its research, development, and technology efforts to develop broad-based priority recommendations for the years ahead. In examining U.S. highway research and technology (R&T) activities, RTCC found them to be highly decentralized and diversified: several federal agencies, each state highway agency, private companies, universities, and various public and private groups sponsor or conduct highway R&T programs. The committee's report, *Highway Research: Current Programs and Future Directions*, provides a single source of information about highway R&T programs, activities, and expenditures.

The three principal public-sector highway R&T programs, the FHWA program, the State Planning and Research (SP&R) program, and the National Cooperative Highway Research Program, are described in the report. These programs and their 1993 expenditures are examined in terms of eight categories of R&T activity (see accompanying box). The categories were defined by committee consensus to reflect current research priorities. By focusing on 1993 expenditures the committee developed a "snapshot" of R&T activities; aware of the limitations of this approach, the committee recognized that significant changes have already taken place that should be considered in any discussion of current and future programs. Consequently the steps taken to enhance weak areas and aggressively pursue strong ones are also discussed in the report. Ample evidence exists to indicate that the high-

way research and development programs described are dynamic and that change is fundamental to their nature. Also presented is the committee's vision of appropriate new directions and emphasis areas for highway R&T.

Major Public Sector Programs

FHWA is the single largest sponsor of highway research; it spent \$168.5 million on research and \$32.5 million on technology transfer activities in 1993. Its research focuses on traditional topics related to highway engineering such as pavements, structures, and materials, as well as planning, environment, and highway financing issues. In recent years the agency has taken the lead in the search for improving highway capacity and safety through the application of computer, information, and telecommunications technologies. FHWA also continues the large-scale, 20-year pavement test initiated under the Strategic Highway Research Program.

The Intermodal Surface Transportation Efficiency Act of 1991 redefined the Highway Planning and Research program as the SP&R program, required states to spend 2 percent of their total federal-aid highway apportionments for planning and research, and specified that at least one-quarter of these funds be spent for R&T. In 1993 states spent approximately \$79 million under this program, compared with \$25 million in 1991 and \$69 million in 1992. State research studies generally emphasize practical solutions for quick application to current problems. In addition states provide technical assistance to regional and

local transportation agencies, perform materials and equipment testing, and support staff development and training with SP&R research funds.

States can pool SP&R funds to address problems of common interest. The most significant pooled-fund research program is NCHRP, which is administered by the Transportation Research Board. NCHRP was created soon after construction of the Interstate system began, when many states experienced similar problems related to design and construction. In 1993 NCHRP funding was about \$15 million, nearly twice its funding for previous years. NCHRP projects address problems of common interest to many states and are designed to produce results for immediate application. The American Association of State Highway and Transportation Officials' Standing Committee on Research selects NCHRP project topics, and TRB convenes expert panels that oversee the selection and work of a research contractor for each topic.

Private Sector Highway Research

Private sector research consists of many individual programs conducted or spon-

sored by engineering associations and industry groups involved in highway transportation and by companies that design and construct highways and supply highway-related products. Annual research funding by highway-related associations and foundations is greater than \$20 million. Although details about research conducted by individual companies and funding levels are difficult to obtain—because of the hundreds of companies involved and the proprietary nature of the work—such funding is not insignificant. For example, information on companies that manufacture construction equipment indicates that the portion of their 1992 research budgets attributable to highway construction equipment (based on sales volume) is about \$65 million. Private sector research has a large impact on the industry that could be even greater if it were better coordinated with the public sector programs.

Estimated R&T Program Spending in 1993

Estimates of R&T spending by category in FHWA, NCHRP, and SP&R programs in 1993 confirm that the FHWA R&T program focuses on short-term research aimed at many topics, remains true to its modal mission, and supports a substantial amount of technology transfer and field applications (see Table 1). Breakthrough research topics at FHWA were dominated by intelligent transportation systems. Two categories considered important by the committee, U.S. transportation system issues and intermodal issues, are candidates for additional funding. NCHRP 1993 spending reflects the priorities of state officials who select the research topics. Recent priority topics include intermodal issues—a growing concern in states with ports—and breakthrough research, as evidenced by the inauguration of NCHRP's Innovations Deserving Exploratory Analysis (IDEA) program, which supports innovative research. The mapping of state highway research and development expenditures for 1993 underscores state interest in incremental research and problem solving. Because state highway departments are the

operating agencies closest to users, they often need immediate answers to technical questions.

Future Highway R&T Program Directions

The highway R&T program has a solid foundation. Highway research has been most effective when focusing on efforts to reduce costs and improve performance for everything from asphalt pavement to traffic signal systems. Funding for R&T has risen in the past decade in real terms,

and support for breakthrough research has increased. Highway industry leadership strongly supports R&T activities, and public/private partnerships are increasing. Nevertheless to ensure an improving and evolving highway R&T program, changes are needed.

Because several areas of highway research have potential for large payoffs, program funding should be increased. In addition, more partnering among public agencies and cooperative public/private efforts should be undertaken. Further, because revolutionary changes resulting from new technologies, materials, and

TABLE 1 Summary of Expenditures for Highway R&T Program, 1993

CATEGORY	EXPENDITURE [\$ millions (%)]			
	FHWA ^a	NCHRP	STATES ^b	TOTAL ^c
1. Incremental Improvements in Highway Performance and Costs	118 (59)	4.2 (56)	36.2 (54)	157 (57)
2. Breakthrough Research To Improve Highway Performance and Costs	10 (5)	1 (13)	0	11 (4)
3. Reassessment of U.S. Transportation System and the Role of Highway Transportation	0.82 (1)	0.3 (4)	0.07 (<1)	1.2 (<1)
4. Compliance with Government Regulations and Policy Proposals	18.3 (9)	0	0.3 (<1)	19 (7)
5. Improvements in Intermodal Transportation Services that Involve Highways	0.5 (<1)	0.8 (<10)	0.4 (<1)	1.8 (1)
6. Transfer of Promising Research Findings to Field Application	22 (11)	1.1 (15)	3.7 (6)	26.4 (9)
7. Education and Training of Highway Professionals	19 (10)	0.1 (1)	10 (15)	30 (11)
8. Other Research, Technical Support, and Testing	12 (6)	0	16.7 (25)	30 (11)
Total ^d	201	7.5	67.4	276

^aFederal funds for the Local Technical Assistance Program (LTAP) are included in the education and training category.

^bState data are based on a sample of 15 states that comprise more than 50 percent of SP&R spending. State expenditures have been factored upward to 100 percent of SP&R funding. State LTPP and TRB Research Correlation Service contributions have been included in the education and training category.

^cTotal includes actual FHWA and NCHRP expenditures and estimated total state expenditures based on a 50 percent sample.

^dErrors in sums due to rounding.

SOURCE: FHWA, TRB, personal communications with state highway department officials.

methods—which often involve a radical departure from conventional approaches—hold great promise, more exploratory, high-risk research should be undertaken. Initiatives aimed at ensuring that other federal agencies, as well as state and local agencies and the private sector, are active partners in highway R&T efforts, should be expanded to ensure the largest possible leveraging of the overall research investment.

The future highway R&T program should also take a broader view than it has in the past, encompassing the interactions among highways, other transportation modes, and nontransportation societal objectives as well as other factors, such as maturing telecommunications technologies, that are affecting many aspects of transportation. Finally, the barriers to innovation need to be addressed comprehensively by the entire highway industry so that attitudes and practices

that stifle innovation can be overcome. Successful implementation of research products requires involving the end users of innovation in the research process as early as possible, beginning with project planning. In addition, as technologies become more complex, their implementation will also be more complex and require additional education and training.

transportation contributes to various local, national, and international environmental problems. More needs to be known about the costs, effectiveness, and other consequences of design changes, material choices, and system performance of transportation-related policy proposals aimed at reducing harm to the environment.



TRB Executive Director Robert E. Skinner, Jr. (left) and H. Norman Abramson, Chairman of Research and Technology Coordinating Committee (right), present copy of committee's report, *Highway Research: Current Programs and Future Directions*, to FHWA Administrator Rodney Slater.

New Emphasis Areas

The following topics warrant increased emphasis and resources in the future highway R&T program.

- *Reassessment of the U.S. transportation system and the role of highways.* The question of what the highway transportation system should be like in 20 years—or 30 or 40 years—needs to be addressed and a strategic direction explored.

- *Environmental research.* Research is needed to better understand how highway

Research and Technology Coordinating Committee

H. NORMAN ABRAMSON, Southwest Research Institute, San Antonio, Texas (retired), *Chairman*

A. RAY CHAMBERLAIN, American Trucking Associations, Alexandria, Virginia, *Vice Chairman*

LAURENCE J. ADAMS, Martin Marietta Corporation, Bethesda, Maryland (retired)

KATHLEEN BRAATEN, Richland County Commissioner, North Dakota (retired)

DAVID G. BURWELL, Rails-to-Trails Conservancy, Washington, D.C.

RAYMOND F. DECKER, University Science Partners, Ann Arbor, Michigan

JAMES N. DENN, Minnesota Department of Transportation, St. Paul

JOHN W. FISHER, Lehigh University, Bethlehem, Pennsylvania
DELOH HAMPTON, Delon Hampton and Associates, Washington, D.C.

THOMAS F. HUMPHREY, Massachusetts Institute of Technology, Cambridge

LESTER P. LAMM, Highway Users Federation for Safety and Mobility, Washington, D.C.

CHARLES A. MACHEMEHL, JR., Vulcan Materials Company, Birmingham, Alabama

RAY D. PETHEL, Virginia Polytechnic Institute and State University, Blacksburg

STEPHEN EDWIN ROWE, S. E. Rowe and Associates, Hacienda Heights, California

PATRICIA F. WALLER, University of Michigan, Ann Arbor

RICHARD P. WEAVER, California Department of Transportation, Sacramento

FRANKLIN E. WHITE, Los Angeles County Metropolitan Transportation Authority, California

CLYDE E. WOODLE, JR., Trucking Research Institute, Alexandria, Virginia

CHARLEY V. WOOTAN, Texas Transportation Institute, College Station

Liaison Representatives

ROBERT J. BETSOLD, Federal Highway Administration, U.S. Department of Transportation

JOHN A. CLEMENTS, Federal Highway Administration, U.S. Department of Transportation

DENNIS C. JUDYCKI, Federal Highway Administration, U.S. Department of Transportation

FRANCIS B. FRANCOIS, American Association of State Highway and Transportation Officials, Washington, D.C.

- *Contracting for innovation.* More research is required to determine the extent that practices, put into place to reduce risk, protect public investments, and ensure accountability, impede innovation, and what alternatives or incentives are available to encourage innovation.

- *Support for breakthrough research.*

Although some resources are being focused on breakthrough research, more could be done. In addition, if a portion of current defense conversion activities is directed to highway transportation problems, the range of potential breakthrough research topics could be broadened.

- *Overcoming barriers to long-term and*

intermodal research. Many complex transportation topics that should be addressed are not because there is little support for long-term research or funding, or research that cuts across modal boundaries. Gaining support for research in these areas will require changes in research program funding and management.

Categories of R&T Activity

Category 1: Incremental Improvements in Highway Performance and Costs

Such research pursues evolutionary changes in the ways in which highways are planned, designed, constructed, maintained, financed, and managed; it seeks payoffs that are relatively certain and tangible: reduced maintenance and construction costs, added highway capacity, reduced highway fatalities and injuries, reduced adverse environmental impacts, and a variety of user benefits (improved travel time, fewer hazards, and so on).

Category 2: Breakthrough Research To Improve Highway Performance and Costs

This research is aimed at breakthroughs leading to dramatic improvements in highway performance and cost. Examples include new ways to control vehicles on highways through electronics, building bridges using newly engineered materials, and designing asphalt pavements with radically new approaches to modeling performance. This is speculative, high-risk research with potentially high payoffs.

Category 3: Reassessment of U.S. Transportation System and the Role of Highway Transportation

This research takes a long-term view of highway transportation and its interactions with other modes, land use, the environment, and the national economy; it seeks to better understand these interactions and to help shape the long-term direction of both urban and rural highway transportation in the United States as well as in regions and individual states.

Category 4: Compliance with Government Regulations and Policy Proposals

This category includes both research that examines proposals for changes (mostly short and midrange) in regulations,

taxes, and other policies that affect highway transportation and research that helps highway agencies and others comply with new regulations and policies.

Category 5: Improvements in Intermodal Transportation Services that Involve Highways

Research in this category addresses interconnections between highways and other modes and ways in which these interconnections can be modified or developed to improve door-to-door intermodal transportation services. It includes physical design as well as the institutional, economic, administrative, and regulatory issues associated with developing better intermodal connections.

Category 6: Transfer of Promising Research Findings to Field Application

Activities in this category are aimed at transferring promising research results to field application and involve such mechanisms as demonstrations, publications, and special training activities as well as studies, surveys, and monitoring activities that seek to better understand and improve the effectiveness of the innovation process for highways.

Category 7: Education and Training of Highway Professionals

Although the activities in this category are not always considered part of the R&T program, they are essential to building the technology and knowledge bases necessary for innovation.

Category 8: Other Research, Technical Support, and Testing

This final category contains a broad range of investigatory, testing, certification, and support activities that do not fall into the previous seven categories.