

A Half Century of Delivering Research That Works

Lessons from a Proven Organizational Model

JOHN HALIKOWSKI

For 50 years, the National Cooperative Highway Research Program (NCHRP) has provided leadership not only through outcomes and published reports, but in the research process. NCHRP is the backbone of the Cooperative Research Programs, a large and thriving component of the Transportation Research Board (TRB). Following the model of NCHRP, the other programs include TCRP for transit, ACRP for airports, NCFRP for freight, HMCRP for hazardous materials, and NCCRP for rail.

Many research programs at state departments of transportation (DOTs) look to NCHRP for a model that works. In addition, experts in a variety of fields, from industry associations to other divisions of the National Academies—TRB's parent organization—look to NCHRP for ideas and practical insights on research management.

What makes the NCHRP model work so successfully? First, stakeholders are involved throughout the process; second, resources are used efficiently and effectively; third, objectivity is upheld; and fourth, the consultant selection process is competitive.

Stakeholder involvement is key. Those who will implement and benefit from the research participate in the process from beginning to end and develop a sense of ownership of the results. Stakeholders identify, choose, and prioritize research proposals; they help prepare the requests for proposals (RFPs) and provide technical guidance throughout the project, ensuring that the research product will be practical, relevant, and implementable.

Efficient and effective use of resources is an NCHRP hallmark. Because NCHRP addresses problems that affect many states, the states have less need to spend money on independent research

projects. The reduction of duplication allows states to apply research funds to specific local needs and at the same time benefit from a national body of knowledge more extensive than they could assemble on their own. NCHRP projects have led to solutions for roadway congestion, to innovations for safety, and to new materials for better-performing, longer-lasting products, saving time, money, and lives. NCHRP products affect people's lives directly and indirectly.

Objectivity characterizes NCHRP's procedures and successes. NCHRP is part of TRB, a division of the National Research Council of the National Academies, which provide independent, objective advice to the nation on science, engineering, and medicine. NCHRP does not own or manage roads, make laws, or set policy and does not need to make a profit or to tailor its research. NCHRP provides a neutral forum for research, without bias or prejudgment, bringing together diverse stakeholder groups with common interests to achieve common goals.

NCHRP selects contractors and consultants by a competitive process. Project panels of expert stakeholders from around the country develop the RFPs for projects, then select the consultant or contractor to perform the research based on qualifications and on the merit of the proposal. This competitive process ensures that NCHRP projects have the best-qualified teams at work, leading to strong and successful outcomes.

NCHRP's effectiveness stems from projects directly targeted at current problems. People are eager to implement the results. Although the NCHRP model has stood the test of time, it is far from unchanging—program staff and the members of the AASHTO Standing Committee on Research, which selects projects and allocates funds, are constantly searching for ways to improve the products and processes. As its highly successful first 50 years indicate, NCHRP will continue to evolve, becoming an even better model for how to do research.



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Evolution of an Effective and Productive Partnership

NCHRP's "Splendid History"

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In the fall of 1960, Alfred Johnson and E. H. Holmes held a conversation about the need for a program that would enable state highway departments to pool resources to address common research problems. Johnson was the Executive Director of the American Association of State Highway Officials (AASHO), the predecessor to the American Association of State Highway and Transportation Officials (AASHTO). Holmes was the Assistant Commissioner for Research at the Bureau of Public Roads, the agency that later evolved into the Federal Highway Administration (FHWA).

The two men shared the view that highway research in the United States was inadequate and often duplicative. In a paper delivered to the American Society of Civil Engineers, Johnson had pointed out that 32 states were conducting research on the same problem simultaneously. Holmes had chaired a 1959 Highway Research Board study that had found highway research was not keeping pace with the rapid expansion of the road system.

Construction of the Interstate Highway System was under way and was generating new problems and challenges. Responsibility for highways in the United States was more decentralized than that for any other public service. Johnson, Holmes, and other highway leaders knew that no single agency had the mandate or the resources to meet the growing demands.

Landmark Project

When the two men spoke, the single largest cooperative research effort to date was nearing completion. Funded with \$27 million pooled from state governments, the Bureau of Public Roads, the Department of Defense, and others, the landmark AASHO Road Test was the first national study to examine the impacts of moving truck loads on various asphalt and concrete pavement designs. The project was



E. H. Holmes (center) of the Bureau of Public Roads (BPR), received the Roy W. Crum Award from K. B. Woods (left) and BPR Administrator Rex Whitton at a 1958 ceremony. Holmes was a key figure in the formation of the National Cooperative Highway Research Program.

larger than any previous pavement studies and included 836 separate pavement test sections. By the end of the program, each section had been subjected to more than 1 million axle-load applications.

HRB—predecessor to the Transportation Research Board (TRB)—administered the AASHO Road Test; the project is regarded as one of the Board's most significant successes. Fred Burggraf was Executive Director of HRB when the Road Test was initiated in 1955; Burggraf had a strong experience in research and research management—he previously worked as a research fellow at the Calcium Chloride Association. Burggraf assigned William N. Carey, Jr., to supervise the AASHO Road Test and W. B. McKendrick to serve as Project Director. Carey later became HRB's sixth Executive Director, from 1967 to 1979.

K. B. Woods of Purdue University chaired an AASHO Road Test advisory committee on which hundreds of the country's leading pavement experts



served throughout the life of the program.¹ The AASHO Road Test garnered worldwide attention, attracting more than 14,000 visitors from 62 countries to observe the test procedures. The AASHO Road Test was considered the most significant pavement research effort conducted in the 20th century and served as the basis for pavement design in the United States for the next 50 years.

Early Partnership

Although the AASHO Road Test was the largest cooperative research effort managed by HRB, it was not the first. HRB was formed in 1920 to correlate state highway research activities to assure efficiency and effectiveness for the public and private sectors. Thomas MacDonald, head of the Bureau of Public Roads, was one of the major figures in the formation of HRB. MacDonald was a strong proponent of collaborative research and had pioneered several research partnerships between the bureau and state highway agencies in the early 1920s.

The foundation for these cooperative efforts was the Federal-Aid Highway Act of 1916, which stipulated that the federal and state governments would share responsibilities for the road system. MacDonald soon recognized the challenges in forming and maintaining federal-state partnerships and proposed that the National Academy of Sciences serve as a neutral coordinating body.

An Advisory Board on Highway Research to the National Research Council was formed in 1920. The

¹ Today, TRB presents annual awards bearing the name of Fred Burggraf, recognizing outstanding papers by young researchers; of William N. Carey, Jr., for distinguished service to transportation research and to TRB; and of K. B. Woods, for outstanding paper in design and construction.



Fred Burggraf (*right*), with W. N. Carey and A. C. Benkelman, inventor of the Benkelman beam for pavement testing, on site at the AASHO Road Test.



Advisory Board evolved into HRB. The solid partnerships that TRB, AASHTO, and FHWA currently enjoy were established in those early years and remain key to the success of TRB today.

In 1931, the AASHO Board of Directors formed a special committee to evaluate cooperative efforts between AASHO and HRB. This led to a cooperative agreement and several joint projects; the first was "A Study of the Laws, Funds, Organization, and Technical Practices Relating to Roadside Development," in 1932.

Correlating Research

A lack of dedicated funding, however, made substantial research efforts difficult. In the absence of a true national research program, AASHO adopted a resolution that established HRB's Research Correlation Service in 1944, to identify research needs and ongoing projects and to reduce duplication and promote efficiency. Congress responded a year later by passing new highway legislation that expanded the areas in which federal funds could be used for research.

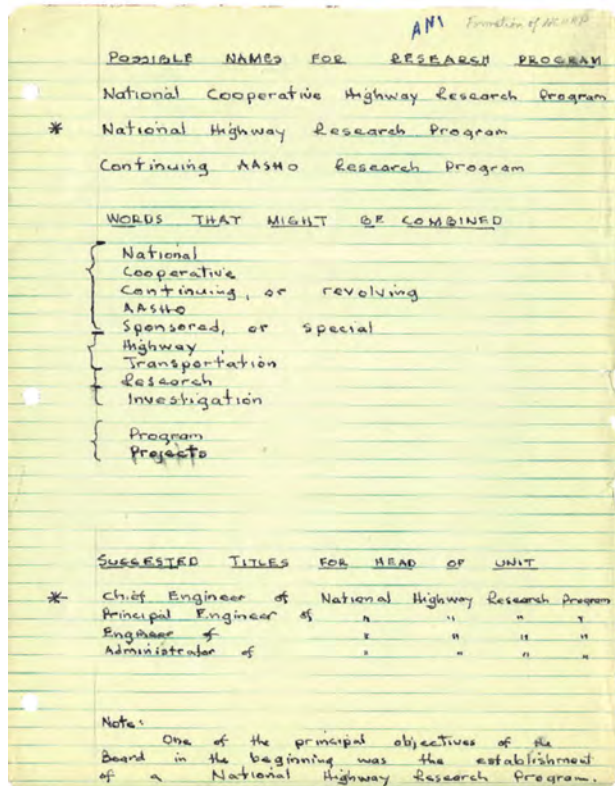
The Bureau of Public Roads authorized the states to apply a portion of their Federal-Aid money to the costs of the HRB Research Correlation Service. Through the Research Correlation Service, HRB established technical committees, engaged in field visits, and issued publications to share knowledge about research needs and results. The Research Correlation Service became an important foundation for HRB's partnership with the states, and the related activities continue today.

The AASHO Road Test, administered in the late 1950s by the Highway Research Board, examined pavement and bridge performance and served as the prototype for cooperative research at the national level.



Thomas MacDonald, head of BPR from 1919 to 1953, was integral in the formation of HRB and a leading advocate for collaborative research.

Handwritten notes show some of the names considered for NCHRP. Continuing AASHO Research Program, or CARP, received some early support.



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agreements with the funding states, provide staff to manage the project, form advisory panels to guide the work, and publish the research findings. The procedures developed in the late 1940s became the model for the National Cooperative Highway Research Program (NCHRP) and for the FHWA Transportation Pooled Fund Program.

Touchstone Report

HRB's role in coordinating and managing research reached a pinnacle with the AASHO Road Test, which lasted from 1955 to 1961. During this period, HRB formed a special committee, chaired by Holmes, to study the state of highway research in the United States. The committee's work produced HRB Special Report 55, *Highway Research in the United States: Needs, Expenditures, and Applications*, a touchstone that changed highway research.

The committee's findings made clear that highway research was falling rapidly behind in the face of growing needs. Research results were implemented slowly and sporadically, if at all. The committee noted that highway transportation was more than a factor in the country's economic vitality—it had become a central component of the American way of life.

The study predicted increases in motor vehicle registrations and in miles traveled, accompanied by a large-scale migration from rural areas to the cities. These changes would put major demands on the highway system and would create problems and challenges that could not be addressed with current levels of research funding.

Program Launched

These issues were on the minds of Johnson and Holmes during their conversation in 1960. That discussion conceived the idea of a national program for cooperative highway research. The two leaders believed that a pooling of resources would focus research on the most pressing problems and would reduce or eliminate duplication of effort. HRB's success in managing the AASHO Road Test made the Board the logical choice for the new program's home.

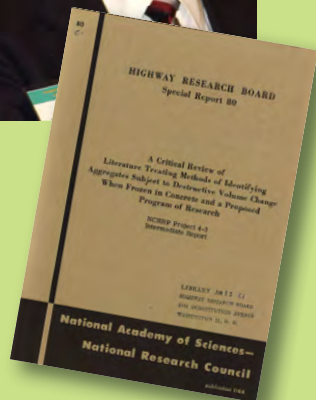
The efforts of Johnson and Holmes resulted in the signing of a three-way agreement between AASHO, the Bureau of Public Roads, and the National Academy of Sciences, on June 19, 1962, launching NCHRP. The three-way partnership continues today.

At the same time, the Federal-Aid Highway Act of 1962 increased the level of funding that state DOTs received for research and planning activities; this provision continues today as the State Planning and Research (SP&R) Federal-Aid Fund. With a mecha-

Members of an NCHRP panel on smoothness specifications for pavements meet to review research progress. Findings from the project were published in 1997 as NCHRP's first Web-Only Document.



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The first NCHRP-related publications—TRB Special Report 80, *A Critical Review of Literature Treating Methods of Identifying Aggregates Subject to Destructive Volume Change When Frozen in Concrete and a Proposed Program of Research: NCHRP Project 4-3 Intermediate Report*, and NCHRP Report 1, *Evaluation of Methods of Replacement of Deteriorated Concrete in Structures*—were produced by Thomas Larson (left) and L. Gary Byrd (right) and associates, respectively. Both were active in transportation research administration: Larson became Federal Highway Administrator and TRB Executive Committee chair, and Byrd served on the Executive Committee and as interim director of the first Strategic Highway Research Program.



nism to leverage funding to address common research problems, the states elected to contribute a portion of the SP&R funds voluntarily to sponsor NCHRP. The first year of the program initiated 34 projects valued at a total of \$3.5 million.

The first Program Director of NCHRP, Earl Campbell, wrote in 1971:

It is not too hard to portray an institution's physical growth by its increasing budget, its expanding staff, and its accelerating activities—and these are worth portraying—but a more difficult portrayal and one that the historian must attempt is that of the growth of service and the diffusion of worthy ideas in useful form. These are the resources that make a history splendid.

Service and Ideas

The growth of service and the diffusion of ideas in useful form could be viewed as the axiom of NCHRP. Most of the standard technical guidance in the highway transportation sector today is based wholly or partly on NCHRP research. National manuals on geometric design, highway capacity, traffic control, and highway safety are updated regularly with results from NCHRP projects; the guidance and procedures are recognized and accepted as best practices.

Almost 50 years after the AASHTO Road Test, for example, an NCHRP project produced the *Mechanistic-Empirical Pavement Design Guide*, published

by AASHTO. The guide was the result of more than \$10 million of research over several years, and—like the AASHTO Road Test in its time—is considered the state of the art in pavement design.

NCHRP's scope has expanded beyond the physical and materials research of the past to include new domains that are driving policy decisions, such as climate change, security, the environment, intelligent transportation systems, and workforce development. State DOTs have implemented innovations from NCHRP projects to save time, money, and lives and to improve stewardship of the public infrastructure. Building on its successful first 50 years, NCHRP will continue to use research partnerships to adapt, to innovate, and to solve the transportation problems of the future.

Sources

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Advancing Transportation and Meeting States' Needs

Highlights from NCHRP's Hefty Portfolio

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The National Cooperative Highway Research Program (NCHRP) is a forum for coordinated and collaborative research, addressing issues integral to the functions of state departments of transportation (DOTs) and of transportation professionals at all levels of government and private practice. Through NCHRP, the transportation community assists in finding objectively derived solutions to pressing problems facing the industry and in developing innovations to improve practice. For 50 years, state DOTs and the transportation industry have benefited from NCHRP results.

TRB has managed or facilitated the business of NCHRP on behalf of its sponsors, the state DOTs, which provide the funds and identify shared and emerging problems, and which participate throughout the process. The successes are attributable to the thousands of expert volunteers and hundreds of contractors who address problems affecting the delivery and operation of the U.S. transportation system.

Although state DOTs drive NCHRP, the Federal Highway Administration (FHWA) plays a significant role by pooling the state funds that support TRB's management of the program. FHWA also provides

liaisons to panels to coordinate with its efforts and to provide added, specialized expertise to the problems at hand.

The results of NCHRP research are adopted or adapted into the standards, specifications, guidance, software, and policy documents of the American Association of State Highway and Transportation Officials (AASHTO). Practitioners use the results directly or tailor applications to specific local needs and conditions. Examples can be found on the NCHRP website as part of the *NCHRP Impacts on Practice Series*; the brochure, *NCHRP at 50 Years*; and a recently completed video featuring comments from state DOT and FHWA leadership. The leaders' comments confirm that NCHRP is a successful, results-oriented program that effectively delivers innovation and continuous improvement.

Collaborative Effort

The foundations of NCHRP were established in 1962 with a three-way agreement between the predecessor organizations of AASHTO, FHWA, and TRB. The basic terms and philosophy of that original agreement have remained unchanged for 50 years. The findings and recommendations from the projects have made a difference, through direct guidance to the state DOTs or through other means, such as AASHTO specifications and guides and the updates based on NCHRP research.

What has changed, however, is the breadth and diversity of NCHRP activity, reflecting the changes in transportation and in the functions and operations of state DOTs. As highway and transportation systems have evolved, so has NCHRP.

A meeting of the NCHRP Project Panel on Asset Management Guidance for Traffic Control Devices, Barriers, and Lighting. Panel members select and monitor the progress of contractors addressing priority research needs that have been identified by state DOTs.



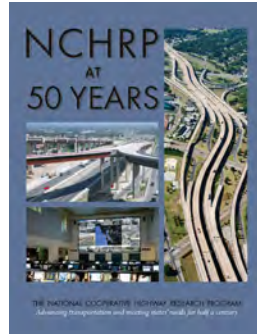
Full Complement of Highway Research

NCHRP research addresses the delivery and operation of highway-related facilities and services from the initial systems and network planning through project development—which involves safety and environmental impacts, design issues, and right-of-way and preconstruction activities—to construction and subsequent maintenance and operations. To keep up with the challenges, research now is dealing more with intermodal planning and connectivity, economic and financial impacts, and freight transport concerns.

NCHRP also engages in fact finding to support state DOT and AASHTO leadership in taking positions with federal decision makers. These efforts have led to many accomplishments over 50 years; a few, select highlights follow.

Advancing Highway Safety

In 1998, AASHTO approved a Strategic Highway Safety Plan. NCHRP Project 17-18(3) helped implement that plan by producing a series of guides for state and local agencies. Published as volumes of NCHRP Report 500, the 23 guides address a range of topics, including user factors such as impaired and aggressive drivers, older drivers, pedestrians; vehicle types—for example, heavy trucks and motorcycles; collision types, such as head-on or run-off-road; and highway configurations—for example, unsignalized intersections and work zones.



The brochure *NCHRP at 50 Years* details program accomplishments and notable research results.

More recent contributions of NCHRP to highway safety are the publication of AASHTO's *Highway Safety Manual* (HSM), which provides information and tools for roadway planning, design, and operational decisions related to safety; the AASHTO *Manual for Assessing Safety Hardware*, an update of NCHRP Report 350; and NCHRP Report 600, *Human Factors Guidelines for Road Systems*, a complement to the HSM.

Better, Safer Bridges

Bridges are high-profile structures; many are iconic. In the late 1980s, NCHRP undertook a recasting of the bridge design specifications in accordance with the newly developed load and resistance factor design format and concept. Improvements and updates to the specifications continue.

NCHRP research has helped advance techniques such as accelerated bridge construction and precast elements; NCHRP Report 698, *Application of Accel-*

How Does NCHRP Work?

- ◆ Problem statements are solicited annually from state departments of transportation (DOTs), committees of the American Association of State Highway and Transportation Officials (AASHTO), and the Federal Highway Administration (FHWA).
 - ◆ Candidate problem statements are reviewed by stakeholders: the state DOTs; FHWA and NCHRP staff; and the Research Advisory Committee, the Standing Committee on Research, and other AASHTO committees, as appropriate to the topic area.
 - ◆ The AASHTO Standing Committee on Research selects projects and recommends approval by the AASHTO Board of Directors; a two-thirds majority vote is required.
 - ◆ After project selection, nominations are sought for members to serve on the project advisory panels. A panel is formed for each project and typically consists of eight members, mostly experts from state DOTs. The panel membership is approved by the chair of TRB's Subcommittee for National Research Council Oversight.
 - ◆ The first panel meeting develops the request for proposals (RFP).
 - ◆ RFPs are posted on the TRB website (www.trb.org); usually six to seven proposals are received for each project from private consultants and academia.
 - ◆ The second panel meeting selects the contractor.
 - ◆ Projects typically run 18 to 30 months, usually with at least one interim panel meeting.
 - ◆ Products of research projects include NCHRP Reports, Synthesis of Practice, Research Results Digests, Legal Research Digests, Web-Only Documents, and quick-response reports to AASHTO committees. AASHTO also may adapt or adopt NCHRP products for publication as AASHTO specifications, guidance, or policies.
- For more information, see www.trb.org/NCHRP/Public/NCHRP.aspx.

NCHRP research adapts to current needs in highway planning and operations; intermodal planning and connectivity, economic issues, and freight transportation have emerged as focus areas.



PHOTO: PORT OF SEATTLE/DON WILSON

erated Bridge Construction Connections in Moderate-to-High Seismic Regions, and NCHRP Report 584, *Full-Depth Precast Concrete Bridge Deck Panel Systems*, are examples.

At the same time, NCHRP research has provided guidance to state highway agencies on detecting such damaging effects as fatigue, scour, and seismic activity, and making repairs or retrofits. Example publications include NCHRP Report 206, *Detection and Repair of Fatigue Damage in Welded Highway Bridges*; NCHRP Report 587, *Countermeasures to Protect Bridge Abutments from Scour*; and NCHRP Report 472, *Comprehensive Specification for the Seismic Design of Bridges*.

Long-Lasting Pavements

NCHRP projects have advanced the design of pavements, including improvements to paving materials and construction techniques and testing. The results have helped highway agencies improve pavement performance and durability while reducing costs, accelerating construction, and efficiently using resources.



PHOTO: WIKIMEDIA COMMONS

Precast concrete piers were used in the Edison Bridge, Fort Myers, Florida. NCHRP research has helped advance the application of techniques such as precast bridge elements.

In the 2000s, state DOTs adopted mechanistic-empirical pavement design, a wholly different approach that uses numerical models to analyze traffic, climate, subgrade composition, and material properties to predict the performance of various pavement designs over their entire service life. NCHRP contributed to the development of this methodology through Project I-37A, which led to the publication of AASHTO's *Mechanistic-Empirical Pavement Design Guide* and the DARWin-ME software. Offering precise, scientific design techniques, these tools allow DOTs to build longer-lasting pavements more cost-effectively.

Design, Operations, and Maintenance Tools

AASHTO has published guidance on geometric highway design since the early 1950s, with updates and new volumes on rural highways, urban highways, and arterial streets in the 1960s and 1970s. These efforts culminated with the "Green Book," *A Policy on Geometric Design of Highways and Streets*, in 1984, with updates in 1990, 1994, 2001, 2004, and 2011.

NCHRP has supported each of these editions with critical research, contributing to the development of the geometric design process. NCHRP has addressed many developments affecting geometric design, including such external factors as changes in highway speeds and vehicle types, as well as improved methods for the design, construction, and management of roads, bridges, and other assets.

When NCHRP marked its 25th anniversary in 1987, the *Highway Capacity Manual* was considered the primary national reference for planning, design,

and operational analysis of highway capacity and was one of TRB's top-selling publications. Ongoing NCHRP research has kept the manual—recently released as *HCM 2010*, a fully revised and expanded fifth edition—relevant and responsive to changes in traveler demographics, technologies, and management approaches.

Tools and strategies for preserving the nation's highways make sense in every economic climate. NCHRP research on maintenance helps transportation agencies protect their investments. Beyond publications that address best maintenance approaches for a variety of transportation infrastructure items—from pavements to highway medians to suspension bridges—NCHRP has played a role in advancing the national trend toward quality assurance for all highway maintenance activities. NCHRP Report 422, *Maintenance QA Program Implementation Manual*, published in 1999, laid the groundwork for developing and implementing maintenance quality assurance programs, including guidelines for a level-of-service rating system and for field inspections, analysis, and reporting.

Planning and Environmental Stewardship

In the 1960s and 1970s, federal planning requirements, together with advances in computing technology, focused efforts on travel demand planning



A mounted magnetic extensometer measures strains for the dynamic modulus test on a pavement specimen. The development of a simple performance tester for routine hot-mix asphalt design is one of many NCHRP projects that have advanced the practice of pavement design.



and modeling. Early planning tools were expensive and data intensive; state DOTs needed ways to make the process simpler and more useful.

NCHRP Report 187, *Quick-Response Urban Travel Estimation Techniques and Transferable Parameters (User's Guide)*, published in 1978, became widely used by planning offices. The guide provided a basis for selecting highway improvements with simplified inputs to provide low-cost, highly effective solutions. The methods in the publication were updated and expanded in NCHRP Report 365, *Travel Estimation Techniques for Urban Planning*, published in 1998, and more recently in NCHRP Report 716, *Travel Demand Forecasting: Parameters and Techniques*.

NCHRP research has assisted highway agencies to respond to emerging environmental issues without compromising the transportation system. The research has addressed an array of issues related to natural, cultural, air quality, and social aspects of the environment by developing compendia, such as the *Compendium on Environmental Field Work Technologies* (NCHRP Project 25-25, Task 48) and *Compendium of Best Practices for Incorporating Environmental Commitments into Transportation Project Construction Contract Documents* (NCHRP Project 25-25, Task 47).

Incorporating the results of NCHRP research, AASHTO published the *Transportation Asset Management Guide* in 2002—the definitive handbook for managing transportation assets large and small. The guide goes beyond bridges and highways to present techniques that are equally applicable to drainage facilities, overhead lighting, sign structures, retaining walls, intelligent transportation systems, and traffic control systems.

Practical selection criteria for bridge-pier scour countermeasures—tested at the Colorado State University Hydraulics Laboratory—are presented in NCHRP Report 593, *Countermeasures to Protect Bridge Piers from Scour*.



PHOTO: RISSON PHOTOGRAPHY

A session at the 2011 TRB Annual Meeting provided an overview of the new approaches in the *Highway Capacity Manual 2010*, the fifth edition of the volume first published in 1950 and updated over the years with research from NCHRP and other programs.

More recently, AASHTO published a second volume on asset management, working with NCHRP research that stresses implementation. Both volumes have advanced transportation asset management in the use of systematic and data-driven approaches to making investment decisions about physical assets.

Infrastructure Security

The terrorist attacks of September 11, 2001, ushered in a new era of security planning in transportation. The situation was urgent—state DOTs needed a coordinated effort to protect their infrastructure and the people who use it. NCHRP responded and continues to respond with guidance on integrating security into current practice for handling all hazards, natural or manmade.

A series of volumes on transportation security was initiated and collected under NCHRP Report 525, with the first released in 2004. Each of these concise reports—16 volumes and growing—focuses

on a specific security or emergency management issue. The series broke new ground for transportation agencies, providing guidance on integrating security into current practice for all hazards. Covering the breadth of surface transportation security issues, the series enables transportation professionals in all roles—even if not directly involved with security or emergency management—to expand their knowledge of emergency preparedness.

Productive Subprograms

Although the main focus of NCHRP activity is to carry out individual research problem assignments selected by AASHTO, each with a specific scope, objective, and budget, several special projects or subprograms address issues on a more ongoing and immediate basis. AASHTO allocates annual budgets for these activities, each managed by an NCHRP panel.

The synthesis program, under Project 20-05, produces reports on the state of the practice and knowledge. The products offer an easy path to expertise on a subject.

Other projects support the activity of various AASHTO committees. One provides research support to the Standing Committee on Highways and its subcommittees in developing and maintaining guides, standards, and specifications, under Project 20-07. Other projects support the member needs of the Standing Committees on Planning, through Project 08-36; on the Environment, through Project 25-25; and on Public Transportation, through Project 20-65.

The NCHRP Innovations Deserving Exploratory Analysis or IDEA program jump-starts innovations by providing seed money for feasibility studies and



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Urban traffic planning in the 1970s was aided by NCHRP Report 187, *Quick-Response Urban Travel Estimation Techniques and Transferable Parameters (User's Guide)*. The guide, published in 1978, was widely used by planning offices and was updated in 1998 and 2012.



The NCHRP domestic scan team studied Minnesota DOT's right-of-way and utilities relocation procedures for Phase 2 reconstruction on I-494 west of Minneapolis.

the development of prototypes, under Project 20-30.

A legal studies program synthesizes case law on subjects affecting DOTs and their employees, through Project 20-06. During the beginning of the Interstate program, legal studies were a major project, dealing with rights-of-way issues—such as eminent domain and relocation assistance—as well as construction contracts and later, environmental and tort issues. These are collected in an ongoing treatise, *Selected Studies in Transportation Law*.

Project 20-24 assists the leadership of AASHTO and the state DOTs by providing information to frame recommendations on policy and positions to federal decision makers. In partnership with FHWA, NCHRP has supported international scans, under Project 20-36, and domestic scans, under Project 20-68.

Through Project 20-83, NCHRP recently moved into longer-range projects envisioning and preparing for conditions 30 to 50 years out, exploring such topics as the impacts of climate change, alternative fuels, demographic shifts, and adaptation to technological advances. These long-range scenario planning exercises are designed to provide guidance and help DOTs prepare for the unexpected and for the challenges of the future—to become more proactive instead of reactive.

Implementable Research

NCHRP has delivered implementable research and remained relevant by adapting its research to the complex and changing issues that state DOTs face. As the transportation landscape has shifted in the past five decades with new societal, political, and financial demands, states have sought new solutions through research. NCHRP has responded and has

grown to address the range of issues involved in sustaining and improving the nation's highway system.

Although the demands on the U.S. transportation system continue to grow and evolve, the NCHRP partnership will be ready to assist the states in delivering a safe, efficient transportation system by implementing the results of collaborative research. The past 50 years emphatically confirm what early visionaries had in mind: NCHRP works!

Keys to NCHRP's Success

- ◆ State DOT funds are leveraged to work on problems common to many states.
- ◆ Practitioners identify the research needs and are involved throughout the process.
- ◆ State DOT representatives make the decisions about NCHRP programming.
- ◆ Panels composed of technical specialists and expert practitioners guide the research.
- ◆ Panels competitively select highly skilled contractors.
- ◆ The process ensures objectivity.
- ◆ NCHRP's scope covers the many functions of state DOTs.
- ◆ AASHTO adapts or adopts the research results for standards, software, and guides.
- ◆ NCHRP staff and panel members interact with AASHTO committees.
- ◆ FHWA provides assistance through its headquarters, resource center, and technical groups.
- ◆ TRB provides its publication distribution system, as well as expert assistance from standing committees.
- ◆ Staff and panel members have flexibility to address and facilitate applications.

Transit Cooperative Research Program Celebrates Two Decades of Service to Public Transportation

Two years after the formation of the National Cooperative Highway Research Program (NCHRP), the Urban Mass Transit Act of 1964 authorized the U.S. Secretary of Transportation to undertake research in all facets of public transit. Studies on planning and system operations were the initial emphasis, but influenced by the burgeoning U.S. space program, the Urban Mass Transportation Administration (UMTA) began to focus in the 1970s on technology-based research.

Accumulating Research Needs

UMTA initiated large-scale, high-budget projects—for example, to develop personal rapid transit systems; air-cushioned, levitated trains; and the Transbus, an advanced, safe, and comfortable bus designed to attract the traveling public away from the private automobile. By the late 1970s, transit operators were criticizing these high-tech projects, lobbying for needed improvements to transit systems instead. To create a more balanced, stakeholder-driven research program, UMTA representatives met frequently with transit operators at seminars and workshops.

In the mid-1980s, the Reagan administration reduced the federal role in public transit. Federal funding for transit research declined to approximately one-third of the level in the 1970s; moreover, the research focused on policy issues, which could be funded at relatively low cost. The day-to-day problems of transit operators received little attention, and research needs accumulated.

UMTA asked the Transportation Research Board (TRB) to review the state of federal transit research and to explore mechanisms to address the growing research needs. The study committee appointed by the National Research Council comprised a cross section of industry stakeholders, including representatives of transit agencies, state departments of transportation, contractors, equipment suppliers, and academic researchers. William W. Millar, then Executive Director of the Port Authority of Allegheny County, chaired the commit-



Among the many issues addressed in the second edition of TCRP Report 100, *Transit Capacity and Quality of Service Manual (TCQSM)*, are methodologies for analyzing bus operations on grade-separated busways. First published in 1999, TCQSM is one of TCRP's best-selling reports.



William W. Millar (right), past president of the American Public Transportation Association, chaired the 1980s National Research Council–TRB study that led to the formation of TCRP.



Mosaic Apartments at the Akard Street Dallas Area Rapid Transit station. TCRP projects have explored transit-oriented development and livable communities.

tee. Millar also was a member of the TRB Executive Committee and of the Board of Directors of the American Public Transit Association, now the American Public Transportation Association (APTA).

The study committee presented its findings and recommendations in TRB Special Report 213, *Research for Public Transit: New Directions*, released in 1987. Recommendations included the establishment of a research program focused on the needs of public transportation operators, addressing high-priority topics of common interest. A report by APTA, *Transportation 2000*, also identified the need for local, problem-solving research.

Launching TCRP

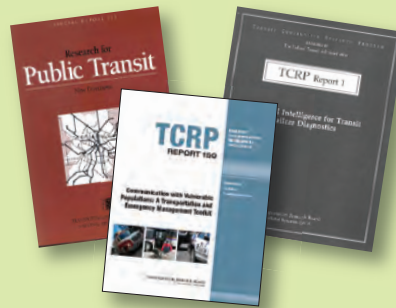
The recommendations resulted in the formation of the Transit Cooperative Research Program (TCRP) on May 13, 1992. Three organizations signed a memorandum of agreement outlining the program's operating procedures: the Federal Transit Administration; the National Academy of Sciences, acting through TRB; and the Transit Development Corporation, Inc., a nonprofit educational and research organization established by APTA.

The program was modeled after the longstanding and successful NCHRP. The TCRP Oversight and Project Selection (TOPS) Committee, an independent governing board, was established to guide the program, which is administered by TRB with funding from FTA; APTA provides a vital link to facilitate implementation of the program results. Millar was appointed the first Chair of TOPS; he later became President of APTA.

TCRP published its first report, *Artificial Intelligence for Transit Railcar Diagnostics*, in December 1994. Since then, the program has published more than 146 titles in the Report series, as well as more than 200 titles in the Transit Synthesis of Practice and other series. At the program's 10th anniversary, a survey of transit operators showed that TCRP project results were widely used in the industry and were providing considerable value. The program's array of key products

includes works on capacity and level of service, scheduling, maintenance of transit vehicles, livable communities, security, fare systems, rural transit, bus rapid transit, driver fatigue, and a variety of other topics.

Beginning its third decade of operation, TCRP maintains the commitment to develop near-term, practical solutions to problems facing transit agencies by providing high-quality research results for the 21st century.



Published in 1987, TRB Special Report 213 (left) outlined recommendations for a research program focused on public transportation. In its 20 years, TCRP has published more than 470 titles in several series, addressing transit issues from artificial intelligence (Report 1, right) to communicating with underserved populations (Report 150).

National Cooperative Rail Research Program on Track

The National Cooperative Rail Research Program (NCRRP) has selected its first nine projects for research, including two quick-response studies. Authorized by the Passenger Rail Investment and Improvement Act of 2008, NCRRP has received one year of funding at \$5.0 million.

The objective of the Transportation Research Board's (TRB's) newest cooperative research program is to provide applied research in intercity passenger, commuter, and freight rail operations. Topics to be addressed include issues in the forefront of the growing national, state, and regional emphasis on enhancing freight and intercity rail passenger services.

NCRRP projects will help solve common operating problems, adapt appropriate new technologies from other industries, and introduce innovations into the rail industry. Of primary interest are issues and complexities shared by freight, intercity, and commuter rail operating agencies but not adequately addressed in federal research programs.

In September 2010, the Federal Railroad Administration (FRA) signed a contract with the National Academies, acting through TRB, to manage NCRRP. Secretary of Transportation Ray LaHood has appointed an independent governing board, the Rail Oversight Committee (ROC), including representatives from freight, intercity, and commuter rail operating agencies, other stakeholders, and relevant industry organizations such as the Association of American Railroads, the American Association of State Highway and Transportation Officials, the American Public Transportation Association, and the National Association of Railroad Passengers.



Tim Hoeffner (second from right), Michigan DOT, participates in the first meeting of NCRRP's Rail Oversight Committee in May 2012, which identified high-priority research projects for 2013.



PHOTO: RICHARD MASSENER

Passengers wait to board Caltrain commuter trains in San Jose, California. Tools and procedures for planning and developing intercity passenger rail service are being developed under NCRRP.

The ROC has identified the following highest-priority projects and has defined funding levels and expected products:

- ◆ A comparison of passenger train energy consumption with that of competing modes;
- ◆ Production of a handbook of tools and procedures for planning and developing intercity passenger rail service;
- ◆ The prospects for passenger rail in the context of a competitive economic market;
- ◆ Building and retaining workforce capacity for the rail industry;
- ◆ Developing innovative financing approaches for passenger and freight rail projects;
- ◆ The delivery and operation of passenger rail projects by multistate organizations; and
- ◆ Legal aspects of rail programs.

The quick-response problems are the following:

- ◆ Preparation of a strategic plan and research agenda and
- ◆ Inventorying federal and state passenger and freight rail programs.

Panels are conducting initial meetings, and the first research contracts are expected in early 2013.

Advancing the State of Highway Practice

Testimonials from NCHRP Participants



During a 35-year career in transportation, I have been involved with the National Cooperative Highway Research Program (NCHRP) in a variety of roles. When I headed up a state DOT operating agency, my colleagues and I were users of NCHRP products in many disciplines across the agency. Earlier in my career, as the principal investigator for an NCHRP project, I appreciated the high standards for conducting research and reporting results. As chair of two NCHRP project panels and a participant on several others, I appreciated the integrity of the competitive procurement process in selecting researchers, as well as the importance of the peer review process in ensuring quality products. As a member of the American Association of State Highway and Transportation Officials' (AASHTO's) Standing Committee on Research, I appreciated that research projects were selected based on the highest-priority needs identified by state DOTs and AASHTO committees and subcommittees. As a member and 2011 Chair of the TRB Executive Committee, I appreciated that NCHRP is one of the Board's most important programs and yields some of the most widely used products of the National Academies.

—Neil J. Pedersen

*Former Highway Administrator;
Maryland State Highway Administration*



More than 40 years ago, as a graduate student, the first research project in which I participated was for NCHRP, on integrating social and environmental impacts into highway project development and system planning. The National Environmental Policy Act had gone into effect, and NCHRP quickly recognized and addressed a research and policy challenge for state transportation agencies. NCHRP continues to maintain its relevance and impact by focusing on the most challenging and important transportation issues. The program has had a profound impact on our understanding of key issues and has advanced the state of the practice in countless areas. I congratulate the sponsors for their vision and commitment to improving transportation and commend the staff for their tireless efforts to make the program an ongoing success.

—Lance A. Neumann

Former President, Cambridge Systematics, Inc.



The foundation and strength of any nation correlates with its foresight and desire to discover and provide fundamentally sound solutions to its problems. In the past half a century, NCHRP has made possible the efficiency, management, and solutions to complex problems in the developing U.S. highway network. One cannot offer enough praise and accolades to the most prestigious transportation research program in the world. The United States owes a special debt of gratitude to the men and women who have worked to transform an idea into a successful program.

—M. W. Witczak

*Emeritus Professor of Civil Engineering,
University of Maryland and Arizona State University*



Transportation researchers focus on making a difference within their agencies, states, and the industry by improving information and technologies. NCHRP produces excellent and focused research. In any initiative, our DOT's first step is to review and investigate what NCHRP has produced—NCHRP reports are the best resources available. When NCHRP speaks, state DOTs listen. The money the states invest in NCHRP has a tremendous payback in helping to move forward in the technical areas of concern to all.

—Sandra Q. Larson

*Research and Technology Bureau Director, Iowa Department of
Transportation; Chair, AASHTO Research Advisory Committee*



In 44 years of practice in the field of transportation engineering, I have been a participant in, as well as a beneficiary of, NCHRP. The research results from a range of topics have been essential and beneficial to me as a practitioner with Kansas DOT and have provided necessary findings for establishing national criteria through the AASHTO "Green Book," the *Roadside Design Guide*, and other manuals of practice.

—James O. (Jim) Brewer

*Engineering Manager, State Road Office,
Kansas Department of Transportation*



NCHRP products have maintained a high reputation for quality and applicability among local, state, federal, and international practitioners, managers, and directors throughout the program's 50-year history. As a result, the products are an obvious first resource for many who seek to standardize analysis methods, procedures, and assessment criteria. In this way, NCHRP has a tremendous influence on our profession and on the quality of life in our communities and world. The NCHRP process of identifying a problem, evaluating it, and then funding attention or action has had the ancillary benefit of

promoting collaboration, awareness, and consistency in transportation practices among states—a benefit in and of itself. NCHRP projects offer opportunities for academic institutions and private entities to come together to apply their strengths in a common cause. These opportunities are not available in most other venues. The project-specific marriages put together by NCHRP have resulted in better practices in the field, better education in the classrooms, and a much quicker and more effective path for ideas and concepts to move from theory to practice.

—Wayne K. Kittelson
President, Kittelson and Associates

The Value of Research to Transportation Executives

CHRISTOPHER HEDGES

“Why is research important? Because research spawns ideas, and ideas foster innovation. Without innovation, we cannot be good stewards of our highways and spend taxpayers' money responsibly,” John Halikowski told a meeting of the Research Advisory Committee of the American Association of State Highway and Transportation Officials (AASHTO). The session featured heads of state departments of transportation (DOTs) discussing the value of transportation research.



Halikowski

Director of Arizona DOT and chair of the AASHTO Standing Committee on Research, Halikowski continued: “The key values of Arizona's transportation department are accountability, integrity, and respect. Good research helps us fulfill all three.”

He went on to describe a recent example of how research can help a transportation department save money and operate more efficiently. The Deck Park tunnel on Interstate Highway 10 in downtown Phoenix is a little more than one-half mile long, and electricity fees to light the tunnel are one of the agency's highest expenses. Halikowski asked the research office to look

into the feasibility of solar power to light the tunnel. As a result, a private firm is poised to demonstrate a solar lighting technology that will save Arizona DOT hundreds of thousands of dollars.

Halikowski emphasized that research must pervade an organization and its daily operations. Important decisions at a highway agency need to draw on the best available information. Research must inform the decision-making and problem-solving processes.

Achieving Goals

John Njord, Executive Director of Utah DOT, past Chair of the TRB Executive Committee and past President of AASHTO, agrees: “Most DOTs today are facing significant funding constraints. We have to focus on making the most of what we have, and research plays an important role in finding effective and efficient solutions.”



Njord

Utah DOT has been a leader in developing innovative technologies and solutions to improve the way the department operates. The use of accelerated bridge construction (ABC) techniques has resulted in enormous savings to the traveling public by minimizing traffic disruption.

“At 354 feet, the Sam White Lane Bridge was the largest ever moved in the Western hemisphere using ABC techniques,” Njord reported. “We have now moved almost 40 bridges into place using ABC. Why? Because research showed us that the technique was feasible and would result in much shorter delays for the traveling public. We value people's time, and our goal is to minimize the impacts on the public.”

Utah's population growth rate far outpaces that of most of

(continued on next page)



PHOTO: AARON STARK

Arizona DOT applied research findings to realize a significant cost savings in lighting the Deck Park tunnel in downtown Phoenix with solar power.

The author is Senior Program Officer, Cooperative Research Programs, Transportation Research Board of the National Academies, Washington, D.C.



NCHRP has made it possible for state DOTs and the industry as a whole to share and solve chronic and emerging technical challenges. Without NCHRP, we would be struggling individually and perhaps never would find the most effective solutions. Writing proposals, participating on panels, and receiving the research results have enhanced my career and my state's ability to solve problems with ideas from practitioners.

—Michael T. Long
Project Delivery Manager, Oregon DOT;
Chair, TRB Low-Volume Roads Committee



California DOT was able to leverage State Planning and Research dollars for approximately \$30 million in NCHRP projects that would benefit the state. NCHRP offers practical and timely solutions to operational problems facing highway and transportation practitioners and administrators. NCHRP afforded me an opportunity to participate on panels with smart and committed transportation officials who shared the same passion for the topics.

—Randell H. Iwasaki
Executive Director, Contra Costa Transportation Authority;
former Director, California Department of Transportation

The Value of Research to Transportation Executives

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the country, and vehicle-miles traveled also are increasing, but the road network is expanding only marginally. Njord described the four key goals he has set for Utah DOT: "Take care of what we have, make the system work better, improve safety, and increase capacity."

Research has helped to achieve these goals. For example, traffic flow on express toll lanes in Utah averages 10 to 15 percent faster than on regular lanes, making travel times more predictable. State-of-the-art traffic signal timing has reduced delays at key high-volume intersections by as much as 75 percent. The more than 77 miles of innovative cable barriers installed in 2010 have prevented heavy trucks from crossing the median and have reduced crashes and fatalities. These and other innovative techniques are saving lives, time, and money in Utah.

Njord understands the value that research can provide and is committed to taking advantage of the best information from around the world. Utah sends more staff to the TRB annual meeting than to any other conference. The staffers have a mission: bring back and implement new ideas that will benefit Utah.

"Research has made our DOT a better organization," Njord observes.

Specifying Benefits

Susan Martinovich, former director of the Nevada DOT and past president of AASHTO, learned the value of research early in her career at the DOT, before rising to the most senior position. Martinovich understands, however, that research has no value until implemented; for that to happen, senior executives need to understand clearly the resulting benefits to the DOT.

"You may think we all suffer from attention deficit disorder, but CEOs have incredible demands on their time and must deal with a vast range of issues and problems every day. We are generally not experts in any narrow field; we are interested in products and benefits, not the technical details." She added: "Explain research to senior executives the way you would explain it to your mother. Give them brief summaries; don't give them long reports or links to websites."

Halikowski agrees. "Be specific about the benefits of research to the organization and to the stakeholders. Quantify whenever possible. Show how research will benefit the internal operations of the department, bring credit to the agency, and improve the quality of life for the agency and for taxpayers. Tell me what you *can* do, don't ask me what you *should* do. If there are barriers, think about possible strategies to overcome them. Don't present roadblocks without some ideas for solutions. Help the CEO, and the CEO will help you engage the other leadership."

All three CEOs understand the value of research and are committed to finding new solutions to address their day-to-day challenges. Njord summed up the session: "Good information makes for good decisions."

The AASHTO Research Advisory Committee promotes quality and excellence in research and in the application of research findings to improve state transportation systems. Each AASHTO member department is represented on RAC. For more information, see research.transportation.org.



Martinovich

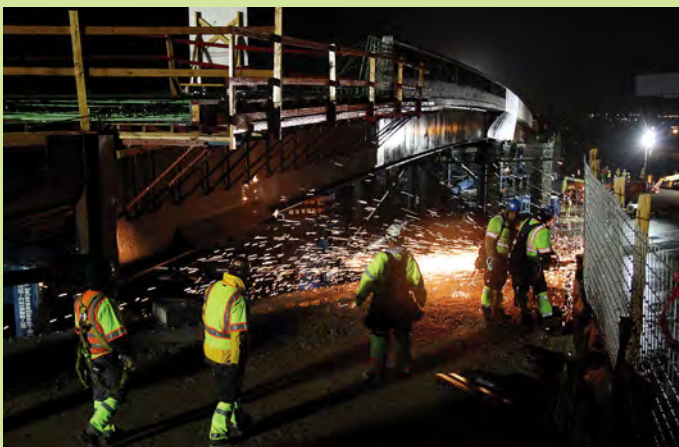


Photo: Utah DOT

In early 2012, Utah DOT and contractor Provo River Constructors moved the Sam White Bridge using accelerated bridge construction techniques perfected through NCHRP research. The two-span bridge was the longest ever to be moved in the Western hemisphere.



NCHRP's half century of expanding horizons through practitioner-focused research built on a collaborative model of professionalism and objectivity has advanced transportation practices from planning to operations. My first exposure to NCHRP began decades ago as a state DOT participant on project panels, and more recently I have served as a principal investigator and researcher on projects. NCHRP has a value-added impact on panel members, on researchers, and most importantly, on advancing the leading edge of industry practices.

—Hal Kassoff

Senior Vice President, Parsons Brinckerhoff



NCHRP has had an impact on the bridge community. NCHRP research developed the AASHTO LRFD Bridge Design Specifications, which have been refined and strengthened in subsequent projects. Another major impact of NCHRP, sometimes overlooked, is the opportunity for state DOT staff to participate on project panels. This helps develop the leaders of tomorrow, exposing engineers to new colleagues, new ideas, new processes, and innovations, providing an opportunity for professional growth beyond their jobs. This hidden benefit affects not only the engineer but the state DOT.

—Malcolm T. Kerley

Chief Engineer, Virginia DOT



The NCHRP process of selecting research topics based on state DOT needs has provided important practical benefits to bridge owners. For example, recent research products for accelerated bridge construction will provide significant benefits to states and to the traveling public. In addition, NCHRP panel membership provides practitioners an opportunity to broaden understanding of a specific topic and to develop a network of colleagues to continue discussions to advance bridge technology.

—Mary Lou Ralls

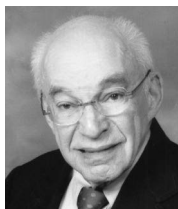
*Principal, Ralls Newman, LLC;
former State Bridge Engineer, Texas DOT*



Having been involved with NCHRP since its inception in the early 1960s, I can attest to the importance of the program's research in the pavement and materials areas. NCHRP has been a leader in the development of mechanistic-empirical pavement design and rehabilitation of pavement.

—Carl L. Monismith

*R. Horonjeff Emeritus Professor of Civil Engineering,
University of California, Berkeley*



NCHRP enabled me to grow professionally and to contribute to the highway transportation profession. The program has made many contributions, has set the standard for transportation research, and has enabled many researchers to grow and to contribute. May the next 50 years be as promising and productive as the first 50!

—Herbert S. Levinson

Transportation Consultant

NCHRP has been an effective force for continuous improvement across the range of transportation endeavors, providing the challenges, opportunities, and resources that have motivated professionals to make a positive difference beyond the confines of their day jobs. NCHRP has fostered the productive collaboration that many participants would cite as the single most rewarding aspect of their careers in public service.

—Gary R. McVoy

*Vice President, Transportation Sustainability and Climate Change,
Parsons Brinckerhoff*



The key word in NCHRP is "cooperative." Through the collective financial commitment of the states, this program has advanced the science, knowledge, resources, and partnerships necessary to build a safer, more efficient transportation system in the United States and throughout the world.

—Leanna Depue

Former Director, Missouri DOT Highway Safety Division



During 40-plus years in transportation, I have been acutely aware of the service that NCHRP consistently has provided by researching solutions to critical transportation problems and by facilitating the networking of experts. The research solutions have been practical and have improved transportation services and facilities throughout the country.

—Wesley S. C. Lum

*Former Chief, Safety Innovation and Cooperative Research,
California DOT; Past Chair, AASHTO Research Advisory Committee*



NCHRP research fills a gap not addressed by environmental research programs outside the transportation sector. Local, state, and federal transportation organizations rely on the research results to develop widely accepted tools, techniques, and technologies. The research is guided by multidisciplinary panels of practitioners familiar with the environmental impacts of transportation from inside and outside the transportation sector.

—Wayne W. Kober

Transportation Consultant