MAY–JUNE 2003
NUMBER 226

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

TR NEWS

Tapping New Energy Sources

Plus

- Accelerating Technology Transfer
- Making the Critical Issues Lists
- Archiving the Profession's History
- Revitalizing Naval Engineering

82nd Annual Meeting Highlights

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

The Transportation Research Board is a division of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering. The Board's mission is to promote innovation and progress in transportation through research. In an objective and interdisciplinary setting, the Board facilitates the sharing of information on transportation practice and policy by researchers and practitioners; stimulates research and offers research management services that promote technical excellence; provides expert advice on transportation policy and programs; and disseminates research results broadly and encourages their implementation. The Board's varied activities annually draw on approximately 4,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation.

The National Research Council was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities.

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Cover: Haul truck empties a load of oil sands mined from the surface of the Athabasca Oil Sands Deposit in Aurora, Alberta, Canada (*photo courtesy of Syncrude Canada Ltd.*).

TR NEWS

features articles on innovative and timely research and development activities in all modes of transportation. Brief news items of interest to the transportation community are also included, along with profiles of transportation professionals, meeting announcements, summaries of new publications, and news of Transportation Research Board activities.

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ALSO IN THIS ISSUE

CORRECTION: The caption to the photographs illustrating the "mix of fixes" approach to pavement preservation (January–February 2003, p. 32) mixed up the identifications. Here is the fix: Photo *a*, resealing joints; Photo *b*, dowel-bar retrofit; and Photo *c*, diamond grinding. Thanks to Gerardo Clemena of the Virginia Department of Transportation for pointing out the mix-up.

COMING NEXT ISSUE

Transportation and air quality is the focus of the feature articles slated for the July–August *TR News*, covering the potential impacts of climate change, of new air quality standards, of multimodal activity, of air toxics, and more.

The Clean Air Act Amendments of 1990 have had a salutary effect on many cities, but research is needed to identify cost-effective strategies for reducing transportation-related emissions.

Turning the Spotlights on Transportation Research

TRB's 2003 Annual Meeting

MORE THAN 9,000 transportation researchers, practitioners, and administrators representing government, industry, and academia gathered from the United States and abroad, January 12–16, 2003, in Washington, D.C., to participate in the 82nd Annual Meeting of the Transportation Research Board. The program assembled more than 500 sessions plus 40 workshops and 350 TRB committee meetings; the weekend before the formal start of the meeting also offered several well-attended programs and events. Four spotlight themes—security, congestion, safety, and reauthorization—tied many of the diverse program sessions together. More details and highlights appear on the following pages.

SESSIONS & MEETINGS

The TRB Technical Activities Division Council, the leadership of the standing committees responsible for the full scope of the Annual Meeting program, met midday on Sunday to start the countdown (*left to right*): Division Director Mark R. Norman; Neil Pedersen, Maryland State Highway Administration; Council Chair Anne P. Canby, Cambridge Systematics; Jonathan Upchurch, American Society of Civil Engineers Congressional Fellow; Brelend Gowan, California Department of Transportation; Gale Page, Florida DOT; and Katherine Turnbull, Texas Transportation Institute.

Mark R. Norman, Director of TRB's Technical Activities Division, talks new attendees through the intricacies and benefits of the meeting program and offers tips on how to make the most of abundant opportunities to learn from colleagues.

Leonard Evans, NAE, longtime researcher for General Motors Corporation, founder and president of Science Serving Society, and author of *Traffic Safety and the Driver*, was the luncheon speaker at the 36th Annual Human Factors in Transportation Workshop, nine simultaneous all-day sessions on Sunday, January 12, covering roadway visibility, seat belt use, intersections, personal mobility, pedestrian access, and more.

Planning Committee for the 36th Annual Human Factors in Transportation Workshop (*left to right*): Thomas Raslear, Federal Railroad Administration; Neil Lerner, Westat, Inc.; Helmut Zwahlen, Ohio State University; Peggy Drake, Baltimore City Department of Planning; Michael Perel, NHTSA; Richard Schwab, Consultant; Harvey Sterns, University of Akron; Essie Wagner, NHTSA; Gregory Davis, FHWA; Kathryn Lusby-Trebor, NETS; Christopher Monk, NHTSA; and Richard Pain, TRB Transportation Safety Coordinator.

Donn E. Hancher, University of Kentucky, presides over session on Environmentally Sensitive Construction. Speakers provided an overview of the challenges of construction on environmentally sensitive lands and how agencies have worked within the boundaries of environmental mitigation requirements and policies.

Anual Meeting photography by Cable Risdon Photography.

Planning out their meeting itinerary during the New Attendees and Young Participants Welcome Session and Networking Reception, Sunday, are Luis Diaz and Sandra Ospina of the University of Illinois.

Suzanne Sale, FHWA, contributes to a roundtable debate on transportation finance policy issues during a Sunday afternoon workshop.

Gloria Jeff, Michigan DOT (*left*), visits with Lou Lambert and Hyun-A Park of Cambridge Systematics at the Sunday reception hosted by Women's Transportation Seminar.

Wesley Lum, Caltrans (*above*), and Robert Reilly, Director of TRB's Cooperative Research Programs Division (*right*), speak to members of the American Association of State Highway and Transportation Officials Research Advisory Committee–Standing Committee on Research, one of many meetings conducted by related organizations.

Session on Innovations in Bridge Design included discussion on load and resistance factor design calibration for wood bridges, structural reliability of bridges in Michigan designed with HS25, and intermediate diaphragms for laterally impacted PC girder bridges. Tom Melton, DMJM + Harris, presides.

Ricaurte Vasquez, Panama Canal Authority, talks about development of the master plan for the Panama Canal during session on Future Panama Canal Improvements and Impacts on International Trade.

Networking can rise to the level of team-building.

Session on Transferring Military-Developed Technologies to Transportation featured discussion of current military technologies, including advanced information systems technologies and new high-resolution land information satellites now operating in the private sector. Then-Administrator Ellen G. Engleman talks about the Research and Special Programs Administration and technology transfer.

Session on Latest Developments in Bus Rapid Transit provided updates on the Federal Transit Administration's BRT Demonstration Program, the American Public Transportation Association's new BRT committee, the University of South Florida Center for Urban Transportation research recently established National Bus Rapid Transit Institute, and the *BRT Implementation Manual* that was prepared as a product of Transit Cooperative Research Program Project A-23. Bert Arrillaga, Federal Transit Administration, responds to questions after his presentation.

At session on Report on TRB-FAA Aviation Forecast Workshop, Richard S. Golaszewski, GRA, Inc., provides the international airlines outlook.

Todd Spencer, Owner-Operator Independent Drivers Association, Inc., participates on the panel at session on Motor Carrier Insurance Rates: Crisis? What Crisis?

In November 2002, Federal Transit Administrator Jennifer L. Dorn convened a meeting of national leaders to address the question "Who Cares About Transit? Mainstreaming Public Transportation in America." The meeting examined how public transit can develop ridership that helps to manage traffic congestion, to increase economic productivity, and to meet key community mobility needs. At the FTA Administrator's Roundtable Session, participants, including Lois Fu, Special Assistant to the FTA Administrator (*left*), shared key outcomes from the meeting and described efforts to meet these goals.

SESSIONS & MEETINGS

Presenters for session on Safety Impact of Graduated Driver Licensing: Recent Developments include (*from left*) Robert Hagge and Scott Masten, California Department of Motor Vehicles; Anne T. McCartt, Insurance Institute for Highway Safety, presiding; Rob Foss, University of North Carolina, Chapel Hill; Daniel R. Mayhew, Traffic Injury Research Foundation; and Jean T. Shope, University of Michigan.

Chandra R. Bhat, University of Texas, Austin; Chair, TRB Committee on Passenger Travel Demand Forecasting, talks about modeling the choice and frequency of home-based telecommuting during session on Impacts of Information and Communications Technology on Travel Behavior.

From left: Joseph M. Sussman, Massachusetts Institute of Technology; E. Dean Carlson, Carlson Associates, presiding; and Mortimer L. Downey, PBConsult, Inc., spoke at session on Spotlight on Congestion, Security, and Safety.

Roy S. Turner, Jr., Lexis Nexis, participates on the panel at session on Elements of Personal Security, sponsored by the Committee on Transportation Law, examining such issues as electronic privacy.

Patricia Nelson, The Transtec Group, Inc., presents information on early-age behavior of concrete overlays on continuously reinforced concrete pavements at session on Case Studies: Pavement Development Process in Rehabilitation Projects.

Brian Wolshon, Louisiana State University, presides at session on Transportation Research for Evacuation Planning, Operation, and Management, which included topics on the development of the Dynamic Trip Generation Model for hurricane evacuation using survival analysis and the state of the practice for evacuation transportation management.

Cutting-edge personal vehicles made inroads at the meeting, as Dean Kamen of DEKA Research and Development Corporation, demonstrated the use and flexibility of the Segway.

RESEARCH SHOWCASE EXHIBITS

At the FHWA Automatic Road Analyzer exhibit, Project Manager James Kennedy explains some of the van's technological features.

Hiu Wang of A/E Group, Inc., explains FHWA's Interactive Highway Safety Design Model, a road safety evaluation software package that assists highway planners and designers in applying safety research.

Tom Scullion, Texas Transportation Institute, and Christopher Rogers, University of Birmingham, United Kingdom, discuss highlights of a session.

Midwest Roadside Safety Facility representatives (*from left*) Kayla Polivka, Ronald Faller, and Bob Bielenberg arrive prepared for the meeting's rewarding treks.

(*From left*) Ayesha Williams and Camilla Stanley of Winston-Salem State University, North Carolina; Alice Jackson, Clark-Atlanta University; and Brandie Fleming and Kimberlee Wynn of Winston-Salem State University learn about FHWA's Universities and Grants Programs Transportation Education Pipeline from Benjamin Colucci.

The University of Florida was among the many academic institutions sending a large and engaged student contingent.

POSTER SESSIONS

Jae-Joon Lee, North Carolina State University (*left*), gains insights from poster coauthor Jin-Tae Kim, Hanyang University, Korea, into a Framework for the Investigation of Level-of-Service Criteria and Thresholds on Rural Freeways.

Luis Revuelta, World Bank, provides feedback comments to Kristof Carlier, TNO Inro, Netherlands, coauthor of Supernetwork Approach Toward Multimodal Route Choice Modeling.

Coauthor Jennifer Vanderburgh, McCormick, Taylor and Associates (*left*), reviews findings from the Mon/Fayette Expressway Education Outreach Program with Jareene Barkdoll, FHWA.

SPECIAL PROGRAM SESSION

Wilfred Owen Remembered

A "Giant" of Transportation

PHYLLIS ORRICK

"An anniversary is a time to look back and look ahead. But we should also look around," transportation thinker Wilfred Owen once said, and his words would have been appropriate for the program held in his memory at the 2003 TRB Annual Meeting. A capacity crowd filled a Hilton Hotel meeting room to hear tributes to Owen's nearly 70-year career and praise for his importance as a mentor, colleague, thinker, writer, and friend. Owen and his wife, Ellie, died within weeks of each other in November 2001.

"He was one of the genuine giants in the transportation pantheon," noted Mel Webber, emeritus faculty member at the University of California, Berkeley (UCB), and a longtime friend. The program was presented by the TRB Committee on Transportation History and presided over by Martin Wachs, former TRB Executive Committee Chair and Director of the UCB Institute of Transportation Studies.

Owen started his career as the first economist at the Highway Research Board, the precursor to TRB, in 1935, followed by stints in the 1940s on the National Resources Planning Board. For roughly 30 years, Owen was affiliated with the Brookings Institution, directing the Transportation Research Program, and also was a consultant to many universities, governments, and agencies, including the National Academy of Sciences, the Commerce Department, the World Bank, the Asian Development Bank, and the United Nations.

Owen at work in his Brookings Institution office, circa 1960.

Owen wrote more than 30 books including such classics as *The Metropolitan Transportation Problem*, *Cities in the Motor Age*, and *Transportation and World Development*, all of which continue to shape transportation policy. Known for his lively writing and his ability to express extremely technical concepts in accessible terms, Owen also authored *Wheels*, a history of transportation and an explanation of its universal role, for the popular Life Science Library.

"His thoughts shaped our own thoughts," Wachs said in introductory remarks. Wachs recalled the impact of reading Owen's 1966 work, *The Metropolitan Transportation Problem*, as a first-year graduate student: "He understood that cities changed with technology; that technology changed with land use; that the political economy of regions determined their success; that transportation was technical in nature but essentially political."

Visionary Optimist

Owen was noted for his humor, gentleness, and openness. "No matter how far apart you were, that friendly, unpretentious, impish smile of his would disarm any potential hostilities," recalled Thomas B. Deen, former Executive Director of

Peter Koltnow prepares to illustrate Owen's reliance on hard data in developing public policy.

Attending her first TRB Annual Meeting, Ranjitha Manchukonda, University of North Carolina, Charlotte, pores over listings of summer internships.

Attendees share transportation research headlines.

Regina McElroy, FHWA Team Leader and Industry Economics Analyst, who serves as liaison representative to three National Cooperative Research Program (NCHRP) project panels, visits with NCHRP Manager Crawford Jencks, TRB.

TRB. "He made you think, and he made you enjoy thinking." Deen cited Owen's *Cities and the Motor Age* as seminal in the urban planning process that has been incorporated into federal transportation legislation.

"At the very beginning of the Interstate highway program, Will constructed a coherent and sensible picture of urban transportation: its shape, its scale, its promise, and its problems," echoed transportation consultant Peter Koltnow, onetime Executive Director of the Highway Users Federation.

"Early on he identified the essential roles that transport plays in every society's development," Webber noted in written comments. "His understanding of the subtle processes that tie transport into the world economy was and remains extremely rare."

Gabriel Roth, a transportation economist, praised Owen's "universalist approach to transport" that would not permit different transportation modes to be held to different standards and that advocated for the inclusion of the less developed world in research and policy discussions.

Nuts-and-Bolts Thinker

Owen may have thought large, but he built his theories on "hard" information: "He was a data sponge," Koltnow recalled. "It was impossible to counter his urban prescriptions or even to pretend to understand them without reference to numerical information….He made it hard for professionals to build public policy on opinions alone. He forced his fellow transportation practitioners to construct database foundations for whatever position they took."

David J. Hensing, SAIC (*left*), and two of the speakers at the Wilfred Owen Memorial session: former TRB Executive Director Thomas Deen; and Neville Parker of the City University of New York Institute for Transportation Systems.

"He always talked about how many ton-miles there were in the average breakfast," recalled Alan E. Pisarski, a transportation consultant and chair of the program sponsoring committee. "This was his way of talking about the power of transportation. I remember Will saying, 'If you're in Polynesia, your breakfast probably came 100 yards from where you were eating it; but on the average day in Washington, you've got coffee from Costa Rica, bananas from Ecuador, fruit from Australia, cornflakes from Minnesota. So the ton-miles that we consume in our average day are embedded in our lifestyle."

Ongoing Dialogue

A decade ago, TRB sponsored a "Dialogue with Wilfred Owen." Owen's son, Wilfred Owen III, read from a letter his father wrote him about the event: "There were 200 people, and they asked me questions about everything, from the future of the cities to the future of democracy, high-speed ground transport, and petroleum. What impressed me was the number of people, men and women, who were interested in CHANGE."

The 2003 memorial program closed with comments from the audience and the playing of a brief recording from the TRB dialogue session. Owen contrasted the transportation policies of Japan, which had made large investments in high-speed rail to achieve unprecedented mobility, with those of Singapore, which used transportation spending to transform land use patterns and improve living conditions.

"The Japanese went to an extreme in concentrating on transportation, and the Singaporeans went to an extreme in telling people what to do. I think we're going to have a middle ground in America," he said. "[Singapore] is not the model one would choose for an American city, but…the experience demonstrates how transportation can be the means of achieving the goals of a society."

The author is Publications Director, Institute of Transportation Studies, University of California, Berkeley.

AWARDS

Larson Receives Turner Medal for Lifetime Achievement

Thomas D. Larson is the 2003 recipient of the Frank Turner Medal for Lifetime Achievement in Transportation. The medal recognizes a distinguished career in the field, professional prominence, and a distinctive, widely recognized contribution to transportation policy, administration, or research.

The award citation described Larson as "a man of vision who successfully has translated vision into practice as an innovative and effective administrator, policy maker, and public servant, … a role model of the highest order." Larson made notable contributions as a university professor and researcher, provided innovative leadership to a state transportation agency, and shaped national transportation policy as head of the Federal Highway Administration (FHWA).

Larson earned bachelor's and master's degrees, as well as his Ph.D., all in civil engineering, from the Pennsylvania State University (Penn State). From 1962 to 1979 he taught and served as an administrator at Penn State, where he founded and became the first Director of the Pennsylvania Transportation Institute (PTI).

Appointed Secretary of Transportation for the Commonwealth of Pennsylvania in 1979, he succeeded in revitalizing the ailing agency into a model state department of transportation. He returned to his alma mater in 1987 to serve as Pennsylvania Professor of Government and Management and as Special Assistant to the university president.

In 1989, Larson was appointed FHWA Administrator. At FHWA, he headed the U.S. Department of Transportation (DOT) team that was responsible for developing the 1990 National Transportation Policy, which earned him U.S. DOT's highest award, the Secretary's Gold Medal. Larson also led the DOT's negotiations with Congress for the Intermodal Surface Transportation Efficiency Act of 1991.

As a researcher, teacher, administrator, and policy maker, Larson has emphasized consistently the vital connections among transportation policy, research, and innovation. As Director of PTI, he led a national effort to gain federal support for university transportation centers of excellence; as Federal Highway Administrator, he provided the leadership that gained full funding for the system.

Larson is the author of one textbook and more than 100 publications, including the first published National Cooperative Highway Research Program report. As President of the American Association of State Highway and Transportation Officials (AASHTO) and as Chair of the TRB Executive Committee, he championed innovation and the innovative application of research results. He chaired the TRB–National Research Council study committee that recommended creation of a strategically targeted program of highway research, which resulted in the establishment of the $150 million Strategic Highway Research Program (SHRP). Larson also served as Chair of the first SHRP Executive Committee.

Larson, who has attended 44 consecutive TRB Annual Meetings, served as a member of the TRB Executive Committee from 1980 to 1984 and as Chair in 1981, later returning *ex officio* as Federal Highway Administrator. Other TRB committees to which he has contributed include standing committees on Mineral Aggregates and the Performance of Concrete; Manpower Management; Taxation and Finance; Highways; and Transit. Larson is currently a member of the standing Committee on Transportation History.

Thomas D. Larson displays his Frank Turner Medal.

His awards and honors include designation as the 1982 Construction Man of the Year in *Engineering News-Record*; the George S. Bartlett Award; the Pennsylvania State University Distinguished Alumnus Award; the TRB W. N. Carey, Jr., Distinguished Service Award; The American Society of Civil Engineers' President's Medal; the Council of University Transportation Centers Distinguished Award; and AASHTO's Thomas MacDonald Memorial Award. Larson was elected to the National Academy of Engineering (NAE) in 1985 and is also a Fellow of the National Academy of Public Administration.

TRB serves as the secretariat for the Frank Turner Medal, which may be awarded biennially. The following organizations are sponsors of the award: American Association of State Highway and Transportation Officials; American Concrete Pavement Association; American Highway Users Alliance; American Portland Cement Alliance; American Public Transportation Association; American Road and Transportation Builders Association; American Traffic Safety Services Association, Inc.; Asphalt Institute; Associated General Contractors of America; Construction Industry Manufacturers Association; Equipment Manufacturers Institute; Eno Transportation Foundation; Institute of Transportation Engineers; National Asphalt Pavement Association; Road Gang; and Texas A&M Foundation.

Honoring Contributions to Transportation Research

Awards were presented at the Chairman's Luncheon to recognize distinguished service to the transportation community and to acknowledge authors of outstanding papers published by TRB in 2002.

Distinguished Service Awards

The *Roy W. Crum Distinguished Service Award*, named for the Executive Director of the Highway Research Board 1928–1951, honors outstanding achievement in the field of highway research. This year's award was presented to **John R. Meyer**, the James C. Harpel Professor of Capital Formation and Economic Growth, Emeritus, at Harvard University, for his pioneering contributions to transportation economics.

The *W. N. Carey, Jr., Distinguished Service Award*, named in honor of TRB's Executive Director 1967–1980, recognizes outstanding leadership and service to transportation research and TRB. **Martin Wachs**, Director of the Institute of Transportation Studies at the University of California, Berkeley, was this year's honoree.

Outstanding Paper Awards

The *K. B. Woods Award*, named for the 19th Chairman of the TRB Executive Committee, goes to the outstanding paper in the field of design and construction of transportation facilities. This year's recipients were **George C. White, Joe P. Mahoney, George M. Turkiyyah, Kim A. Willoughby,** and **E. Ray Brown** for their paper, "Online Tools for Hot-Mix Asphalt Monitoring," published in *Transportation Research Record: Journal of the Transportation Research Board, No. 1813*.

The *D. Grant Mickle Award*, named for the 1964–1966 TRB Executive Director and the 1970 Executive Committee Chairman, recognizes the outstanding paper in the field of operation, safety, and maintenance of transportation facilities. **David A. Noyce** and **Kent C. Kacir** were the 2003 recipients for their paper, "Drivers' Understanding of Simultaneous Traffic Signal Indications in Protected Left Turns," published in *Transportation Research Record: Journal of the Transportation Research Board, No. 1801*.

The *Fred Burggraf Award*, named for TRB's 1951–1963 Executive Director, recognizes excellence in transportation research by researchers age 35 or younger whose papers have been published under the sponsorship of any Technical Activities Division standing committee. Receiving awards this year were **W. Spencer Guthrie** and **Hongbin Zhan** for their paper, "Solute Effects on Long-Duration Frost Heave Behavior of Limestone Aggregate," published in *Transportation Research Record: Journal of the Transportation Research Board, No. 1786*.

John R. Meyer receives the Roy W. Crum Award from TRB Executive Committee Vice Chair Genevieve Giuliano. Known for his excellence and generosity as a teacher, Meyer thanked his students and colleagues for the inspiration he received from them, in remarks following the award presentation.

Award-winning researcher-authors gather with TRB Technical Activities Division Chair Anne P. Canby (*left to right*): George C. White, Kim A. Willoughby, George M. Turkiyyah, E. Ray Brown, Canby, David A. Noyce, Kent C. Kacir, and W. Spencer Guthrie.

Longtime TRB activist and leader Martin Wachs receives the W. N. Carey, Jr., Distinguished Service Award from Genevieve Giuliano. In comments from the podium after the presentation, Wachs humorously recalled his first glimpse of a TRB awards ceremony as a first-year graduate student.

EXECUTIVE COMMITTEE SESSIONS

Keeping the Executive Committee to an ambitious agenda of policy discussions and business are incoming Executive Committee Chair Genevieve Giuliano, University of Southern California; TRB Executive Director Robert E. Skinner, Jr.; and 2002 Chair E. Dean Carlson, Carlson Associates.

John C. Horsley, American Association of State Highway and Transportation Officials (*center*), gains input from both a federal and a state official: Allan Rutter, Federal Railroad Administration (*left*), and Michael W. Behrens, Texas DOT (*right*).

Giuliano Guides 2003 Executive Committee

2003 Executive Committee Chair Genevieve Giuliano accepts the gavel from her predecessor, E. Dean Carlson, at the close of the Chairman's Luncheon.

Genevieve Giuliano, Director and Professor, School of Policy, Planning, and Development, Metrans Transportation Center, University of Southern California (USC), Los Angeles, is Chair of the TRB Executive Committee for 2003.

Active with the Board since 1991, Giuliano has served on several committees, including Social and Economic Factors in Transportation, Transportation and Economic Development, and an International Comparison of National Policies and Expectations Affecting Public Transit. Currently she is a member of the Committee on Physical Activity, Health, Transportation, and Land Use, as well as a member of the Executive Committee's Subcommittee for National Research Council Oversight.

Before joining USC, Giuliano conducted research at the University of California's Institute of Transportation Studies. She is also a former faculty fellow of the Lincoln Institute of Land Policy. Her research interests include the relationships between transportation and land use, transportation policy evaluation, and the impacts of information technology on transportation and travel behavior.

TRB's Vice Chair for 2003 is **Michael S. Townes**, President and Chief Executive Officer, Hampton Roads Transit, Virginia.

Keith Keen, European Commission, briefs the Executive Committee on an initiative that focuses on transatlantic transportation research issues.

The Executive Committee policy session focused on Decision-Making Processes for Public-Sector Transportation Investments. Megaprojects: The Changing Politics of Urban Public Investment was the topic of the presentation by David Luberoff (*left*), John F. Kennedy School of Government, Harvard University. Lester Lave (*center*), Carnegie Mellon University, spoke on Transportation Infrastructure Investment: How Much Can Analysis Contribute? Myron Orfield, Ameregis (*right*), detailed the Role of Institutional and Funding Structures in Decision Making. Rapporteur for the session was Ronald Kirby (*not pictured*), Metropolitan Washington Council of Governments.

Sharing points of view during a break are H. Thomas Kornegay, Port of Houston Authority, and Joanne F. Casey, Intermodal Association of North America.

The Executive Committee Subcommittee for National Research Council Oversight works to ensure that TRB committee appointments and reports conform to the high standards of the National Academies (*left to right*): John Craig, Nebraska Department of Roads; Susan Hanson, Clark University; Lester A. Hoel, University of Virginia (Chair); TRB Associate Executive Director Suzanne Schneider; E. Dean Carlson, Carlson Associates; Genevieve Giuliano, University of Southern California; Michael S. Townes, Hampton Roads Transit; and TRB Executive Director Robert E. Skinner, Jr.

Admiral Loy Details Agenda for Transportation Security

Admiral James M. Loy, Under Secretary of Transportation for Security, U.S. Department of Transportation, was the featured speaker at the Chairman's Luncheon, providing a detailed overview of the mission of the Transportation Security Administration (TSA). He admonished the overflow audience of transportation professionals, "Regardless of what emblem is on your hat, the job of securing our transportation systems and our homeland is everybody's business."

Loy described TSA as "the steward of security for the nation's transportation system" for all modes, "not just aviation travel but maritime, rail, highway, transit, and pipeline. Our mission is to protect the nation's transportation systems to ensure freedom of movement for people and commerce." He traced out several TSA initiatives:

- Bringing together government and industry to examine innovative technologies, practices, and policies for transportation security;
- Gauging the intermodal emergency response preparedness of the nation's critical transportation infrastructure;
- Implementing standards and response-planning requirements;
- Developing the Transportation Worker Identification Credential;
- Ensuring passenger security for travel across modes; and
- Addressing maritime security through participation in Operation Safe Commerce, a public-private partnership.

An ex officio member of the TRB Executive Committee from 1999 to 2002 as Commandant of the U.S. Coast Guard, Loy emphasized "the interconnectivity between and among government agencies and private organizations such as TRB" as "a driver for the future." He concluded: "We welcome the input of TRB. Having seen the program for the meeting this week, it's evident that the research community has a firm handle on transportation security issues."

As U.S. Coast Guard Commandant, Loy undertook to rebuild the Coast Guard's work force to authorized levels, to improve personnel retention, and to manage the pace of operations. He served as the Coast Guard Chief of Staff from 1996 to 1998 and was Commander of the Coast Guard's Atlantic Area from 1994 to 1996.

Loy has received two U.S. Department of Transportation Distinguished Service Medals, the Department of Defense Distinguished Service Medal, four Coast Guard Distinguished Service Medals, the Bronze Star with Combat "V," the Combat Action Ribbon, and other military awards. He is a graduate of the U.S. Coast Guard Academy and holds master's degrees from Wesleyan University and from the University of Rhode Island.

Admiral James M. Loy, featured speaker at the Chairman's Luncheon, details the role of the Transportation Security Administration, which he described as "the national transportation systems security manager."

EXECUTIVE COMMITTEE SESSIONS

Ronald Kirby, Metropolitan Washington Council of Governments, and Jennifer L. Dorn, Federal Transit Administration, discuss points raised in the policy session.

Glad to take the lead—2003 Executive Committee Chair Genevieve Giuliano and Vice Chair Michael S. Townes are ready to keep TRB successfully on mission.

Gale Page, Florida DOT, comments on a point of business as a member of the TRB Technical Activities Council.

Deen Sets Standard for Deen Distinguished Lectureship

The TRB Executive Committee has renamed the TRB Distinguished Lectureship in honor of Thomas B. Deen, the Board's eighth Executive Director, who served from 1980 to 1994. "Policy Versus the Market: Transportation's Battleground," the first Thomas B. Deen Distinguished Lecture and the 12th in the series, was delivered by Deen on January 13.

Headliner Thomas B. Deen escorts his wife Bettie into the lecture hall for the official renaming of the TRB Distinguished Lectureship.

"Over my 45-year career, I have watched with a mixture of awe and fascination as our nation has struggled to impose its collective will over its massive transportation system," Deen told the audience. "Each decade a new generation of professionals and activists comes on the scene, expecting to easily reform the system and make it respond to their goals. They often underestimate the difficulties of influencing the system, and are often disappointed with its intractability."

One of the problems, Deen explained, is that "transportation … is a huge, decentralized enterprise….Trying to make it respond to some new national policy, however desirable, is like, but much harder, than changing the direction of a fully loaded supertanker at full throttle."

Drawing on examples from his experience as an organizational leader, policy maker, and consultant, Deen fleshed out the difficulties of implementing transportation policy. He concluded, "Democracy has been characterized as the most inefficient form of government ever devised, except that it is enormously better than any other alternative. Much the same can be said for our transportation system and the philosophy on which it rests."

The lecture will be published in a volume of the 2003 series of the *Transportation Research Record: Journal of the Transportation Research Board*.

Deen pioneered the development and application of methods for analyzing urban transportation problems and designing urban transit systems. Following service in the early 1960s as Director of Planning for the National Capital Transportation Agency in Washington, D.C., Deen spent 16 years as Vice President and then President of Alan M. Voorhees and Associates, with overall responsibility for preparing plans and feasibility studies for highways, airports, rail systems, and ports in more than 100 cities in 15 countries.

As TRB Executive Director from 1980 until his retirement in 1994, Deen provided international leadership in transportation research and innovation. He presided over the Board's expansion into new program areas and modes, while preserving and enhancing the quality and breadth of its traditional technical activities.

Under his leadership, TRB increased the participation and partnership of government, academia, and industry in the range of its activities and for the first time took on the challenge of conducting policy studies on national transportation issues. Concerned with the direction of transportation research, Deen conceived and successfully promoted a series of strategic transportation research studies, which resulted in the establishment of the Strategic Highway Research Program and the Transit Cooperative Research Program.

In 1999, the Maryland Governor appointed Deen chair of the Transportation Solutions Group, charged with recommending solutions to transportation problems in the Washington, D.C., region. More recently, the Maryland legislature asked Deen to cochair a task force to evaluate a proposed high-speed maglev transit system between Baltimore and Washington, D.C.

The Thomas B. Deen Distinguished Lectureship is an annual award that recognizes the career contributions and achievements of an individual in one of five areas covered by TRB's Technical Activities Division. Honorees are provided the opportunity to present an overview of their technical area, including its evolution, present status, and prospects for the future.

TRB Committees Applaud Emeritus Members

TRB's emeritus membership category recognizes the significant, long-term contributions of individuals who have provided exemplary leadership and service on the Board's standing committees. The 2003 group of honorees, recognized at the Annual Meeting, are listed below.

Structures Section Chair Andrzej Nowak (*left*) acknowledges the leadership of Arunprakash Shirole, Chair, Committee on General Structures, staffed by TRB's Engineer of Design Stephen Maher (*right*).

Group 1

Transportation Systems Planning and Administration

William Bowlby, Committee on Transportation-Related Noise and Vibration (A1F04)
David E. Boyce, Committee on Transportation Network Modeling (A1C05)
A. H. Childs, Committee on Intergovernmental Relations in Aviation (A1J01)
Arlene L. Dietz, Committee on Inland Water Transportation (A1B01), Committee on Ports and Channels (A1B08)
Mike Florian, Committee on Transportation Network Modeling (A1C05)
Thomas N. Harvey, Committee on Social and Economic Factors of Transportation (A1C06)
Herbert S. Levinson, Committee on Access Management (A1D07)
Franklin Spielberg, Committee on Bus Transit Systems (A1E01)

Group 2

Design and Construction of Transportation Facilities

William W. Dickhart III, Committee on Guided Intercity Passenger Transportation (A2M05)
Fred N. Finn, Committee on Flexible Pavement Design (A2B03)
John W. Fisher, Committee on Fabrication and Inspection of Metal Structures (A2F07)
George G. Goble, Committee on Foundations of Bridges and Other Structures (A2K03)
Jack H. Hansen, Committee on Photogrammetry, Remote Sensing, Surveying, and Related Automated Systems (A2A01)
Chris Hendrickson, Committee on Applications of Emerging Technology (A2F09)
Robert B. Newman, Committee on Construction Management (A2F05)
Orrin Riley, Committee on Construction Management (A2F05)
Arunprakash M. Shirole, Committee on General Structures (A2C01)
Eugene L. Skok, Jr., Committee on Pavement Rehabilitation (A2B04)
Shiraz D. Tayabji, Committee on Pavement Rehabilitation (A2B04)
Mehmet T. Tumay, Committee on Soil and Rock Properties (A2L02)
Robert B. Watson, Committee on Guided Intercity Passenger Transportation (A2M05)

Steve Dewitt (*left*) of the North Carolina Department of Transportation, Chair, Construction Section, honors the long-term contributions of Consultant Orrin Riley to the Committee on Construction Management.

Group 3

Operation, Safety, and Maintenance of Transportation Facilities

R. Wade Allen, Committee on Simulation and Measurement of Vehicle and Operator Performance (A3B06)
John Fegan, Committee on Pedestrians (A3B04)
Russell M. Lewis, Committee on Traffic Safety in Maintenance and Construction (A3C04)
Donald M. Walker, Committee on Winter Maintenance (A3C09)
Marcus R. Wigan, Committee on Motorcycles and Mopeds (A3B14)
Charles V. Zegeer, Committee on Pedestrians (A3B04)

Group 5

Intergroup Resources and Issues

Denis E. Donnelly, Committee on Conduct of Research (A5001)
John B. Metcalf, Committee on Low-Volume Roads (A5002)

Driving to New Sources of

Gaining Flexibility, Ensuring Supply, and Reducing Emissions

JONATHAN RUBIN

The author is Interim Director, Margaret Chase Smith Center for Public Policy, and Associate Professor, Department of Resource Economics and Policy, University of Maine, Orono.

In July 2002, three TRB Committees—on Energy, on Transportation and Air Quality, and on Alternative Fuels—convened representatives of the automobile and fuels industries, U.S. and Canadian regulatory agencies, academia, national laboratories, and research organizations to discuss air quality, global warming, future fuels and vehicles, and transportation energy policy.[1] The conference presented an overview of energy and technology options and possible solutions to some vexing transportation challenges.

Harnessing Hydrogen

Promising Fuel Cells

Major automobile makers have announced the impending rollout of fuel-cell vehicles. The FreedomCAR Partnership between the U.S. Department of Energy and the U.S. Council for Automotive Research—representing DaimlerChrysler Corporation, Ford Motor Company, and General Motors Corporation—is a prominent proponent of fuel-cell vehicles. But major challenges include customer acceptance, cost, hydrogen storage, infrastructure development, and technological progress.

More surprising than the positive outlook on fuel cells was the widely held view that the need for a widescale switch to hydrogen-based fuel cells within 20 to 30 years has not been established conclusively. Viable competitors include advanced conventional vehicles with gasoline and diesel options, as well as hybrid and compressed natural gas (CNG) vehicles. Hydrogen-powered internal combustion engines (ICE) also appear attractive, and fuel-cell fuels besides hydrogen also may prove successful.

[1] For presentation materials and additional information, see the TRB Energy Committee website, gulliver.trb.org/wb/wbpx.dll/~A1F01.

Transportation Energy

General Motors Hy-wire fuel-cell car runs on hydrogen and electricity.

Testing the Limits

Dedicated hydrogen ICEs have nearly the same tailpipe emission benefits as fuel cells and use the same fuel feedstocks (*1*). Because they are similar to conventional gasoline engines, ICEs can capitalize on investments in engine transmission and component plants. In addition, unlike fuel cells, hydrogen ICEs are not constrained by fuel quality—for example, ICEs can burn carbon monoxide, which would contaminate fuel cells.

Hydrogen ICEs, however, have several limitations. Hydrogen is the smallest molecule but has the highest diffusivity, requiring the development of hydrogen sensors. In addition, gaseous hydrogen is severe on fuel injection equipment. Hydrogen engines also have lower specific output—that is, power and torque—than gasoline engines. Overcoming these limitations must be a core technological objective.

Weighing Investments

Many of the benefits of fuel cells and hydrogen ICEs accrue to society—such as zero tailpipe emissions, improved energy efficiency, and energy security. Many conference participants therefore believe that a transition to fuel-cell vehicles within the next 20 years would not be consumer-driven but would be undertaken for societal reasons. Consequently, only an active public sector can accelerate adoption of the technology. Many participants maintain that catastrophic climate change also may force near-term change in vehicle technologies and expedite the introduction of fuel-cell vehicles.

A minority viewpoint holds that the transition to fuel-cell vehicles will not require a high level of public investment, because fuel-cell vehicles have desirable characteristics—such as smooth electric drive and remote power generation—and will be perceived as superior. In addition, other technological breakthroughs may create a market-driven transition.

Researchers and policy makers must decide on the baseline vehicle for measuring the incremental energy and environmental benefits of fuel-cell vehicles. Should the baseline be the performance of a conventional vehicle, an advanced conventional vehicle, or a hybrid vehicle? The answer will affect desirability and cost.

Transitioning to Hydrogen

Large-scale renewable hydrogen fuel, produced from biomass or from nuclear, solar, or wind power, could be the solution to many transportation energy problems, including greenhouse gas (GHG) emissions,[2] criteria pollutants,[3] and energy security. Solutions at a reasonable economic cost, however, remain out of reach. If a transition to a hydrogen fuel occurs in the near term, several different feedstocks and pathways for hydrogen are technically viable, many from traditional nuclear and fossil fuels.

Marianne Mintz of Argonne National Laboratory presented results from a recent study by the U.S.

[2] Any gas that absorbs and traps heat in the atmosphere. GHGs include water vapor, carbon dioxide, methane, nitrous oxide, hydrochlorofluorocarbons, ozone, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

[3] Criteria air contaminants include particulate matter (liquid or solid aerosols), carbon monoxide, nitrogen oxide, sulfur dioxide, and volatile organic compounds.

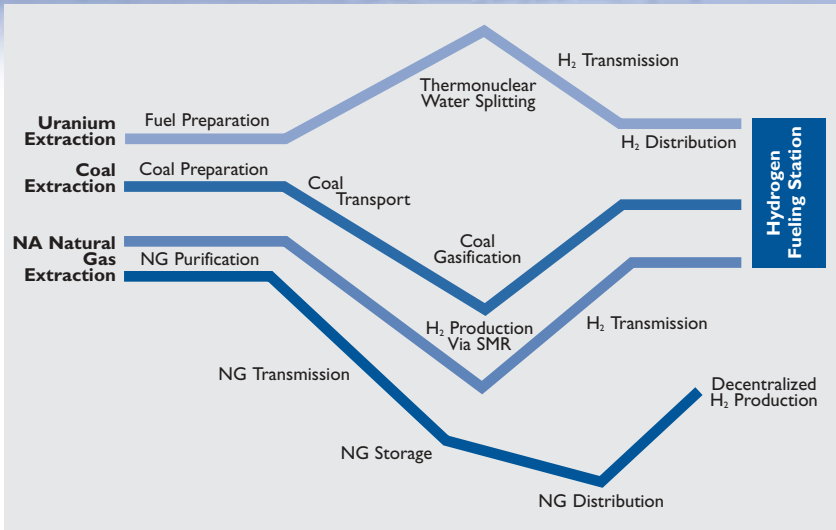

FIGURE 1 Four hydrogen pathways.

Source: M. Mintz, Argonne National Laboratory, used with permission.

Department of Energy and Natural Resources Canada (2), examining four pathways to large-scale hydrogen production and use: nuclear, coal, natural gas, and a mix of centralized and decentralized transmission options (Figure 1). The study did not consider biomass or other renewable fuel pathways.

The transport and production of hydrogen were the largest cost components for each path. According to the study, the unit cost of hydrogen was likely to be two to three times that of gasoline, on a well-to-pump basis using current technologies: $20–$23 per million BTU for hydrogen vs. $7 per million BTU for gasoline, excluding taxes and markups. The pathway that is most cost-effective and provides the greatest environmental and energy security benefits remains an important question.

GM diesel hybrid can switch to auxiliary power from hydrogen fuel cell.

Considering Alternatives

Policy makers and niche markets can assist in the adoption of hydrogen and other alternative fuels. Some participants were optimistic about the increased use of alternative fuels, particularly CNG, biodiesel (mono alkyl esters), and ethanol.

Finding Niches

Military installations are a niche for alternative fuels and hybrid vehicles. Jim Muldoon of the U.S. Air Force noted that a Department of Defense goal for 2020 is to reduce "sustainment requirements"—the logistical demands of getting water and fuel to a battlefield—which will require greater fuel efficiency (3).

Hybrids and fuel cells may be the enabling technologies—hybrids can reduce fuel consumption on the battlefield and provide onboard electric power in remote locations, and fuel cells can offer modular, standardized, "plug and play" compatibility across vehicles. Moreover, fuel cells can maintain performance if one unit in a multiple-cell system fails, which could reduce maintenance and increase resilience during a military engagement.

Going Natural

According to Rich Kolodziej of the Natural Gas Vehicle Coalition, natural gas vehicles (NGVs) are the alternative-fuel vehicle leader, with 110,000 on America's roads (4). Natural gas offers the most engine and vehicle choices of any alternative fuel.

DaimlerChrysler, Ford, General Motors, and Honda offer dedicated or bifuel natural gas vehicles as original equipment. For medium- or heavy-duty applications, Caterpillar, Cummins, Deere Power Systems, Detroit Diesel, Mack, AFT, and Crusader/IMPCO produce natural gas engines. Many transit bus and truck manufacturers provide a natural gas option.

The NGV market will continue to grow. Primarily a domestic product, natural gas is an attractive alternative to foreign oil—85 percent of current consumption comes from U.S. sources, and most of the rest is produced in Canada. Moreover, new technologies can enhance low-grade natural gas with hydrogen for power generation and for use in vehicles (5).

Although only 1,600 fueling sites serve NGVs, compared with 95,000 for gasoline-fueled vehicles, natural gas is available throughout the country. In addition, natural gas is clean-burning with relatively low GHG emissions. Stricter National Ambient Air Quality Standards for ozone and particulates and stricter heavy-duty vehicle emission standards will give NGVs an advantage over diesel vehicles.

The long-term cost and availability of natural gas, however, remain questions. Long-term supply is uncertain, depending on the worldwide demand and

the rate at which conventional gas can be discovered and produced, according to Steve Plotkin of Argonne National Laboratory (*6*). Accurate, long-term U.S. natural gas prices are impossible to predict, with such unknowns as the size of the world gas resource base; world economic growth rates; changes in energy intensity; the development of a worldwide gas trading system; improvements in technology for gas discovery, production, and transport; the development of methods to exploit gas hydrates; and cost reductions in gas backstops, such as coal gasification with carbon sequestration.

Riding on Alcohol

The U.S. Environmental Protection Agency (EPA) initiated research and engine test programs on alcohol fuels in the late 1970s and early 1980s. EPA had focused on methanol but recently has transitioned to ethanol research, responding to shifts in market and legislative interests.

According to Matt Brusstar of EPA, alcohol fuels have several advantages over gasoline: alcohol has a higher octane content, greater vaporization heat, more flame speed, and cooler combustion. These features promise to lower emissions of oxides of nitrogen (NOx) and produce higher thermal efficiency. The manufacturing costs of engines optimized for alcohols are similar to those of gasoline engines.

There are now 2.3 million ethanol flexible-fuel vehicles on the road in the United States. These vehicles could use E85 (ethanol for light-duty vehicles) if it were more widely distributed. If ethanol, which is made primarily from corn, can be produced more cheaply, a renewable, domestically produced fuel could power dedicated or flexible alcohol engines, providing an economic alternative to conventional gasoline engines.

The current demand for fuel ethanol is in low-volume blends with gasoline; these blends comprise 15 percent of all U.S. gasoline (*7*). Under a renewable fuel standard proposed in the Energy Policy Act of 2002 (H.R.4), fuel ethanol demand would grow from 2.1 billion gallons in 2002 to 5.1 billion gallons by 2012.

But greater use of ethanol also raises the question of supply. Cellulosic ethanol, from feedstocks such as agricultural residues, softwoods, hardwoods, and municipal solid waste (MSW), may play a significant role in ethanol supply. All of the feedstocks, however, present problems in harvesting, collection, transportation and storage, lack of bulk density, supply (for example, weather variations can have an effect), and moisture content; moreover, MSW presents the additional problem of variable composition (*8*). Nonetheless, cellulosic ethanol can reduce GHG emissions from transportation, provide a means of agricultural diversification, and help manage biomass residue.

Some conversion processes for cellulosic ethanol are commercially available; others are in demonstration or are experimental. The conventional method is the simple and inexpensive dilute acid process. The concentrated acid process is also simple and inexpensive and has improved sugar recovery, but with losses in materials compatibility and acid recovery. Experimental processes in development include enzymatic, organosolv, and thermochemical gasification.

The commercial viability of cellulosic ethanol depends on low-cost feedstocks and low-cost processes to produce ethanol and valuable coproducts. A dozen companies are either seeking financing for chemical plants to manufacture commercial dilute and concentrated acid or are operating small pilot plants for the enzymatic, organosolv, and thermochemical processes. The first commercial plant employing any of these technologies will not be in operation before 2006 (*8*).

Natural Resources Canada and the U.S. Department of Energy have examined a range of energy scenarios, from environment-friendly to business-as-usual. The preliminary conclusion is that ethanol is a potentially significant alternative fuel. By 2050, biofuels could account for 11 percent of transportation energy in Canada, and petroleum-based fuels would decline from a 99 percent to an 84 percent market share (*9*).

Blending Diesels

E-diesel and biodiesel could increase the use of renewable fuels with little or no infrastructure or engine changes for heavy-duty, on- and off-road compression-ignition engines. E-diesel contains conventional diesel blendstock with up to 15 percent (by volume) of anhydrous ethanol stabilized with 1.0 percent to 5.0 percent additives, as well as cetane enhancement, if required.

Diesel systems generally include a substantial amount of water, posing the risk of phase separation, the formation of solid crystals or a separate liquid layer on the bulk diesel fuel; but new technologies can maintain stability in the presence of water (*7*). Adding ethanol, however, lowers the flashpoint of diesel, normally 132°F, to about 75°F degrees—so that e-diesel must be handled like gasoline.

Biodiesel is produced by combining triglycerides (oils or fats) with alcohol (ethanol or methanol) in the presence of a catalyst to produce mono alkyl esters and glycerine. The source of oil or fats could be soybeans, corn, canola, cottonseeds, sunflowers, beef tallow, pork lard, or used cooking oils. Biodiesel has a 7 percent to 9 percent lower heating value and freezes at a higher temperature than Number 2 diesel. Biodiesel

Diesel hybrid military pickup truck equipped with a fuel-cell auxiliary power unit, introduced in January 2003, by General Motors and the U.S. Army. Built on a Chevrolet Silverado crew cab frame, the diesel hybrid improves fuel consumption by 20 percent, reduces emissions, and provides troops with a source of electrical power.

can be used as a pure fuel or blended with petrodiesel (petroleum diesel).

Soy-based biodiesel costs $2 per gallon. The EPA low-sulfur rule for diesel fuel has led to an increase in the use of biodiesel—adding 2 percent biodiesel, as in B2 diesel, can restore the lubricity lost in reducing sulfur.

In addition, biodiesel offers environmental advantages. Compared with petrodiesel, B20 diesel (20 percent biodiesel and 80 percent petrodiesel) has lower emissions of carbon monoxide (10 percent to 20 percent), hydrocarbons (20 percent to 30 percent), particulate matter (5 percent to 15 percent), and GHG emissions. Emissions of NOx, however, are higher than from petrodiesel (4 percent) but should be controllable with improved vehicle systems (*10*).

Resort shuttle bus and other municipal vehicles in Breckenridge, Colorado, run on B20 fuel—20 percent biodiesel and 80 percent petroleum diesel.

PHOTO: UNITED SOYBEAN BOARD

Keeping Conventional

Relying on Oil

Other participants endorsed the continuing importance of oil. John Johnston reported ExxonMobil's long-term energy outlook:

- World energy use will grow by 1.9 percent annually;
- Oil will remain the dominant source of fuel and maintain market share, growing by 1.8 percent per year;
- Natural gas will grow by about 3 percent per year, picking up market share for power generation;
- Other fuels including hydro, nuclear, solar, wind, and biomass will grow moderately, with no near-term breakthrough in liquid biofuels; and
- Fossil fuels, therefore, will remain critical to energy needs for the next 20 years.

In ExxonMobil's view, vehicle and fuel systems will change, with many high-potential options now in development, such as advanced gasoline, advanced diesel, gasoline hybrid electric vehicles (HEV), diesel HEV, and fuel-cell vehicles. Many additional options also would improve conventional internal combustion engines, but adoption of new technologies will depend on marketplace acceptance.

Refining Sands

Kevin Cliffe of Natural Resources Canada described Canada's 141,000 square kilometers (55,000 square

PHOTO: SYNCRUDE CANADA LTD

Trucks haul Canadian oil sands from the Athabasca Oil Sands Deposit, Alberta.

miles) of oil sands deposits. Oil sands are composed of 80 percent to 85 percent mineral materials (sands and clays), 4 percent to 6 percent water, and 10 percent to 12 percent bitumen, a tar-like mixture of petroleum hydrocarbons with a density 20 percent greater than that of light crude oil. The bitumen is upgraded into a light, high-grade synthetic crude oil with a low sulfur and nitrogen content.

Since 1996, investments in completed oil sands projects have totaled $17 billion (Canadian), and $86 billion is invested in additional projects. Canadian oil sands could produce 5 million barrels of synthetic crude oil per day, which would satisfy 200 percent of Canadian, 16 percent of U.S., and 4 percent of world petroleum demand in 2025.

Key issues include refinery compatibility and capacity, pipelines, market segments, cost reductions, and dilutent alternatives. Additional research is needed to reduce the substantial impacts on water and the high levels of carbon dioxide (CO_2) emissions, as well as to guide land use in oil sands development.

Steering the Transitions

Recognizing Barriers

Participants observed that significant barriers to alternative fuels and alternative-fuel vehicles remain:

- The technological successes in reducing the emissions and increasing the efficiency and performance of gasoline and diesel vehicles;
- The low cost of petroleum; and
- The lack of a retailing infrastructure for alternative fuels, especially for hydrogen.

Paul Leiby and Jonathan Rubin presented results from the Transitional Alternative Fuels and Vehicles Model, which simulates market outcomes for alternative-fuel and hybrid vehicles. The model considers possible transitional barriers related to infrastructure needs, production scale, and investments in vehicle and fuel production capacity. These transitional barriers accounted for approximately $1 per gallon of alternative fuel in 2000 but will account for $0.50 per gallon by 2010 (*11*).

Electric cable shovel loads Canadian oil sands into hauling truck.

Meeting the Standards

Motor vehicles emit criteria pollutants, contributing to unhealthy air for millions in urban areas. Conference participants disagreed over what to do about the problem. An EPA representative expressed belief that the next generation of standards must anticipate growth in vehicle miles traveled. The new standards may require a long-term move to cleaner technologies in some metropolitan areas.

Others, including John German of Honda Motor Company, advanced the view that vehicle criteria emissions can be reduced through advanced conventional gasoline or CNG vehicles. For example, all 2003 Honda Accord four-cylinder automatic transmission vehicles sold in California will meet California's super-ultra-low-emission vehicle standards.

Evaluating the Alternatives

Two directions emerged in discussions about the potential for alternative fuels and alternative-fuel vehicles to reduce criteria and GHG emissions. One direction depends on individual fuel analyses that compare the emissions of a particular alternative fuel with a gasoline or diesel baseline. The other direction depends on studies that predict emissions as alternative fuels and alternative-fuel vehicles are integrated into the transportation system, taking into account rates of adoption, costs, and driving behavior.

Participants agreed that evaluations of individual technologies should use a well-to-wheels (WTW) approach to compare the combined production and combustion processes of fuels and vehicles. Some, however, questioned the ability of WTW studies to assess robustly competing technologies, because the results can reflect the input assumptions. One participant noted that WTW estimates for CO_2 emissions from gasoline hybrid, diesel hybrid, gasoline fuel-cell, hydrogen fuel-cell-from-gas, E85, and ethanol fuel-cell engines show little difference and concluded that policy makers should not be picking winners yet.

A WTW assessment of the carbon impacts of biofuel must include the entire cycle of feedstock production, distribution, and conversion (Figure 2). According to Michael Wang of Argonne National Laboratory, an assessment of ethanol must consider agrochemical production and transport, farming energy, crop or feedstock transport, ethanol production efficiency, and coproduct energy allocation (*12*). An assessment of biodiesel would involve consideration of soybean farming, crop transport, soy oil extraction, and coproducts. An important issue for ethanol is the use of nitrogen-based fertilizers and the mobilization of resulting nitrogen oxides into the atmosphere.

Another key issue is the allocation of energy use and GHG emissions to coproducts such as animal feed and electricity. Corn-based ethanol and biodiesel have different coproduct allocations: depending on the method, the allocation for corn ethanol coproducts could be 16 percent or 52 percent, and for soybean diesel, 38 percent or 82 percent—or somewhere in between.

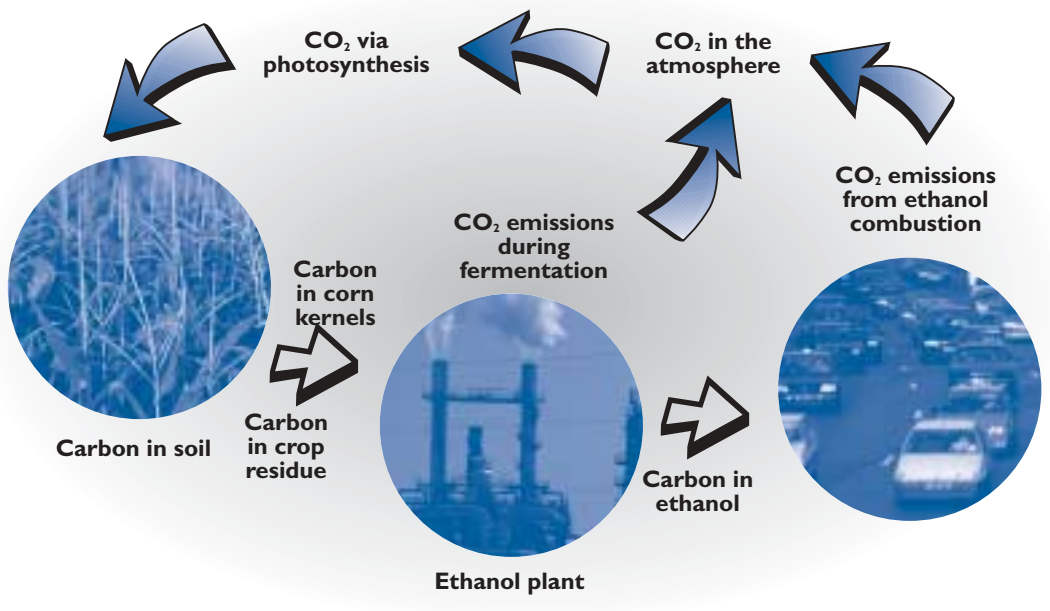

FIGURE 2 Recycling of carbon by biofuels results in net CO_2 benefits.

Source: M. Wang, Argonne National Laboratory, used with permission.

The displacement method, which yields the 16 percent coproduct allocation for ethanol, assigns a 25 percent reduction in GHG to corn-based E85 on an energy-equivalent comparison with gasoline. Cellulosic ethanol fares better, with an estimated reduction of 65 percent to 120 percent in GHGs for E85, compared with gasoline. The GHG reductions for biodiesel range from 10 percent to 15 percent for B20, and proportionally higher for B100 (100 percent biodiesel), compared with petrodiesel.

A systemwide study by Don Pickrell of the Volpe National Transportation Systems Center compared future GHG emissions from light-duty vehicle travel with results from an all-gasoline baseline (*13*). Pickrell's study focused uniquely on total GHG emissions, instead of on per-vehicle or per-mile emissions.

By 2010, assuming that alternative fuels will have replaced 10 percent of gasoline, Pickrell estimates only a slight reduction in GHG emissions, because of increases in emissions from fuel production and in vehicle miles traveled. In the longer term, however, according to the study, commercial development of technology to produce ethanol from cellulosic biomass could reduce GHG emissions significantly, assuming a 25 percent displacement of gasoline by alternative fuels by 2025.

Developing Public Policy

The public sector has a vital role in any major transition in the fuel-vehicle transportation system to address GHG, criteria emissions, and energy security. As Barry McNutt of the U.S. Department of Energy pointed out, environmental or clean air concerns historically have driven the development of many energy policies, but energy policy for energy policy's sake—that is, without the supporting public concern—has been less successful (*14*). Fuel flexibility and diversity that only serve to achieve energy security may not be worth the cost—the social costs of oil price swings may not be high enough to justify the cost of flexibility and diversity in infrastructure, vehicle investments, and operating costs.

For many participants, global warming and criteria emissions are important social problems that require action. Other important goals include homeland security, economic security, and energy security.

To some participants, transportation's environmental trends are mostly negative: the rise in vehicle miles traveled, the decline in fuel economy, and the minimal use of alternative fuels. Several participants suggested that the public sector ought to promote research, assist with infrastructure development, facilitate demonstrations and pilot programs, and provide incentives to accelerate early market acceptance of new technologies, especially of hydrogen fuels.

Acknowledgments

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Technologies for Champions

Group Identifies High-Payoff Breakthroughs and Accelerates Deployment

ELLEN SCHWEPPE

The author is a contract writer for the Federal Highway Administration, Washington, D.C.

PHOTO: TEXAS DOT

Setting a 75-ton precast interior bent cap on Lake Belton Bridge, 60 miles north of Austin, Texas, on State Highway 66.

Installation of a precast interior bent cap on Lake Ray Hubbard Bridge near Dallas, Texas.

PHOTO: TEXAS DOT

The American Association of State Highway and Transportation Officials (AASHTO) created the Technology Implementation Group (TIG) to identify high-payoff, ready-to-use technologies and to champion use of the technologies throughout the country. The group initially has chosen six priority technologies likely to yield significant economic or qualitative benefits and has developed plans for accelerating deployment:

- Prefabricated bridge elements;
- Intelligent transportation systems (ITS) for work zones;
- Accelerated construction methods;
- Air void analyzers (AVA) for concrete;
- Ground-penetrating radar (GPR) for asphalt; and
- Global positioning systems (GPS) for surveying.

Furthering Innovations

Introducing innovative technologies into day-to-day practice can save time, money, and even lives. For example, using prefabricated bridge elements—such as precast bent caps—in replacing two 113-span sections of a busy bridge through the central business district of Houston, Texas, enabled the state's Department of Transportation (DOT) to complete the job in 190 days, instead of the 1.5 years required for conventional construction.

The Puerto Rico Department of Public Works relied on totally prefabricated bridge systems and two-stage construction to build four overpasses on a San Juan road carrying more than 100,000 vehicles a day. Once the substructures were in place, erecting the overpasses took 21 to 36 hours each.

These ready-to-use technologies had significant payoffs. This is the goal as the AASHTO TIG champions the six chosen technologies to transportation agencies, encouraging implementation across the country.

"All too often, when a technological innovation is promoted, implementation doesn't go far enough," states TIG Chair Gary Hoffman, Deputy Secretary of Pennsylvania DOT. "Energy, planning, and resources are required for an innovation to become part of transportation organization operations."

Formed in December 2000 with representatives from state and local DOTs, as well as from the Federal Highway Administration (FHWA), the Transportation Research Board (TRB), and industry, the TIG developed a process to identify promising technologies. Each year the group considers approximately 50 nominations from state DOTs, AASHTO units, and FHWA.

"What we're looking for are ready-to-implement technologies that should be replicated across the United States," Hoffman notes. "One of the major criteria is that at least one state has used the technology and is willing to champion it." The group also considers whether the technology meets a need or solves a problem in the transportation system, how effective the technology is, what costs are involved, and the ease of widespread implementation.

PHOTO: BEXAN CONCRETE WORKS, INC.

Prefabricated bridge elements, such as bent caps (above, in precasting yard, San Antonio, Texas), help transportation agencies achieve the construction goal to "get in, get out, and stay out."

Once the group has selected a technology for fast-track treatment, a lead state team develops and carries out a strategic plan for delivering the technology to users. Activities are tailored to each technology and may include the development of training programs and materials, as well as sending out teams to help agencies learn how to apply the technology.

The model of designating lead state teams to promote the technologies came from the former AASHTO State Highway Research Program Product Implementation Task Force. "That was a good concept: find champions with a burning desire to see a technology implemented and with the expertise to implement it, and then give them the freedom, authority, and resources to market the technology," Hoffman asserts.

Minimizing Disruptions

Prefabricated bridge elements and systems have been around for years, but DOTs now are using the systems more extensively and in innovative combinations to rebuild bridges more rapidly, safely, and cost-effectively.

"As state DOTs move from a focus on building to maintaining highways, we need to rethink how we do our business," observes Mary Lou Ralls, state bridge engineer for Texas DOT and chair of the TIG panel on prefabricated bridge elements and systems. "Our number one priority is safety, but we also need to minimize disruption to the traveling public and look at methods for protecting the environment and improving constructibility. One answer is to move detailed work away from traffic lanes."

Manufactured away from the work zone and then

PHOTO: TEXAS DOT

Only 18 hours after installation, including setting and grouting time, precast interior bent cap can be ready to carry a load.

transferred to the construction site for installation, prefabricated bridge elements help achieve the construction goal of "get in, get out, and stay out." This benefits highway users by minimizing the need for detours, lane closures, and narrowed lanes.

Prefabrication not only decreases traffic disruptions but improves construction zone safety. Because much of the preparation is off-site, workers can spend less time working near traffic, at elevations, or over water. Other on-the-job constraints, such as working around power lines, also are reduced.

Using prefabricated elements reduces the amount of heavy equipment required, as well as the time the equipment needs to be in the work zone, making construction less disruptive to the environment. Tennessee DOT, for example, used prefabrication to minimize the environmental impact and the traffic disruption when replacing a bridge over the Wolf River in Fayette County. The bridge crosses sensitive wetlands and carries the only east-west route through the region.

Tennessee chose staged construction for the 20-span replacement bridge, maintaining one lane of traffic with timed signals. The department also chose bent caps and other prefabricated elements, completing construction in 11 months without having to place equipment in the surrounding wetlands.

Many job sites impose constraints on the constructibility of bridge designs, such as difficult elevations or work areas restricted by adjacent structures. Prefabricated bridge elements and systems can relieve these constraints.

New York State DOT chose precast, prestressed concrete and steel composite superstructure units to improve constructibility by allowing staged construction over a busy commuter railroad in the village of Tuckahoe. All work was done between 2 and 4 a.m. on weekends, avoiding disruptions for rail commuters and adjacent stores.

In a controlled environment, prefabrication can overcome job-site limitations and can increase quality and durability. Prefabrication also can lower costs on projects involving long water crossings or multilevel interchanges, which require sophisticated techniques for cast-in-place bridge elements.

The TIG lead state team has organized three national conferences on prefabricated bridges—including a recent conference in St. Louis, Missouri—and has organized presentations at other transportation meetings. The group also has developed a brochure, a video, and a CD-ROM with case studies on how states have used the technology.[1]

"The focus of our implementation effort is to give state DOTs, other bridge owners, contractors, and industry in general a level of comfort with this technology, so that they'll use it when their job requirements make it an attractive option," Ralls says.

Clearing Up Work Zones

As rehabilitation work on the nation's aging highway system increases, so does the need to move drivers through work zones with minimal frustration. ITS technology shows promise in achieving that goal.

Highway agencies started using ITS technology for traffic congestion and incident management about 15 years ago. The more recent application of ITS technology in work zones—including such measures as traffic metering systems, changeable message signs, and variable speed limits—aims at increasing safety for workers and road users and at ensuring more efficient traffic flow.

"It is essential that highway agencies have traffic control in work areas that is both comprehensible to the public and recognized as necessary," observes Tom Hicks, Maryland State Highway Administration traffic engineer and chair of the ITS lead state team. "We want to inform the public, not just regulate. We want people to know there will be some inconvenience, but to have a better understanding of why, so they will comply with traffic controls. ITS technology enables us to do that."

ITS technology increases in importance as the nation's roads become more congested. From 1980 to 1999, vehicle travel increased by 76 percent, but the total miles of public roads grew by only 1 percent. The average length of congested periods in U.S. cities was 2 to 3 hours in 1982 but increased to 5 to 6 hours in 1999.

The combination of these two trends—more highway improvement projects and more congestion—shows why the traveling public is frustrated with work zone delays. An FHWA survey indicated that work zones are second only to traffic flow as causes of traveler dissatisfaction.

Maryland State Highway Administration demonstrates variable speed limit system to be deployed in summer 2003.

[1] All are available on the TIG website, www.aashtotig.org.

ITS technology offers ways to monitor traffic flow through work zones and to provide real-time information to motorists. Message signs and traveler advisory radio, for example, can provide information about what lies ahead, as well as alternative routes to ease the way around work zones.

"We want to inform motorists about what they're going to encounter, so that there are no surprises," Hicks explains. "We try to give them accurate and timely information to make good decisions."

Besides improving work zone mobility and safety, ITS technology can reduce construction time and costs. Several states have begun applying ITS technology in work zones, sometimes adapting general traffic monitoring equipment in congested areas. For example, Maryland has used ITS for projects on the state's sections of the Interstate 495 Beltway around Washington, D.C.

Maryland serves as the lead state in promoting ITS technology in work zones. The TIG plans to convene representatives from nine states that use ITS technology in work zones to inventory projects completed and under consideration. The inventory will be the basis for publications, videos, workshops, and presentations to transportation professionals.

"We want to get the word out on what can be done, and then it will take off on its own," says Hicks.

Accelerating Delivery

As traffic congestion and the number of highway reconstruction projects increase, accelerated construction also is attracting attention. The strategy relies on a variety of innovative techniques and technologies to get the job done faster and with improved long-term results.

"Accelerated construction is the way of the future," says Ted Ferragut, president of TDC Partners in Alexandria, Virginia, and chair of the TIG lead state team for accelerated construction. "It's a major readjustment in the way we deliver highway projects, but public tolerance for congestion is decreasing, and we have to bring corridors online faster."

Accelerated construction does not focus on speed at the expense of safety or quality. The project planning allows for decision making in an environment of maximum flexibility. Innovative contracting and designing for extended life of the finished product are part of the process.

"It's an entire process of reconstructing highway corridors and delivering services to customers in a faster, better way," Ferragut points out. "It involves getting people with a variety of skill sets in one room early on, so that they can work together on a strategic plan."

Indiana and Pennsylvania have tried the accelerated construction planning process, gathering teams of experts to develop recommendations for rebuilding corridors. The experts examined such issues as innovative contracting, traveler mobility and work zones, geotechnology, prefabricated elements, expedited right-of-way procurement, and long-life pavements.

Air void analyzer can test fresh concrete in less than half an hour, allowing engineers to make immediate adjustments and improve quality.

The result in Indiana was a proposal for rebuilding 18 miles of Interstate 465 in Indianapolis that reduced estimated construction time from eight years to three, and the number of contracts from four to one. The team also recommended incentive-based contracting to assure the best outcome.

In Pennsylvania, the experts determined that the estimated time to reconstruct a section of Route 28 through Pittsburgh could be cut from four years to two, and that creative geotechnology could eliminate nearly a year's worth of impact on the traveling public. The experts also showed that using three wider lanes with a reversible center lane during construction could move as much traffic as four narrower lanes and allow more work space for the contractor.

The TRB Task Force on Accelerating Innovation in the Highway Industry conducted the Indiana and Pennsylvania workshops. The TIG lead state team on accelerated construction will build on TRB's work by identifying appropriate corridor projects in other states and by organizing accelerated construction workshops during the next three years.

Airing Concrete

Using an AVA, Kansas DOT engineers can measure the entrained air void structure of fresh concrete in less than half an hour. The measurement enables immediate admixture adjustments that can improve the durability of concrete on roadways dramatically in a state that experiences extremes of weather.

The AVA also saves money. The traditional method tests the hardened concrete up to 4 weeks later. "By that time, there may be a lot of bad concrete out there, and that can create great economic hardship," com-

Texas DOT is preparing to train personnel from other state agencies in the use of ground-penetrating radar units, with help from Texas Transportation Institute.

ments Kansas DOT concrete research engineer John Wojakowski, an AVA implementation panel member.

Air entrainment—the deliberate introduction of many small, closely spaced air bubbles into the cement paste—can enhance the durability of concrete that will be subjected to freezing and thawing. The AVA device measures the air content, specific surface, and spacing factor of fresh portland cement concrete. Studies show that the AVA technique yields results similar to those from standard methods of analyzing hardened concrete—but on site, in real time, improving quality control.

Kansas adopted the technology two years ago and has developed specifications for routine use. The improved quality of the concrete pavement tested with the AVA during the past two years is expected to save the state about $1.1 million in future repairs.

AVA use is spreading to other states. In California, engineers plan to use the technology in reconstructing spans on the east end of the San Francisco Bay Bridge. The AVA will enable testing to determine whether the fresh concrete meets specifications that make it impermeable enough to resist saltwater, yet flexible enough to meet earthquake construction standards.

New York DOT has proposed AVA technology for testing precast concrete panels during manufacturing, instead of weeks later after hardening. "While waiting to test by the old method, you may already have produced a lot of panels," Wojakowski notes.

In addition to quality control and cost savings, AVA caught TIG's attention because Kansas was able to implement the technology quickly: "Two weeks after we decided to use AVA, I was in the field testing concrete," Wojakowski recalls. "The equipment had been bought and shipped, and I had trained on it."

Kansas DOT is working with FHWA to lead the implementation effort on AVA. Goals include developing a standard test protocol, specification, and data collection form that all states can use, as well as identifying training needs and available resources.

Rehabilitating with Radar

One of the biggest challenges in rehabilitating flexible pavements is identifying the source of the problem. Engineers have relied on such techniques as taking core samples to determine the conditions beneath the road surface that may be causing the deterioration.

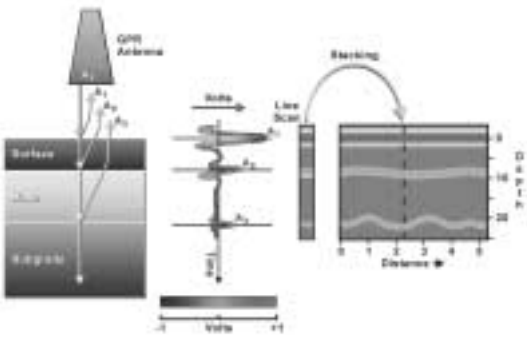
Since 1995, Texas DOT has used GPR to collect information about highway pavement layers. Developed by the U.S. Department of Defense to detect land mines, GPR is a truck-mounted device that transmits electromagnetic waves into the subsurface as the vehicle travels at normal highway speeds. The GPR antenna captures and stores reflected waves for analysis.

"It's analogous to taking an X-ray of the highway," observes Tom Scullion, research engineer for the Texas Transportation Institute at Texas A&M University and a GPR implementation panel member.

GPR can collect pavement layer data quickly, inexpensively, and without disrupting traffic—some of the reasons that the TIG chose the method as a focus technology. GPR data can be collected at up to 1-foot intervals, providing a more complete picture of conditions below the road surface than traditional methods, such as core sampling, can.

By analyzing GPR data, engineers can obtain information about pavement layer thickness, areas of low density, and excessive moisture in the pavement system. These data can help pinpoint problem areas for follow-up testing and enable development of the most effective repair plan.

"If you want to choose the best rehabilitation process, you need to understand what is causing the



Ground-penetrating radar pinpoints problems below the surface of asphalt pavements, allowing development of accurate, appropriate rehabilitation plans.

distress," Scullion explains. "GPR is a great tool for helping figure out what's wrong, so you can spend your rehabilitation money in the right way."

GPR's value was evident on a 14.2-mile highway section in Fort Worth, Texas, which had an initial repair estimate of $3.1 million. GPR analysis indicated air voids under the pavement, and the engineers changed the rehabilitation strategy, saving $550,000.

In another instance, GPR use may have prevented a major traffic accident. Engineers tested a section of roadway in downtown Austin, Texas, after a water main break. The GPR indicated a large washout under the asphalt surface layer, and the road was closed. That same night, the road collapsed.

A more recent GPR application is quality control on new construction. GPR can test asphalt layers just after application, so that engineers can determine the uniformity of the layers and can make adjustments quickly.

Florida and Minnesota have joined Texas in obtaining GPR equipment, and the TIG is developing a strategic plan to expand the technology's use to other state DOTs. The group plans to build on the training programs and interactive CD-ROMs that the Texas Transportation Institute has developed to train those who collect and process GPR data.

"We plan to bring people to Texas to train them and share our experiences with GPR, so that they can start using it in their own states," Scullion reports.

Surveying by Satellite

GPS technology offers many highway applications, but the TIG has focused on surveying because of the increases in accuracy and the reductions in labor, time, and costs. GPS technology uses a network of U.S. Department of Defense satellites that transmit precise signals to the earth around the clock. Ground-based receivers measure the time it takes a signal to travel from the satellite to the receiver, defining locations.

Utah uses GPS for surveying and has found that tasks that once required two or three people now can be accomplished with only one. In one study, GPS equipment recorded 5,511 topographic points in 30 person-hours, while a similar project with traditional surveying methods covered 1,500 topographic points in 120 person-hours. The GPS survey recorded 3.7 times the data points at one-quarter of the labor cost.

"GPS technology enables us to do more with less," reports GPS lead state team Chair John McCracken, director of the Office of Research and Technology Services at FHWA's Turner-Fairbank Highway Research Center. "It saves money because it saves manpower, at the same time offering comparable or greater accuracy."

GPS technology is widely available and quickly adaptable, and the technology does not require high-level training. Another advantage is that GPS can be integrated with geographic information systems for mapping.

Surveying with GPS technology saves transportation departments time, labor, and money over traditional methods.

Utah, Michigan, and North Carolina are the lead states for the initiative on GPS in surveying applications. Implementation plans include hands-on demonstrations of the technology, workshops on the advantages, and training programs for agencies that plan to apply GPS to surveying efforts.

The group also is looking at developing national standards and protocols for GPS programs. "We want to identify and promote best practices nationwide," states McCracken.

Updating Priorities

With promotion efforts under way for the first six focus technologies, the TIG plans to add three or four new technologies to the priority list each year. TIG's website, www.aashtotig.org, will post the additional focus technologies selected for 2003 later this summer.

As soon as a technology has achieved a level of awareness among transportation professionals that enables it to stand on its own, the TIG will retire it from the roster and turn further research and implementation over to other groups, including other AASHTO committees.

"We'll sunset our championing of a technology when we determine it has developed its own life," Hoffman explains. First on the sunset list may be prefabricated bridge elements and systems technology, which already have attracted great interest from transportation agencies and industry.

"The intent of the lead state team has been to bring greater exposure to what is being done and to the benefits," Ralls explains. "Because the technology serves so many purposes and gives us much more flexibility in bridge construction, we believe it's ready to take off."

Prescriptions for

Reviewing the History of TRB's Critical Issues in Transportation

ALAN E. PISARSKI

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Issues are the fodder of policy.

In December 2001 the Transportation Research Board (TRB) Executive Committee published *Critical Issues in Transportation 2002* (*1*)—14 issues deemed the central transportation concerns of this day. Some readers may not have realized that the Executive Committee's statement has a long lineage, starting in 1976 and appearing every two to four years.

The history of the TRB Critical Issues statements follows the ebb and flow of trends in issues. Which issues have been resolved or have disappeared from the radar screen? Which have been hardy perennials, appearing and reappearing on the lists, perhaps with syntax changes as words go in and out of vogue?

What Is an Issue?

Washington lives on "issues":

- To public policy officials, issues are controversial problems to face and to solve with legislation and programs;
- To a trade or professional association or a public interest group, an issue is an item on a list of priorities; and
- To a cabinet-level secretary or agency administrator, an issue is anything the White House, a senator, or a governor is upset about.

These definitions may be somewhat cynical, but the identification, assembling, and culling of issues

Energy, environment, safety, system maintenance, and land use all have been critical issues since the original document, published in 1976.

Research

lists can be a sincere and productive activity. Some issues lists take on the character of goals, effectively defining the ends to be achieved; some lists include agendas. In yet other cases, issues are the problems or the opportunities to pursue. Most important is for the list to convey to the reader the significance and immediacy of the problems.

> **issue:** a matter that is in dispute between two or more parties; a point of debate or controversy.
> —*Webster's Collegiate Dictionary*

Years ago, the National Transportation Policy Study Commission adopted the dictionary definition of an issue as a conflict with identifiable disputants. The Commission's earliest product was a 1978 list of issues and papers from nationwide hearings chaired by Congressman E. G. "Bud" Schuster. The Commission defined an issue as a

> …fundamental, enduring conflict among or between objectives, goals, customs, plans, activities, or stakeholders, which is not likely to be resolved completely in favor of any polar position in that conflict. (2)

For the Commission, therefore, an issue never could be solved but only re-solved, depending on the balances of the disputants' power, resources, and knowledge. The Commission's hearings, nonetheless, identified issues that were more of the "problem to be solved" variety.

Most transportation issues statements do not convey the dictionary sense of conflict and dispute. Instead, most issues lists comprise problems to be solved or areas of focus for action.

The TRB definition of an issue, first formally stated about 10 years after the start of the Critical Issues series, also conveys the dictionary definition's sense of matters unresolved and causing contention. According to the elegantly phrased TRB definition, issues are

> …those unresolved aspects of transportation, national in scope, on which there is a wide variety of viewpoints, for which the impacts of possible actions are unknown, and for which decisions will be made at the policy level. (3)

First Lists, 1976–1981

The first TRB issues list appeared as a terse, three-page "top ten" statement in the November–December 1976 *Transportation Research News* (4). Variations on the list followed in 1978 and 1981 (5, 6). All three hewed to the top-ten concept, and all were titled, "Ten Most Critical Issues in Transportation," constituting a package in themselves.

The first part of Table 1 (page 33) shows the top-ten list from the 1976 article. The 1978 and 1981 updates kept the list to 10 but were more than updates, adding several new items and dropping or restating others.

Until 1981 the order of the issues had no significance, but in 1981 list rank became key. The 1981 list perhaps differs the most from the others—the TRB Group Councils and Committee chairs were invited to make suggestions and finally to vote on the priority order of the 1978 issues for review by the Executive Committee. This process has not been repeated.

New Perspectives

The addition of new issues during this first period is perhaps more apparent than real. The new issues introduced new perspectives on older issues or new ways of phrasing a topic:

- The topic of finance, for instance, took the form of "Financing Transportation and the Equitable Allocation of Resources" instead of addressing only the issue of finding the money.
- The issue, "Viability of U.S. Railroads," introduced in 1978, was probably an outgrowth of the 1976 "Effects of Transportation Regulations." A quotation from that discussion is still pertinent today:


The Ten Most Critical Issues in Transportation

The first Critical Issues list appeared in 1976 and set a "top ten" format as the standard for its immediate successors. The all-text article, bylined by "The Executive Committee of the Transportation Research Board," was initiated "at the request of …the National Research Council," and stated intentions for the list to "be reviewed, refined, and updated every year or two…."

Critical Issues 1991, 1994, 1997, and 2002 opened with signed introductions by TRB Executive Committee chairs and enhanced the informative statements with photographs and charts; the 1997 and 2002 editions also were printed as stand-alone publications.

"Because of the low rate of return on investment, the railroad industry is faced with increasing difficulty in raising capital."

◆ The 1978 issue, "Improved Utilization of Existing Facilities," generalized a more limited topic from 1976, but introduced concern about operations and demand management.

Gauges of Change

The new issue in 1978 was the "Need for Specific, Measurable, and Attainable Goals at the National Level," a theme that has resurfaced from time to time and remains appropriate today. For a while, because of delays in legislative reauthorizations, the federal government's reliability in undertaking surface programs was questioned, and there were conflicts over its role in transit. In 1981, "Survival of Public Transit Systems" joined the "Viability of U.S. Railroads" topic, and "Interrelationship Between Transportation and Economic Development" also appeared on the list.

Energy, environment, safety, and land use were identified as concerns at the first, and—except for brief absences—have been perennials on the lists. Many of the descriptions of these and other issues did not change with updates.

The 1976 version of the system maintenance and management issue began with the mantra, "The U.S. transportation system is now essentially in place," and the 1978 and 1981 versions repeated the phrase. In a totally unrelated event, the 1984 issues list dropped the system-is-now-in-place sentiment but added the topic of congestion for the first time.

The lists developed in the 1970s still would serve well today. Statements of the same topics since then largely reflect shifts in the way of saying things instead of changes in perspective.

Middle Period, 1984–1987

The 1984 Critical Issues list broke away from the mold (3). It not only was the first to define an issue but jumped from 10 to 18 issues.

Why and how it was decided to scrap the top-ten concept and go to a broader list is a matter of conjecture. After 1984 the list reverted to top-tens again for three cycles (*7–9*), dropped to a list of five issues in 1997 (*10*), and jumped again to a large number, 14, in 2002. It will be interesting to see what happens in the next installment.

There were more new issues in 1984 than support for old issues, with 10 of the 18 new or nearly new—since some were variations on past issues. But inspection of the new issues indicates that truly new and current topics were being introduced: improved productivity, international competitiveness, procedural complexity, impacts of high technology, private-sector involvement in the decision-making process, truck freight, and congestion.

Two other new issues were one-time events: "Decommissioning of Existing Infrastructure," dealing with road abandonments that had occurred in some farm states, and "Loss of the Transportation Equipment Manufacturing Industry." A harbinger of current concerns appeared in the discussion of finance, which cited the exemptions of gasohol and other fuels from the motor fuels tax—as well as the anticipated introduction of more fuel-efficient vehicles—as reducing the federal highway trust fund's revenues for investment.

An interesting addition, "Changing Character of Urban Transportation Services," was an extension and broadening of the transit survival topic of 1981. It noted that "the strain of paying for existing services is approaching the breaking-point in many localities" and addressed a broad set of related topics, some of which are still concerns today.

The single new addition to the issues list in 1987 was "Changing Roles of Federal, State, and Local Governments"—in some ways an extension of earlier statements on national goals and intergovernmental relations. The vogue during this period was to shift responsibilities from Washington to state and local governments or to the private sector. An important 1987

TABLE 1 Trends in Critical Issues

		1976	1978	1981	1984	1987	1991	1994	1997	2002
	No. of Issues Identified	10	10	10	18	10	9	10	5	14
Critical Issue as Introduced										
Early Period										
1976	Financing Requirements and Alternatives for Transportation Systems and Services	1		1		4	3	10		8
	Energy Efficiency in Transportation	2	10	8	15		6			6
	Intergovernmental Responsibility for Transportation Systems	3	2	4			7			
	Transportation System Maintenance Technology and Management	4	7	5	12		4	4		7
	Transportation System Performance Criteria and Design Standards	5	5	6						
	Effects of Transportation Regulations	6	4		10	8				
	Improvement of Existing Nonurban Transportation Facilities	7	6	2						
	Transportation, Land Use, and City Forms	8								
	Transportation and the Environment	9			16	10	5			5
	Transportation Safety	10			4	3	8	5		2
1978	Need for Specific, Measurable, and Attainable Goals at the National Level		1	3						
	Financing Transportation and the Equitable Allocation of Resources		3		5					
	Viability of U.S. Railroads		8	9						
	Interrelationship of Energy, Land Use, and Transportation		9							
	Improved Utilization of Existing Facilities		6	2						
1981	Interrelationship Between Transportation and Economic Development			7	3	7				
	Survival of Public Transit Systems			10	11					
Middle Period										
1984	Improved Management of Public Capital Investments in Transportation				1	1				
	Improved Transportation Productivity				2	2	1			
	Procedural Complexity of Government Transportation Decisions				6					
	Challenge of the High Technology/Information Age				7			3	4	
	Transportation and the U.S. Competitive Position Worldwide				8	6		7		
	Decommissioning of Existing Infrastructure				9					
	Loss of the Transportation Equipment Manufacturing Industry				13					
	Congestion of Traffic Facilities				14	9	2			3
	Involving the Private Sector in the Planning Process				17					
	Highway Goods Transportation				18					
1987	Changing Roles of Federal, State, and Local Governments					5			5	
Modern Period										
1991	Human Resources						9	9		9
1994	Sustainable Transportation							1	2	
	Institutional and Legal Reform							2		4
	Intermodal Issues							6		
	Quality							8		
1997	Mobility and Accessibility								1	
	Safety and Security								3	1
2002	Industry Consolidation									10
	Aging Population									11
	Equity									12
	Impact of Telecommunications									13
	Barriers to Innovation									14

Numbers show the order of the issue's appearance in original text

PHOTO: GERALD NINO/U.S. CUSTOMS

Transportation security appeared on the 1997 Critical Issues list but did not generate urgent attention among policy makers. Security topped the 2002 list, published three months after the September 11, 2001, terrorist attacks.

topic, the effects of deregulation—especially the declining number of carriers—reechoes in the 2002 list.

Modern Period, 1991–2002

The 1991 statement first presented the issue of "Human Resources," which has remained on the lists ever since and probably will continue to be listed for years. The approach in the 1991 document is one of the most effective, citing the concerns that framed each issue and posing questions that pointed toward resolutions.

The 1994 treatment introduced several new issues—significantly, the terms "sustainable," "intermodal," and "quality" appeared for the first time. The technical and graphical presentation of the issues in this edition was outstanding.

The 1997 report covered only five issues, which is misleading, because two were composites—"Mobility and Accessibility" and "Safety and Security." But the enduring significance of this report is that it raised the concern about security against terrorist acts. In 1997, this was a prescient statement that was inadequately heeded:

- How vulnerable is the U.S. surface transportation system to threats of terrorism and sabotage, and what should be done to address these concerns?
- Given that the U.S. passenger systems were designed to be accessible, easy to use, and capable of processing masses of users efficiently, what kinds of changes to increase security will users accept and be willing to pay for? (*10*)

These are pressing questions today and have no easy answers.

The most recent Critical Issues statement adds two new elements of significance: the term "equity" applied to socioeconomic groups and the debut of a demographic issue, the aging population. Despite all the demographic drama that America has experienced in the last 30 years—such as the Baby Boom, the Sun Belt migration, suburbanization, and immigration—"Aging Population" is the first expressly demographic issue raised in the series.

Enduring Threads

Synthesizing what has occurred over the 28 years as issues have been introduced may be hazardous—the same words used in the documents may mean different things, as words lose nuances or acquire new currency. Nonetheless, seeing the broader picture over time is valuable.

Is there currency in this collection of issues? Has the TRB Executive Committee and its staff done a good job over the years in identifying issues? A response must avoid measuring the vogues of words coming and going or the waxing and waning of the power of contestants in the issues.

Nonetheless, some overarching themes emerge:

- **Transportation and….** A set of issues always will cover the ways that transportation interacts with the world, usually in terms of the negative effects. Examples of interaction issues with negative implications include transportation and energy, transportation and the environment, and transportation and safety. On the neutral or positive implications side, the interaction theme includes transportation and economic development, transportation and international trade, transportation and productivity, and transportation and land use.
- **Getting more out of the system.** Issues in this theme group identify what might be called an internal set of actions that involve improving the status quo: maintain the system better, manage assets better, increase throughput, streamline processes, respond to future needs, and plan for human resources.
- **Coordinating the players.** Transportation involves all levels of government and many components of the private sector. A set of hardy perennial issues always has developed around the interactions among the players—between the levels of government and the private sector—for example, improving intergovernmental arrangements, regulation and deregulation, planning policy interactions, and public–private cooperation.

◆ **Saving some.** Several issues have identified the needs of a threatened or declining component of the industry—for example: road disinvestments, saving transit, viability of railroads, or equipment manufacturing.

◆ ***Respice, adspice, prospice.*** Surprisingly, few issues have been anticipatory, identifying looming challenges—security is one, the aging population another. Most of the issues have focused on the here and now, implying that something is not working and needs to be fixed. Amtrak is the quintessential example. Issues statements seldom have focused on methods, such as planning, and rarely have mentioned data. A component of issues, however, has focused on where we are and where are we going. These include national goals, performance measurement, design standards, and sustainability.

◆ **Where's the money?** Money is, and probably always will be, the main issue. Concerns about where the money will come from to deal with the problems intertwine with the relationships between levels of government. The unreliability of the federal process will generate continuing concerns, such as finance, sharing costs, funding equity, and new sources of revenue.

Final Scorecard

In the 28-year history of the Critical Issues documents, has it been said of any of the issues, "This one is solved!" or "This one went away by itself"? Perhaps, but of very few. More often, times have changed, and topics were moved off the stage by events or with the arrival of different players.

Semantics can fog the statements. The National Transportation Policy Study Commission's definition of an issue may have some advantages—the case can be made that nothing changes.

But that is too negative a view. In many cases, progress has been made, and the apparent persistence of an issue is really a further refinement, as new values refine old problems and sharpen goals. Environment, safety, and systems maintenance are still critical issues, but that does not mean that progress has not been made in each area.

A reexamination of the TRB definition of an issue supplies a basis for optimism. A key to the TRB definition—appropriate to TRB's role as the center of research in transportation—is the implication that research can resolve portions of any issue.

The TRB definition suggests that better knowledge of the potential impacts of possible actions could enlighten "those unresolved aspects of transportation…for which the impacts of possible actions are unknown." This presents a more positive view of issues, in contrast to the notion of irreconcilable conflict, indicated in other definitions. The TRB definition also implies a guide to action—the first step in addressing issues would be to collect better data to analyze the possible outcomes of alternative policy responses.

A measure of progress, then, would be the extent of TRB's additions, over the years, to the storehouse of knowledge and analytical tools assessing "the impacts of possible actions" in response to policy concerns. By that measure, TRB and the transportation research community have made substantial progress, but with much more to be done.

Overall, the work of many people over many years in identifying critical issues has proved a useful and engaging exercise. In many cases, the issues have heightened recognition of threats to the system and have consolidated and focused responses at all levels.

Others should take on the task of reviewing the history of TRB's Critical Issues from different viewpoints. For example, other organizations also identified transportation issues during this same period—notably the National Transportation Policy Study Commission and the General Accounting Office—providing ample fodder for historians and policy analysts.

Acknowledgment

Eno Transportation Foundation invited the author to examine the topic of issues—including those identified by TRB—in 1990, and this article incorporates some of the research for that presentation.

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Preserving the Profession's Memory *An Archiving Primer*

ROLF SCHMITT

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The field of transportation has a long and rich history that is often best revealed in internal reports, correspondence, personal photographs, and other unpublished material. This raw material of history is frequently lost when individuals retire, organizations change, closets are cleaned, or paper and film deteriorate. E-mail and electronic recordkeeping have increased the rate at which correspondence and unpublished materials are created and lost, as the hardware and software for reading electronic files become obsolete.

Many of today's transportation issues have persisted for decades, as illustrated by the Transportation Research Board's (TRB) list of critical issues—dating back to the 1970s and updated regularly. Understanding how these issues were treated in the past is essential to developing effective responses in the present—decision makers can learn more from past deliberations than from contemporary justifications. Comparing today's data with information compiled in the past is always informative.

The preservation of the profession's history is an individual and an institutional responsibility. Most organizations have rules for archiving official material, and libraries have strategies for identifying and preserving a range of significant records. But many valuable documents and files are maintained by individuals or offices with neither the energy nor the time to determine what is worth keeping and how best to keep it.

Several TRB committees are concerned about archiving—the Committee on Transportation History, the Committee on Library and Information Science for Transportation, and the Committee on National Transportation Data Requirements and Programs. A session at the 2002 TRB Annual Meeting launched a discussion about preserving the transportation profession's memory.[1]

Two of the presentations traced out the archiving

[1] Preserving the Transportation Profession's Memory, Session 241, TRB 81st Annual Meeting, Washington, D.C., January 14, 2002.

PHOTO: ARCHIVES DIVISION, NATIONAL AIR AND SPACE MUSEUM

Archivist retrieves photographs stored in the National Air and Space Museum, Washington, D.C.

issues now confronting committees, transportation organizations, and individual professionals. Janice W. Bain-Kerr, a professional librarian and consultant in the Washington, D.C., area, spoke on "Managing Your Own Stuff: A Practical Guide for Transportation Professionals and Their Survivors," and Steven Puglia of the National Archives and Records Administration considered "Electronic Files: Archivist's Nightmare."

Starting an Archive

One or more of the following may produce the impetus for the preservation of personal and institutional transportation records, memoirs, and libraries:

- A person's retirement or severance from an organization;
- Office relocation;
- Organizational or corporate mergers, closures, or paradigm shifts;
- Self-instituted or mandated action by an individual, government, or organization;
- Solicitation of materials by a library, museum, or archive;
- Estate planning; and
- Personal disability or death.

In the best of scenarios, the disposition of materials is planned in advance and proceeds orderly, regardless of the specific impetus. In the worst-case scenario, time, lack of understanding or lack of appreciation for the materials, or the absence of a plan or of a knowledgeable person who can serve as an agent, present greater challenges. Nonetheless, the requirements will be similar, although without planning the choices will be less than optimal.

The best-case scenario requires the following measures:

- Identifying and organizing the material;
- Preparing a detailed inventory;
- Taking the written and legal steps to ensure that institutional and personal representatives are aware of the plan of action;
- Finding a suitable repository and negotiating a preliminary agreement; and
- Becoming actively involved in the placement, access measures, and financial arrangements to facilitate the transfer.

These measures will help ensure the widest possible access to, and use of, the materials by the patrons and staff of each receiving institution.

The worst-case scenario allows little or no time for an orderly transfer of materials. No directives or advocates are identified, and geographic, financial, or legal issues preclude either transfer to a suitable resource or evaluation by a qualified institutional representative or consultant. As a consequence, materials are destroyed, whether outright or through attrition, or go to institutions without appropriate curatorial services, to languish in storage.

PHOTO: FEDERAL HIGHWAY ADMINISTRATION

Federal Highway Administration staffers Sterling Jones and Velma Mackall consult archival material at the Turner-Fairbank Highway Research Center, McLean, Virginia.

Finding a Repository

Libraries, archives, and museums are the obvious repositories. Less obvious recipients may include the employer, an historical society, or a fraternal organization.

Specialized libraries, archives, and museums—whether public or private—are well documented in national, state, and local directories. Many of these institutions may have extensive, world-renowned specialized collections, while others may have smaller collections dedicated, for example, to the region's history, geography, industry, environment, or notable personages.

Historical societies range from large and well organized state, county, and local societies with extensive holdings, professional curators, adequate physical facilities, and an active membership, to fledgling organizations without permanent facilities or full-time staff. Fraternal organizations, such as the Masons, have extensive archival and historical museum and library collections.

The directories of libraries, museums, and archives, listed in the box on page 40, are a good starting point for considering the possibilities for placing a collection. Most of the directories list contacts and website addresses (many institutions have web-based systems), include a synopsis of each collection, and offer indexes by transportation mode or by specific names.

In response to an inquiry, most institutions will confirm interest in the materials offered, provide more detailed information about the general collections, and explain the policies and procedures, as well as the terms and conditions, under which materials are accepted. Some may arrange for a preliminary assessment or may refer inquiries to a more appropriate repository.

Proper care of papers, photographs, and other materials—as well as the future retrievability of electronic documents—is a key consideration in choosing a repository.

PHOTO: ARCHIVES DIVISION, NATIONAL AIR AND SPACE MUSEUM

The major professional organizations for library and information science, archivists, museums, historical societies, and records managers publish or maintain membership directories and most have state and local or regional chapters or divisions. The box on page 39 provides a descriptive list of sample organizations with resources for managing archives.

Most offer consulting services, often free of charge, or can direct inquirers to members or to related organizations that provide in-depth consultation. Consultants and consulting groups will discuss services, strengths, and fees up front, and many will give some free assistance initially. The benefits from engaging professional assistance in organizing and placing materials may be well worth the cost.

Making the Transfer

Reviewing Policies

Libraries, archives, museums, and other specialized groups use similar vehicles and vocabularies to describe operations and policies. The **collection development policy** documents the institution's guidelines on subject areas and formats of materials routinely acquired and made accessible to the public. Many organizations post their policies on their websites, or copies may be available through the reference desk or the director's office.

The policies reflect the best practices of the professional groups with which the institution is associated and generally will cite the documents and **codes of ethics** under which the institution operates. The policies define acquisitions in terms of the overall objectives, scope, and mission of the organization; provide guidance on the storage, preservation, and conservation of materials; and describe valuation, appraisal, and terms and conditions of acceptance, exchange, or transfer.

Determining Values

Appraisal and valuation of books and materials is also critical in materials transfer. Most organizations will not appraise or value materials directly but will guide donors to appropriate appraisal groups or professionals and may suggest helpful tools. Some institutions have guidelines for valuing materials; however, these may not be applicable to specialized materials—in that case, affordable professional assistance is best.

The original prices of trade books—published by trade and professional societies—are available in back issues of *Cumulative Book Index*, used in most libraries for acquisition and identification. Libraries also can recommend antiquarian book guides, and price listings in reputable online sources such as Amazon and Alibris can give some sense of values.

Not all books or collections have monetary value, nor do they necessarily have intrinsic value. Books—even some specialty titles—are often in print for long periods and circulate widely. Libraries rely on standard buying guides and standard tools for developing subject collections; a title therefore may have been collected widely.

WorldCat, an extensive online catalog of the monographic and serial collections of libraries worldwide that participate in the Online Computer Library Center, a major bibliographic utility for library cataloging and interlibrary loan, will show how widely held a book or serial is.[2] Many public and academic libraries have WorldCat in the online catalog system as part of the FirstSearch database. These resources help to determine the scarcity of an item and its potential value to a region or library system.

Establishing Access

Access, making the material available to the public, is another topic to discuss with a prospective repository. The steps include accessioning and adding to the collection, describing and cataloging an item, and informing the public. Access also involves determining the criteria under which materials can be handled, viewed, used, or loaned.

Organizations want materials that not only are relevant to institutional goals and missions but that also are without major constraints or limitations on access. Sensitive or critical documents, of course, are exceptions.

The issues of **exchange and transfer** also should be discussed with a potential or selected repository. Many institutions routinely transfer materials to other, more appropriate, collections, or may trade for collections or items more appropriate to the holdings. They also lend materials for exhibits. Resolve these questions before making a commitment.

[2] www.oclc.org/worldcat

Preservation and conservation vary with need, funding, and type of material. Policies and procedures may cover everything from the conditions of the physical storage to the conversion to other media, such as microfilm or digital files.

Covering Legal Matters

Legal documentation is a final matter. Write out the legal considerations that represent the best interests of the owner of the material, that allow for the greatest access, and that present the contributions to the transportation community in the best possible way. Documentation should specify the ownership of the materials donated, so that copyright and clear title to the material can be determined effectively.

Retirees now face institutional and legal parameters that were not encountered in the past. Most publicly

PHOTO: GOLDA MEIR LIBRARY ARCHIVE, UNIVERSITY OF WISCONSIN–MILWAUKEE

Public accessibility of documents—including facilities for use and policies for loans—is another topic to consider when donating materials to an archive.

Organizations with Resources for Managing Archives

American Association of Museums
1575 Eye St., NW, Suite 400, Washington, DC 20005; 202-289-1818; www.aam-us.org
AAM represents museums of every variety and promotes understanding of museum missions and purposes. A primary goal is to develop and communicate the highest professional standards in all phases of museum operations, including management and finance, conservation, ethics, education, community involvement, and audience research.

American Library Association
50 East Huron Street, Chicago, IL 60611; 800-545-2433; 312-440-9374 (fax); www.ala.org
The world's oldest and largest library association, with 64,000 members representing academic, public, school, government, and special libraries worldwide, ALA develops policies and guidance to inform and set standard procedures for libraries. Of special interest for records, special collections, and archives are ALA's Association of Specialized and Cooperative Library Agencies (which includes state libraries), Government Documents Roundtable, and a Joint Committee on Library-Archives Relationships with the Society of American Archivists.

Association of Records Managers and Administrators
13725 West 109th Street, Suite 101, Lenexa, KS 66215 ; 913-341-3808; 800-422-2762 (United States and Canada); 913-341-3742 (fax); www.arma.org
ARMA provides standards, codes of ethics, publications, journals, and professional development services, as well as links to extensive archives and records management sites (infomgmt.homestead.com/files/sitefram.htm). The ARMA website lists regional chapters, committees, and special interest groups (SIG); transportation is included in the Product and Technical Services Sector SIG.

Society of American Archivists
527 South Wells Street, 5th Floor; Chicago, IL 60607; 312-922-0140; 312/347-1452 (fax); www.archivists.org
SAA is "North America's oldest and largest national archival professional association," serving more than 3,400 individual and institutional members working "to ensure the identification, preservation, and use of records of historical value." The Sections and Roundtables groups offer information on specialized archives (www.archivists.org/saagroups/index.asp) and a link to the University of Idaho's list of 4,800 repositories of primary sources for archival research (www.uidaho.edu/specialcollections/Other.Repositories.html).

Special Libraries Association
1700 18th Street, NW, Washington, DC 20009-2514; 202-234-4700; 202-265-9317 (fax); http://www.sla.org
SLA's 15,000 members—from academic, research, industry and corporation, government, military, and public libraries worldwide—are organized into 58 regional chapters and 25 divisions according to subjects, fields, or information handling techniques (see listings at www.sla.org/content/chdiv). Transportation has its own division, but is also represented under Engineering (including the Aerospace section), Materials, and Petroleum and Energy Resources. The Transportation Division maintains an active website (www.library.nwu.edu/transportation/slatran) and a listserv (subscription address: listserv@listserv.acns.nwu.edu; list address: TRANLIB@listserv.acns.nwu.edu). SLA chapters and divisions provide consulting services, some free of charge, and can assist in locating appropriate consulting librarians or archivists.

Special Collections Directories

Directory of Archival Organizations in the United States and Canada. Society of American Archivists. www.archivists.org/assoc-orgs/directory/index.asp

Directory of Special Libraries and Information Centers (M. Faerber and M. Miskelly, Eds.; 26th ed.). Gale, Farmington Hills, Michigan, 2001. (See Subject Index volume for transportation-related topics.)

Guide to Archives and Manuscript Collections in the United States: An Annotated Bibliography. D. L. Dewit, compiler. Greenwood, Westport, Connecticut, 1994.

International Biographical Directory of National Archivists, Documentalists, and Librarians (J. M. Wilhite, T. J. Kosmerick, and L. Scrivene, Eds.; compiled by Susan Houck; 2nd ed.) Scarecrow Press, Lanham, Maryland, 2000.

Subject Collections (L. Ash and W. G. Miller, compilers; 6th ed.). Bowker, New Providence, New Jersey, 1985 (2 volumes).

Who's Who in Special Libraries. Special Libraries Association, Washington, D.C., annual. (Membership directory with detailed contact information for chapters and divisions; see also www.sla.org/content/chdiv.)

funded organizations, as well as many private groups, have mandatory records management programs in response to state or federal laws. Many of the materials that once left an office with the former employee or that in the past would have been discarded must now be examined. The employer's records management group should have guidelines, and most web search engines will retrieve state and local government records management guidelines and legislation. Some state agencies have historians on staff who can help.

Going Beyond

Funding is a critical issue for most museums, archives, and historical societies that maintain special collections. Most libraries have funding only for the staff and the space required. Without endowments and gifts, libraries have difficulty allocating a budget for appropriate access and preservation. Therefore any financial assistance that the contributor of the material can offer is always welcome.

Finally, there are other avenues for sharing knowledge and materials with the present-day and future transportation community, as well as the general public.

- Many local public libraries, historical societies, and state libraries or archives have oral history programs—invaluable opportunities for speaking about a transportation subject area.
- Professional organizations have retiree caucuses or committees.
- Organizations such as the Boy Scouts of America, retiree groups, and service groups are always looking for speakers on topics of local interest, as well as on newsworthy national topics that specialized knowledge can place in historical context or perspective.

Reading Electrons

Archiving has become more complicated because of materials recorded in e-mails, electronic databases, and other types of electronic files. Huge amounts of information can be compressed, in searchable formats, into a small space—single disks can store file cabinets of documents, and information can be retrieved by word searches instead of via complicated filing systems.

But the technology for reading computer files changes rapidly. Clay tablets and papyrus have lasted for thousands of years, and the Rosetta Stone has assisted in deciphering the content. Eight-inch floppy disks hold information from three decades ago, but the hardware and software to read the contents are no longer available.

The technology of preservation once focused on countering the deterioration of physical media such as paper and film but now must maintain digital information in a variety of formats and media. As constant updating and replacement of programs and platforms render old technology obsolete, digital information must migrate to the new.

Organizations and individuals should consider an active approach to records management. Issues include the traditional decisions about what to keep and for how long, as well as data security, backup maintenance, and technological obsolescence.

The National Archives and Records Administration is conducting research on preservation of, and access to, electronic records.[3] The National Aeronautics and Space Administration also is looking at functional requirements for long-term preservation of digital data.[4]

Printing electronic documents onto paper or optical media that can be preserved by traditional methods is the safest and perhaps the most manageable solution, although counterintuitive to the demand to digitize for sharing over the web. For now, paper is the ultimate backup.

Looking to TRB

TRB is a major source of information for the transportation profession, through meetings and publications, materials in the TRB Library, and the online Transportation Research Information Service.[5] TRB also has been a major partner of the National Transportation Library, an enterprise of the U.S. Department of Transportation, which has only a fraction of the holdings and tenure of similar repositories for agriculture, medicine, and other fields.[6]

[3] www.nara.gov/era
[4] ssdoo.gsfc.nasa.gov/nost/isoas
[5] ntl.bts.gov/tris or 199.79.179.82/sundev/search.cfm
[6] www.ntl.bts.gov

CALENDAR

TRB Meetings
2003

July

11 Data Analysis Working Group (DAWG) Forum on Pavement Performance Data Analysis
Guimaraes, Portugal
A. Robert Raab

13–15 28th Annual Summer Ports, Waterways, Freight, and International Trade Conference
Portland, Oregon
Joedy Cambridge

15–18 Joint Summer Meeting of the Planning, Economics, Finance, Freight, and Management Committees
Portland, Oregon
Kimberly Fisher

15–17 10th AASHTO and TRB Maintenance Management Conference*
Duluth, Minnesota
Frank Lisle

20–23 42nd Annual Workshop on Transportation Law
New Orleans, Louisiana
James McDaniel

23–26 Highway Capacity and Quality of Service Committee Midyear Meeting and Conference
Buckhead, Georgia
Richard Cunard

27–30 2nd Urban Street Symposium
Anaheim, California
Richard Cunard

September

25–29 International Conference on Pavement Performance, Data Analysis, and Design Applications*
Columbus, Ohio
G. P. Jayaprakash, Stephen Maher, Frederick Hejl

October

28–29 5th National Conference on Asset Management—Moving from Theory to Practice
Seattle, Washington
Thomas Palmerlee

November

16–18 9th National Light Rail Transit Conference*
Portland, Oregon
Peter Shaw

2004

January

11–15 TRB 83rd Annual Meeting
Washington, D.C.
Mark Norman

April

13–17 5th International Conference on Case Histories in Geotechnical Engineering*
New York, New York
G. P. Jayaprakash

May

5–8 5th International Conference on Cracking in Pavements: Risk Assessment and Prevention*
Limoges, France
Frank Lisle

23–26 10th International Conference on Mobility and Transport for Elderly and Disabled People
Hamamatsu, Japan
Claire Felbinger

July

21–24 Highway Capacity and Quality of Service Committee Midyear Meeting and Conference
State College, Pennsylvania
Richard Cunard

August

29–Sept. 1 Sixth National Meeting on Access Management
Kansas City, Missouri
Kimberly Fisher

September

19–22 2nd International Conference on Accelerated Pavement Testing*
Minneapolis, Minnesota
Stephen Maher

19–22 2nd International Conference on Bridge Maintenance, Safety, and Management (IABMAS '04)*
Kyoto, Japan
Frank Lisle

October

19–24 6th International Conference on Managing Pavements*
Brisbane, Queensland, Australia
Stephen Maher

Additional information on TRB conferences and workshops, including calls for abstracts, registration and hotel information, lists of cosponsors, and links to conference websites, is available online (www.TRB.org/trb/calendar). Registration and hotel information usually is available 2 to 3 months in advance. For information, contact the individual listed at 202-334-2934, fax 202-334-2003, or e-mail lkarson@nas.edu.

*TRB is cosponsor of the meeting.

TRB SPECIAL REPORT

Naval Engineering

Alternative Approaches for Organizing Cooperative Research

SUSAN GARBINI AND PETER JOHNSON

Garbini, formerly a Senior Program Officer in the TRB Division of Studies and Information Services, and Johnson, a consultant, served as study directors for this project.

The naval engineering program of the U.S. Navy Office of Naval Research (ONR) is facing serious limitations in supplying the creative talent and know-how—as well as the management—for broad-based, "total ship systems" research programs. ONR therefore asked the Transportation Research Board (TRB) of the National Research Council (NRC) to investigate and evaluate alternative approaches for organizing and managing cooperative research programs in naval engineering.

ONR supports naval engineering science and technology development to enable the Navy to build and operate an effective and capable fleet; ONR also must ensure that the research results are useful in the design of advanced naval warships. This mission requires ONR to

- Define research goals and themes,
- Support innovative and high-quality research, and
- Ensure the continuing availability of the necessary human resources.

In calling for the TRB study, ONR stressed the need to promote innovation, incorporate total systems concepts in naval engineering, and involve all stakeholders—government, industry, and academia—in decision making. ONR programs should attract talented researchers and enable stakeholders to collaborate and guide the research process.

Under the auspices of the Marine Board of TRB, the NRC convened the Committee on Options for Naval Engineering Cooperative Research (see sidebar, page 45). The committee heard extensive presentations from experts in government, academia, and industry with a variety of perspectives on cooperative research organizations. After the presentations, the committee undertook an analytical examination of the goals, objectives, and attributes of successful and effective organizational models for research.

TRB Special Report 266: Naval Engineering: Alternative Approaches for Organizing Cooperative Research presents a synthesis of the information gathered by the committee, along with the committee's analyses. The committee evaluated the basic organizational concepts inherent in the current ONR system, which employs the individual investigator approach, as well as three selected models with venues for cooperative research. The committee then identified the advantages and disadvantages of each model. Finally, the committee commented on features in each model that satisfy the goals and objectives of revitalizing the field of naval engineering and improving ship design and production.

Goals and Objectives

ONR has two overall goals for naval engineering cooperative research: (*a*) to maintain and develop human capital and (*b*) to revitalize naval engineering and improve ship design and production. To compare approaches for organizing naval engineering research, the committee defined these two goals in terms of specific objectives and sets of attributes.

The key objectives embodied in the goal of ensuring an adequate supply of human capital for advanced naval ship systems design and production include attracting students, attracting and retaining faculty, providing continuing education opportunities, and fostering the development of "total ship engineers." Naval engineering graduates and practicing professionals need to approach ship design, development, and production and construction from the total ship point of view, to meet the challenges of the future. The concept of total ship engineer, therefore, must be infused into the education and professional development of future naval engineers.

The second goal requires that the U.S. ship design community revitalize its ability to accomplish creative new research and to support higher-performing, cost-effective designs and more innovative ship systems engineering. In addition, research results must be transferred to the next stage of technology development and be incorporated into ship designs.

Organizational Models

After reviewing an array of organizational models and proposed approaches, the committee focused on core strategies for organizing cooperative research programs. The individual principal investigator model

used by ONR for most of its research programs became the base or reference model for discussions and evaluations. The committee selected three cooperative models that represent three different organizational approaches and that incorporate the features of most existing and proposed models.

- The professional society or community of practitioners model,
- The consortium model, and
- The project-centered model.

The committee assumed that all three models would (*a*) coordinate the contracting functions for individual projects funded by ONR and (*b*) propose annual research themes, present them to ONR for approval, and then contract for and manage the individual projects.

The professional society model is directed by the community of practitioners in the field, usually organized into professional societies, such as the American Society of Naval Engineers or the Society of Naval Architects and Marine Engineers. In this model, the professional society establishes a research council, typically a not-for-profit organization, to organize and manage the research program. The council is made up of representatives from the various stakeholders, with an administrative support staff, and with composition and leadership designed to achieve balance. Committees drawn from the society's membership perform tasks to support the research council.

The organizational structure of the consortium model relies on a permanent entity, or center, for the management of research, education, outreach, and technology transfer. Typically, a director leads the consortium with support from an administrative and contract management staff and reports to an executive committee of stakeholder representatives. To solicit input and disseminate information, the executive committee establishes affiliate committees, advisory boards, industrial liaison groups, and outreach specialists.

In the project-centered model, an executive council similar to that in the consortium model establishes research themes and handles the processing and review of proposals. The council is permanent but rotates membership. The council chair provides the principal leadership for the committee and oversees a small administrative support staff. Additional input on research themes is handled via workshops and open forums, through professional society committees, or by industry associations.

The project-centered model usually focuses on large, multidisciplinary projects. For each project, a technical review committee prepares requests for proposals, evaluates the proposals, and assesses performance. The technical review committee disbands when the project is completed or terminated. Individual project organizations are added as projects are approved and funded, but disband when completed.

Findings

Evaluation of Models

The committee evaluated each model on the basis of how well it appeared to accomplish the ONR program goals and objectives. The evaluation of the selected models led to the following general findings.

Baseline Model

The committee found that the individual investigator model is excellent at promoting innovation and can continue this function as a part of any future naval engineering research program. However, the model is inadequate in meeting all of the program objectives. Cooperative organizational models have the greatest potential to remedy deficiencies in the current system.

Cooperative Research Models

All three models for cooperative research organizations were found to be capable of meeting all of the ONR program objectives. With regard to human cap-

Special Report 266: Naval Engineering: Alternative Approaches for Organizing Cooperative Research is available from TRB (see Publications Order Form in this issue).

TABLE 1 Summary of Cooperative Research Organizational Models and How Well They Meet Objectives

	Baseline Model	Professional Society Model	Consortium Model	Project-Centered Model
Human capital objectives				
Attract students	Medium	High	High	Medium
Retain and attract new faculty	Medium	Medium	High	Medium
Provide continuing education	Low	High	High	Medium
Foster total ship engineers	Low	High	High	Medium
Naval engineering design objectives				
Create new research opportunities	Low	Medium	High	Medium
Promote innovation	High	Medium	High	High
Ensure research useful to ship design	Low	Medium	High	High

The National Naval Responsibility Initiative in Naval Engineering established the government-managed Center for Innovation in Ship Design in October 2002. The center fosters a collaborative environment for experienced naval architects from academia, government, and industry to work with students and junior naval architects in innovation cells, addressing the Navy's high-interest design issues. The innovation cells encourage learning through mentoring. The Center for Innovation in Ship Design is the focal point of ONR-supported research at naval engineering schools and is supported by the naval acquisition community.

ital and naval engineering and design objectives, the consortium model was found to be better than the professional society model, but both were significantly better than the project-centered model. Table 1 shows how each of the three models fulfills the stated objectives. The absolute ranking of the models, however, depends on the relative importance ONR accords to each objective.

Evaluation by Objectives

The committee found that the three cooperative research models had the following attributes for meeting certain specific objectives:

- Both the consortium and project-centered models encourage innovative research. However, to implement the research into innovative ship design, the Navy and other stakeholders must overcome the organizational tendency to resist change—for example, using a new technology for ship acquisition.
- All of the models encourage research useful to advanced ship technology and design development. However, the consortium and project-centered models involve a higher degree of stakeholder participation and therefore have a higher probability of meeting the Navy's needs.
- Total ship engineers develop through a combination of a formal total ship design curriculum and hands-on design experience in multidisciplinary projects. With any model, the ability to foster total ship engineers depends on the opportunities available to all stakeholders to obtain the necessary formal education in total ship design and hands-on design experience.

Merits of the Models

The committee found that each of the three cooperative research models had the following merits:

- The professional society or community of practice model excels in meeting the need to develop human capital. This model can be particularly strong in attracting and retaining students, in supporting continuing education and training programs, and in fostering the education and development of total ship engineers—since these are the principal missions of naval engineering professional societies.
- The consortium model is well suited to meeting all the human capital development and naval engineering design objectives. Its success in meeting these objectives will be determined principally by the leadership of the consortium and its ability to represent and balance the needs of the various stakeholders.
- The project-centered model can excel in promoting innovation in naval engineering design, as well as research in ship design and production. This strength stems from the model's strong, large-scale, interdisciplinary project focus, which encourages participation and collaboration by the key stakeholders.

Hybrid Models

Desirable features and attributes of the models may be combined to create hybrid models. Hybrid models may maximize the performance of the research organization in meeting program objectives, but generally increase the complexity of managing the research enterprise. For example, the individual investigator model may be embedded into any of the three cooperative models, or both the project-centered and individual investigator models may be incorporated into the consortium or professional society models. The committee did not evaluate these hybrids but noted that such combinations are available to a creative manager.

Operational Considerations

Management Issues

Mechanisms for the contracting, management, and oversight of cooperative research organizational models can allow ONR to meet the Navy's needs without adding significantly to its current management burden. In particular, annual reviews—part of all models—allow for directing the research themes toward

successful and pertinent results, as well as providing flexibility to meet future challenges. These management mechanisms, however, need to be reviewed and evaluated to ensure that they fit the model selected.

Research Agenda

The process and manner of setting the research agenda is a fundamental issue. The committee found that in a true cooperative program, all the major stakeholders have a shared interest and shared ownership in the research agenda. To be successful, the organizational models must provide a structure and mechanism to allow appropriately balanced representation and input from stakeholders into the research agenda.

Host Location

The location of the research organization host is important. The choice of venue can have a strong impact on all stakeholders, especially academia, because of the small size of the naval engineering community and the dependence of each institution on the Navy for funding. Careful consideration should be given to the choice of location, to establishing and maintaining an appropriate balance of participation from all the stakeholders, and to rotations in the membership of the governing body.

Merit Reviews

To be successful, merit review of the research in all models should take place at three stages: when the proposal is approved, annually during the course of the research work, and when the project is completed. A merit review panel should be carefully balanced to ensure that innovative, high-risk ideas are not lost and that the results address the Navy's needs.

The small size of the naval engineering community, however, also will affect the merit review process—the number and variety of quality research institutions are limited. This necessitates resourcefulness in assembling a qualified and conflict-free group of individuals with balanced biases as reviewers for research proposals, progress, and outcomes.

Executive Council

Balance in the leadership of the executive council, or governing body, is critical to promoting cooperative work. The leadership of each of the three cooperative research organization models that the committee reviewed would be vested in an executive council. Strategies for establishing the size, composition, tenure, leadership, and decision-making process of this council will affect the overall success of the organization and the research and development programs it manages. The representation of the principal stakeholders on the council will affect the degree to which the constituencies are served, as well as the philosophy, priorities, and direction that the research program will follow.

Committee on Options for Naval Engineering Cooperative Research

Richard J. Seymour, Scripps Institution of Oceanography, University of California, San Diego, *Chair*
A. Bruce Bishop, Utah State University, Logan
John W. Boylston, Totem Ocean Trailer Express, Inc., San Diego, California
Roger H. Compton, Webb Institute, Glen Cove, New York*
Peter A. Gale, John J. McMullen Associates, Alexandria, Virginia
John B. (Brad) Mooney, Jr., NAE, U.S. Navy (retired), Alexandria, Virginia
J. Randolph Paulling, NAE, University of California, Berkeley (Emeritus)
Irene C. Peden, NAE, University of Washington (Emerita), Seattle
Edwin J. Roland, Elmer-Roland Maritime Consultants, Houston, Texas
Malcolm L. Spaulding, University of Rhode Island, Kingston
Richard W. Thorpe, Herbert Engineering, Annapolis, Maryland

Sponsoring Liaison
Albert J. Tucker, Office of Naval Research
** Committee member until January 8, 2002.*

Perception of Balance

The committee found that it is inherently difficult for the stakeholders to collaborate because they do not have a record of cooperative work and their governing bodies have few continuing relationships. Therefore, any new cooperative research organization should develop the needed collaborative process from the beginning.

In addition, the perception of balance is often as important as actual balance. For example, if the headquarters of a consortium is located at one of several universities, companies, or laboratories that are in competition for resources, the perception of imbalance in favor of that organization is inevitable. Steps to offset this perception would need to be included in the organizational structure and operations planning.

Education

The educational objectives of ONR are important to long-term success, and each model has some attributes that will contribute to the objectives. The project-centered model could be expected to have little or no direct impact on education without special or additional efforts. The individual investigator model probably would have a moderate impact on the education of naval engineers. The consortium model, however, has potential to promote educational objectives, as does the professional society model, but effectiveness depends on the individual proposals.

Repairs with High-Performance Materials Make Bridges Stronger, Last Longer

Georgia Researchers Test Carbon Fiber Composites

RICK DEAVER, ABDUL-HAMID ZUREICK, AND BRIAN SUMMERS

Field and laboratory studies in Georgia show that carbon fiber composites can be used efficiently and cost-effectively—increasing bridge strength and service life—with minimal or no disruption of traffic.

Deaver is Chief, Research and Development, Office of Materials and Research, Georgia Department of Transportation; Zureick is Professor of Civil and Environmental Engineering at Georgia Institute of Technology; and Summers is State Bridge Maintenance Engineer, Office of Maintenance, Transportation Management Center, Georgia Department of Transportation.

In the late 1950s, aerospace applications began to use carbon fibers to create high-performance materials with enhanced strength and stiffness, lightness, and heat dissipation. Carbon fibers are 8 to 10 times stronger than steel, but 5 times lighter, and the reinforced composite does not corrode like aluminum or steel.

For the past 11 years, European nations, Japan, and the United States have used polymer composite material technology for strengthening, repairing, and rehabilitating bridge components. The composite materials in bridge applications are either shop-manufactured or field-manufactured.

Problem

Many U.S. bridges are near the end of their design life and require repair or replacement. Both options are expensive and cause disruptions and delays to road users. Finding cost-effective and better ways to extend bridge life while causing the least amount of traffic disruption is a necessity.

Solution

In 1996 the Georgia Department of Transportation (DOT), in cooperation with the Federal Highway Administration and Abdul-Hamid Zureick of the Georgia Institute of Technology, commenced field and laboratory studies to examine carbon fiber composite rehabilitation of bridges and to recommend design and construction guidelines. The laboratory studies involved testing rehabilitated full-size bridge decks, beams, and pier caps. Results from one study showed that, on average, rehabilitated cracked bridge-deck panels with carbon composites were 33 percent stronger than bridge decks without carbon composites.

Georgia DOT decided to evaluate the use of carbon fibers to repair highway bridge decks, caps, and girders. The first field study was carried out on the State Route (SR) 2 bridge over the Conasauga River Overflow, east of Ringgold in north Georgia. The two-lane bridge, constructed in 1957, is 350 feet long and has 10 piers.

Two contractors repaired six of the pier caps in the spring of 1997 using field-manufactured composites. One contractor used carbon-reinforcing fabric that weighed 9 oz/yd^2, and the second contractor used a thicker, mechanically epoxy-impregnated, carbon-reinforcing fabric that weighed 18 oz/yd^2. After surface preparation of the concrete, some epoxy injections, and spall repairs, the first coat of epoxy was applied, and the carbon fiber fabrics were mounted by hand.

In laboratory studies, the strength of the similarly repaired pier caps far exceeded the original strength by an average of 25 percent, and the anchor bolts yielded before any failure in the pier caps. Static load tests on SR 2 showed that the repair was effective in confining the concrete and in transferring loads. Laboratory tests also determined the optimal fabric wrapping patterns for the pier caps.

The repair on SR 2 cost $42,000 and was completed in 4 days without lane closures. An intermediate conventional repair would have cost $170,000 and required one week of lane closures and traffic controls. Eventually the bridge would have required replacement at an estimated cost of $700,000. The carbon fiber repair therefore has saved the bridge from repair with helper bents and has extended its service life by 20 years.

The second bridge repaired with shop-manufactured carbon composite is on Lee Road over I-20 near Atlanta; the 258-foot-long bridge was built in 1962. A quarry and several light industries in the area produced heavy truck traffic, causing moderate deck cracking. Most of the cracking reached full

depth and likely would have developed into a severe condition. Only the worst deck section was repaired as preventive maintenance.

The surface area was prepared for the installation of shop-manufactured carbon plates 0.05 inch thick, 2 inches wide, and varying lengths. Cracks were not sealed with epoxy, so that the examiners could verify how long the repairs lasted. However, a two-part epoxy adhesive was applied to the plates, which then were hand-rolled into place under the deck. Data analysis later showed no significant changes in the crack openings.

This repair to only one quarter of one end span was completed in fall 1998 and cost approximately $4,000. Conventional repair would have involved partial deck replacement by hydroblasting to a depth of about 2.5 inches and then repouring the deck. This would have cost $290,000 and would have required 4 days of lane closures. The carbon fiber repair, if used on the whole deck, would require no lane closures and would cost $170,000—saving $120,000.

Application

The study findings guided repairs to a bridge on SR 120 over Interstate 85 near Atlanta. In 1998, an over-height truck had damaged the bridge, exposing the reinforcement steel of the outside concrete girder.

The repair was made shortly after the accident and was completed within two days, at a cost of $33,000. The carbon fiber repair allowed the daily traffic of 30,000 vehicles to maintain full access to the bridge. Previously, a typical repair replacing the damaged beam would have cost more than $130,000 and caused a one-month (or longer) lane closure.

Benefits

The bridges repaired with carbon fiber composites and the findings from extensive laboratory tests under this research effort together demonstrate that this technology can be used effectively and efficiently for repairing and rehabilitating bridges. As a result of this research, Georgia DOT was able to use carbon fiber composites for an emergency repair on another bridge.

The advantages of this technology include

- Quick repairs,
- Minimal inconvenience for motorists,
- Little or no need for special or heavy equipment,
- An increase in bridge life spans, and
- A reduction in bridge replacements.

Carbon Fiber Fabric, SR 2 application.

The Georgia DOT Maintenance Office estimates that carbon fiber can be used on 20 bridges per year in Georgia. This strategy could save approximately $5 million per year, based on estimated replacement costs versus carbon fiber repair costs and assuming an average extended bridge life of 20 years.

For more information contact Brian Summers, State Bridge Maintenance Engineer, Office of Maintenance, Transportation Management Center, Georgia Department of Transportation, 935 East Confederate Avenue, Atlanta, GA, 30316 (telephone 404-635-8179, e-mail brian.summers@dot.state.ga.us).

EDITOR'S NOTE: Appreciation is expressed to David Beal, Transportation Research Board, for his efforts in developing this article.

Suggestions for "Research Pays Off" topics are welcome. Contact G. P. Jayaprakash, Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001 (telephone 202-334-2952, e-mail gjayaprakash@nas.edu).

Marcy S. Schwartz

CH2M HILL

Whether achieving collaboration between opponents or facilitating collaboration among colleagues, Marcy S. Schwartz loves a challenge. The Senior Vice President and Director of Transportation Technology for CH2M HILL started out as a planner on controversial and complex projects—everything from siting transmission lines to allocating scarce water resources among competing users. She learned early in her career how to make difficult projects work.

"I thrived on situations that were controversial and complex," she says. "I liked sorting out the issues and helping clients and the public come to a common understanding of the problems and the best solutions. It's a fascinating process that takes an effective combination of engineering, environmental, and communications expertise to pull off."

"My aim is to build trust between agencies and communities, so that we can achieve true collaboration. That way, the human and natural environments both can be cared for in the process of meeting critical transportation needs, and our projects become real assets to the community."

Schwartz's mission as technology director is to implement technologies that meet clients' changing needs by delivering innovation, productivity, and value, as well as to achieve measurable increases in project delivery efficiency and intellectual property development. One product of this mission, the Technology Career Development Framework, encourages technologists to grow professionally by increasing their expertise and applying knowledge and innovation to win and to deliver projects. A key aspect is the mentoring of younger staff by senior staff.

"Implementing this framework is a way of ensuring that people with strong technical knowledge and experience can exert leadership in a company," Schwartz explains. "It creates an exciting and energizing environment where each technologist feels he or she can contribute."

Schwartz's technology program also has implemented Communities of Practice (CoP), to share technical information and expertise within practitioner groups and with nonpractitioners who need to access technical resources. By institutionalizing CoPs, CH2M Hill's transportation group can quickly obtain information about best practices, learn which techniques and approaches have worked on other projects, and collaborate with colleagues to stay current.

"Different groups need different things," Schwartz says. "Some need extensive libraries of resources and regulations, others need to establish standards of practice, and some just need to communicate with each other." A common element, however, is the rapid delivery of valuable information—usually within one hour and no later than one day—in response to a query.

Other initiatives that Schwartz directs include a technology development grant program, which funds internal transportation technology research and development efforts, and "e-Engineering," the firmwide application of a data-driven design delivery process based on a standardized set of best tools and practices.

Maintaining a technology focus in the wider transportation community, Schwartz is a member of TRB's Technical Activities Division Group 1 Council, Transportation Systems Planning and Administration. She previously chaired TRB's Committee on Public Involvement in Transportation, where her involvement had a far-reaching effect. A Japanese delegation that had attended the committee's meetings asked Schwartz to help the Ministry of Land, Infrastructure, and Transportation improve its project delivery process.

"Their process had been for engineers to develop the 'best' plan and then tell the public. Decide, announce, defend," Schwartz observed. "Now, they're beginning to discuss the plan with stakeholders before it's finalized and to modify the plan based on public input."

Closer to home, Schwartz has been involved in industry-leading efforts involving context-sensitive solutions. She was an author of National Cooperative Highway Research Program (NCHRP) Report 480, *A Guide to Best Practices for Achieving Context-Sensitive Solutions*, and she managed NCHRP Project 25-22, Technologies To Improve Consideration of Environmental Concerns in Transportation Decisions.

"My aim is to build trust between agencies and communities, so that we can achieve true collaboration. That way, the human and natural environments both can be cared for in the process of meeting critical transportation needs, and our projects become real assets to the community," she explains.

Schwartz is the author of more than 20 papers and presentations, including "Opening the Black Box: The Role of a Structured Decision Process in Building Public Consensus." She earned a bachelor's degree in English from New York University and a master's in urban planning from Hunter College.

Ernest T. Selig

Ernest T. Selig, Inc.

"Without the opportunity to learn the fundamentals [of certain technologies], the user has difficulty deciding between what is good information and what is bad," notes Ernest T. Selig, Professor Emeritus of Civil and Environmental Engineering at the University of Massachusetts as well as president of the engineering consulting firm Ernest T. Selig, Inc., and Senior Director of Optram Incorporated. He adds that, "too often, this does not become apparent until a calamity develops."

Selig's work has focused on two areas for applied technologies: soil-structure interaction of buried pipes and culverts and performance of railroad roadbeds. He refers to these as "specialty topics," which are "essentially absent from the engineering classroom."

"One big gap in the transfer of technology remains…compiling the vast body of existing information in a form suitable for a large group lacking the time or background to acquire the technology from existing reports."

But in his 10 years as a professor of civil engineering at the State University of New York at Buffalo and 20 years at the University of Massachusetts at Amherst, Selig has aimed to remedy that absence. He has taught courses in the areas of geotechnical and materials engineering, including instrumentation for ground monitoring, design and installation of buried pipelines, embankment design and construction, highway pavements, and railroad substructure and dynamics.

Selig's geotechnical engineering research has enhanced understanding of the design and construction of long-span, buried flexible conduits and of concrete, metal, and plastic pipelines, leading to the creation of a comprehensive guide to pipe and culvert installation. His research in railway geotechnology, endorsed by the Association of American Railroads, the U.S. Department of Transportation (DOT), and the Federal Railroad Administration, addresses the influence of ballast, subballast, and subgrade on railway track performance. Selig's book, *Track Geotechnology and Substructure Management*, written with John Waters, is an international resource for learning the fundamentals of design and maintenance of railroad beds. Three products Selig has developed in railway geotechnology have received U.S. patents: the fixed-volume soil sampling device, the soil strain gage, and a computer system for railway maintenance.

To keep his work relevant and applicable in practice, Selig has worked abroad as Visiting Academic Scholar at Moscow State University; as Visiting Professor at the University of Nottingham and Senior Academic Visitor at Oxford University, United Kingdom; and as Visiting Professor at the University of Pretoria in the Republic of South Africa. He has taught courses to practicing professionals in Japan, China, Israel, South Korea, Australia, Brazil, South Africa, England, and North America. His engineering consulting business, Ernest T. Selig, Inc, includes New York State DOT, Amtrak, Caterpillar Tractor, South African Railroad, Union Pacific Railroad, Tren Urbano Railroad (Puerto Rico), and Israel Railroad (Tel Aviv) among a diverse and extensive client base.

A registered professional engineer, Selig has maintained a high level of professional society activity alongside his teaching, research, and business pursuits. Involved in activities of the Transportation Research Board (TRB) since 1969, Selig has been a longtime member of the American Railway Engineering and Maintenance of Way Association, the American Society of Civil Engineers (ASCE), and the American Society for Testing and Materials, and is a past member of the Society of Automotive Engineers. He also served as officer of the American Society for Testing and Materials (ASTM) Soil and Rock Committee and national chairman of the ASCE Geotechnical Engineering Division, as well as editor of ASTM and ASCE geotechnical journals.

In the field of transportation, Selig believes, "one big gap in the transfer of technology remains"—the gathering of the "vast body of information in a form suitable for a large group lacking the time or background to acquire the technology from existing reports." Fortunately, Selig points out, the reports of the TRB's Cooperative Research Programs (CRP) offer an "outstanding synthesis." To accommodate the overwhelming need for this kind of information gathering, Selig would like to see the CRP concept expanded "even a hundredfold or more." This "would make the single largest contribution to the welfare of the transportation industry of any program to which we can add what is already available," he says.

Selig is an emeritus member of TRB's Committees on Subsurface Soil-Structure Interaction and on Railway Maintenance. His awards and honors include the James L. Tighe Civil Engineering Distinguished Teaching Award and the Stephen D. Bechtel Pipeline Engineering Award. He has published nearly 200 journal articles worldwide. Selig earned a bachelor's degree with distinction from Cornell University and a master of science in mechanics and a doctorate in civil engineering from Illinois Institute of Technology.

NEWS BRIEFS

Ohio DOT's Maintenance Quality Survey uses touch-screen technology on a laptop computer for quickly recording roadway defects.

High-Tech Survey Aids Ohio Roadway Repairs

Twice each year, the Ohio Department of Transportation (DOT) records roadside deficiencies, such as damaged guardrails, in all 88 state counties. Applying touch-screen computers and Global Positioning Satellite technology, the Maintenance Quality Survey identifies and locates problems under eight categories: guardrails, potholes, pavement drop-offs, vegetation obstructions, litter, drainage ditch obstructions, sign deterioration, and pavement markings.

The survey information is downloaded into the department's geographic information system to create maps. The maps help in establishing priorities and work plans for each county's day-to-day operations, as well as in determining recurrent problems.

"If we have a regeneration of a deficiency like a guardrail, for example, it might alert us to possible roadway geometric problem or some other kind of problem that we need to look at," said Bill Lozier, Deputy Director of Highway Operations at Ohio DOT.

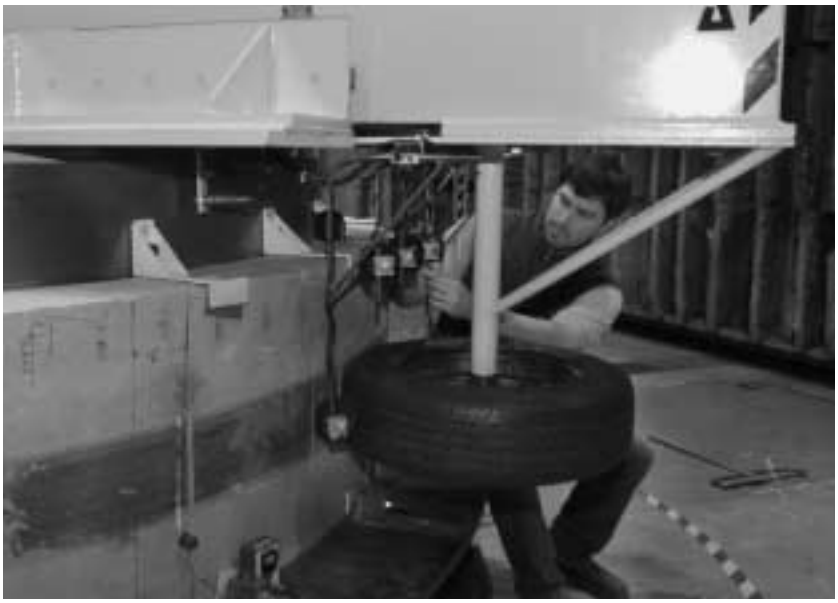
According to Lozier, the survey has reduced the number of highway deficiencies by 42 percent between April 1, 2001, and December 30, 2002. Ohio's is the tenth largest highway network and the fourth largest Interstate network in the nation.

For further information contact Joel Hunt, Ohio DOT, 614-466-7173.

New Apparatus Tests Highway Noise

A new tire–pavement test apparatus at Purdue University, West Lafayette, Indiana, makes it possible to test several types of pavement surfaces and compositions in combination with various tire designs, assisting in research on the causes of highway noise. Most other testing machines use a stationary tire riding over motorized steel rollers, but the circular, 12-foot-diameter, 38,000-pound Purdue apparatus mimics road conditions, with tires rolling over the surface of stationary pavement test samples. Many types of pavement samples may be used in tests, with acoustics, temperature, and other environmental conditions controlled.

Purdue apparatus can test a range of tires and pavements, isolating the causes of highway noise.



To record noise levels from the tires and pavements, the Purdue apparatus includes five microphones set at various distances and at several frequencies or tones. The first results from tests of four tire designs on three types of pavements were inconclusive, although preliminary findings indicated that porous pavement generated the least noise.

According to Robert Bernhard, codirector of Purdue's Institute for Safe, Quiet, and Durable Highways, "What we think is happening is that certain elements of the pavement and tire amplify sound, but we really don't understand this completely yet." Researchers soon will test tires and pavements that contain embedded sensors, which will provide more data on noise generation.

For further information contact Robert Bernhard, Purdue University, 765-494-2141.

Adding Strength to Portland Cement

A research report from the Portland Cement Association, Skokie, Illinois, addresses the substitution of fly ash for part of the sand and cement in concrete mixtures to suppress the deleterious effects of alkali-silica reaction (ASR). The report also shows how to overcome the effects of cold temperatures on concrete strength when using fly ash.

Substitution of Fly Ash for Cement or Aggregate in Concrete: Strength Development and Suppression of ASR (RD127) is available online, www.portcement.org/info_resources.

For further information contact Ryan Puckett, Portland Cement Association, 847-972-9136.

Pavements Receive Durability Awards

The Asphalt Pavement Alliance recognized seven agencies with Perpetual Pavement Awards at the Superpave 2003 conference in Nashville, Tennessee:

- The U.S. Air Force, for a runway at Eareckson Air Station in Alaska;
- Iowa DOT, for I-80 in eastern Iowa;
- Maryland DOT, for two runways at Baltimore-Washington International Airport;

- Minnesota DOT, for a section of I-35;
- Missouri DOT, for a section of I-44;
- Oklahoma DOT, for a section of I-40; and
- Tennessee DOT, for a section of I-65.

To qualify for the award, now in its second year, a pavement must have been in service for 35 years or more, demonstrating long-life characteristics, excellence in design, quality of construction, and value to the traveling public, with only infrequent surface treatments. Engineers at the National Center for Asphalt Technology review nominations, and a panel of industry experts validates the winners.

Warm-Mix Asphalt Holds Promise

The National Asphalt Pavement Association (NAPA) conducted a study of European asphalt practices during the summer of 2002, researching and evaluating new processes to reduce mixing temperatures. If applicable for use in the United States, warm-mix technology could reduce pavement material temperatures by 100 degrees and decrease fuel consumption, potentially eliminating emissions and odors.

NAPA plans to commence research programs in cooperation with the Federal Highway Administration and European technology sponsors to determine if the warm-mix processes are compatible with the mix designs, equipment, climate conditions, and work practices in the United States. Demonstration projects to evaluate field performance and to validate and implement the technologies will take place in the next few years.

Summarized from Hot Mix Aphalt Technology, *March-April 2003.*

Bats Find Homes Near Bridges

Bats Conservation International (BCI) has presented an award of excellence to Texas DOT bridge engineer Mark Bloschock for starting the Bats and Bridges program, a habitat protection project. In 1991, Texas DOT discovered that a large colony of Mexican Free-Tail bats had taken roost under the Congress Avenue Bridge in Austin.

With help from BCI, Bloschock began a study, finding that the slots under the bridge were the same size as spaces in bat caves. The study also showed that bats do not threaten bridge structures or community health. Texas DOT now maintains 218 structures for bat habitats, almost three times more than any of the other 24 states and 17 countries participating in the Bats and Bridges program.

Summarized from Public Roads, *March-April 2003.*

Mexican Freetail bats (Tadarida Brasiliensis) nesting in a bridge crevice between box beams.

PEOPLE IN TRANSPORTATION

Thomas M. Downs

Eno Foundation Appoints Executive

Thomas M. Downs, Director of the National Center for Smart Growth at the University of Maryland, is the new President and Chief Executive Officer of the Eno Transportation Foundation, Washington, D.C. Downs previously was Commissioner of Transportation and Chairman of the Board of New Jersey Transit; City Administrator and Director of Transportation for Washington, D.C.; and Executive Director of the Federal Transit Administration of the U.S. Department of Transportation.

He succeeds Damian J. Kulash, who retired in May 2003. Former head of TRB's policy studies division and of the Strategic Highway Research Program, Kulash had led the Eno Foundation since 1995, building the organization's recognition as an independent, objective forum for debate on transportation policy issues.

For further information contact Kathryn Harrington-Hughes, Eno Transportation Foundation, 202-879-4718.

INTERNATIONAL NEWS

Rail Safety Strategy on Track in Great Britain

Great Britain's five-year Railway Safety Research Programme (RSRP), set up in 2001 to identify achievable ways of improving rail safety, is now under way, with research projects completed on such topics as footpath-level crossing risks, reducing assaults on railway staff, and improving signal-sighting standards to assist train drivers.

Research efforts are divided into 24 themes, ranging from engineering of the wheel–rail interface to human factors, operations, and policy issues. Other program objectives are to create and pilot new products or processes, including best-practice guides, to "improve safety for passengers, customers, workers and neighbors," according to Guy Woodroffe, Stakeholder Manager for the program.

"The railways are in an era of substantial change, arising from investment in new trains, train control systems and infrastructure, new industry structures, and new regulatory approaches and directives from Europe," Woodroffe explains. "The [program] offers the opportunity to ensure safety is built in as a fundamental element during these changes."

For further information contact Guy Woodroffe, e-mail WoodroffeG. railwaysafety@ ems.rail.co.uk.

Wilfrid Nixon of the University of Iowa comments on new techniques and methods for sharing preliminary research findings.

State Representatives Fine-Tune TRB Services

The dissemination and implementation of research results were the main topics of discussion as TRB representatives from 38 state departments of transportation (DOT) gathered May 5–6 at the National Academies Keck Center in Washington, D.C. The 2003 biennial meeting also focused on ways to enhance longtime partnerships between TRB and state DOTs.

The meeting featured a day-long workshop, May 5, "Optimizing the Dissemination and Implementation of Research Results," cosponsored by the TRB Committee on Conduct of Research and the Committee on Technology Transfer, to identify practical strategies for ensuring the optimal application of research. Joining the state DOT participants were approximately 20 representatives from city and county agencies, the private sector, academia (both research and teaching), U.S. DOT, libraries, and other information services.

Discussion groups identified action items on the following topics:

- Techniques and methods for sharing preliminary research findings;
- Efficient dissemination of published materials;
- Developing appropriate spin-off materials for implementation;
- Guidelines for case studies (dos and don'ts); and
- Overcoming barriers to dissemination and implementation.

Workshop leaders William Carr, Laurie McGinnis, and Wilfrid Nixon are summarizing the workshop results, which will be published on the web as an electronic Transportation Research Circular later this year.

Cooperative Research Programs News

Pavement Design Guide Nears Completion

The American Association of State Highway and Transportation Officials (AASHTO) *Guide for the Design of Pavement Structures* has served as the primary document for the design of new and rehabilitated highway pavements. The guide incorporates empirical design approaches developed from findings of the historic AASHO Road Test of the early 1960s. The Road Test, however, covered a limited range of traffic loading, climatic conditions, subgrade soil, paving materials, and structural features and did not include rehabilitated pavements.

The next generation of design approaches will need to incorporate mechanistic principles, because mechanistic-empirical approaches realistically characterize the behavior of in-service pavements and improve the reliability of designs. But mechanistic design methods need to be supported by empirical relationships, and many of the issues relating to the mechanistic-empirical approach must be better defined before practical and realistic design procedures can be developed and put into use.

In 1998, the National Cooperative Highway Research Program (NCHRP) initiated Project 1-37A to provide the highway community with a guide for the design of new and rehabilitated pavement structures that assembles the best knowledge on pavement design into a single, cohesive package of written guidance and software. Nearing completion, the guide incorporates proven technologies to account for the changes in climate, traffic loading, and material properties during pavement life and the impact on performance to identify pavement designs that meet expectations in terms of service life and performance.

Kathryn Harrington-Hughes of the Eno Transportation Foundation leads discussion on the efficient electronic dissemination of published materials.

In the sessions on May 6, TRB state representatives and TRB staff examined the state DOT–TRB partnership for disseminating research results. The meeting advanced several suggestions to streamline and expedite the distribution of TRB-generated research reports to state DOTs.

For further information contact TRB Technical Activities Division Director Mark Norman (mnorman@nas.edu).

The National Academies Dedicates New Building

The new National Academies building at 500 Fifth Street, NW, Washington, D.C., was dedicated as the Keck Center of the National Academies, May 13. TRB occupies the fourth floor and portions of the third floor of the new building, which also houses other divisions of the National Academies—including the National Academy of Sciences, the National Academy of Engineering, the Institute of Medicine, and the National Research Council.

The dedication commemorates a 15-year, $40 million grant from the W. M. Keck Foundation of Los Angeles, California, for the National Academies to realize the untapped potential of interdisciplinary research. Through conferences, grants, awards, and studies, the National Academies Keck Futures Initiative "will catalyze interdisciplinary inquiry and enhance communication among researchers; funding agencies; university, industry, and government research laboratories; and the general public," Bruce Alberts, president of the National Academy of Sciences, stated at the ceremony.

Bruce Alberts, President, National Academy of Sciences, and Robert A. Day, Chief Executive Officer of the W. M. Keck Foundation, cut the ribbon at ceremonies dedicating the the Keck Center of the National Academies.

The *Guide for Design of New and Rehabilitated Pavement Structures* and the accompanying computational software are scheduled for delivery to AASHTO for consideration and adoption this fall.

For further information contact Amir N. Hanna, TRB (telephone 202-334-1892, e-mail ahanna@nas.edu).

Traffic-Signal Response to Enhanced Sensor Data

Until recently, traffic-signal control devices only could receive one type of information, the indication that a vehicle was on top of a detector. Current detection equipment can provide additional information for the operation of traffic signals, such as queue length, speed, and vehicle classification. However, the logic that operates traffic signal controllers has not changed much during the past 40 years and is not yet able to process these additional types of information.

In addition to the normal operation of the signal, a traffic control device must be able to handle special demands such as the crossing of trains or light rail transit near roadway intersections. Preemption of normal operations must occur quickly, safely, and in a fail-safe manner, to avoid vehicle–train collisions.

The University of Tennessee, Knoxville, has been awarded a $600,000, 25-month contract (NCHRP Project 3-66, FY 2002) to develop traffic-signal state transition logic that innovatively employs sensor information. The logic will improve the safety and mobility of vehicles, pedestrians, trains, and light rail transit.

For further information contact B. Ray Derr, TRB (telephone 202-334-3231, e-mail rderr@nas.edu).

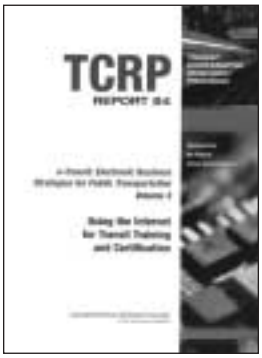
Computers in Railways VIII

E. J. Allan, R. J. Hill, C. A. Brebbia, G. Sciutto, and S. Sone, eds. J. Sakellaris, Associate ed. WIT Press, Billerica, Massachusetts: 2002; $499, hardcover; ISBN 1-85312-913-5; 1163 pp.

This volume contains a majority of the papers presented at the 8th International Conference on Computer-Aided Design, Manufacture, and Operation in the Railway and Other Advanced Mass Transit Systems (also known as COMPRAIL) held in Lemnos, Greece, in 2002.

The papers are divided into sections on advanced train control systems; automatic train control; communications; electromagnetic compatibility; infrastructure; innovative controls in high-speed transport systems; interlockings; maglev and linear machines; maintenance and condition monitoring; multitrain simulators; pantograph and catenary interaction; passenger interface; planning; power supply and traction drives; rail, track, and bridges; rail wheel, brake, and other equipment; safety; strategy and scheduling; systems engineering; traffic control; train location systems; and training, decision support, and human factors.

TRB PUBLICATIONS



Feasibility Study for an All-White Pavement Marking System

NCHRP Report 484

The feasibility of implementing an all-white pavement marking system in the United States is examined in this report, which quantifies and identifies the advantages, disadvantages, benefits, costs, and implementation issues of converting the current yellow-and-white system. The report recommends that (*a*) although an all-white marking system may be necessary in the future, it should not be implemented at present, and (*b*) certain improvements should be made to the current yellow-and-white system. Also recommended are guidelines for the future implementation—if necessary—of an all-white pavement marking system.

2002; 95 pp.; TRB affiliates, $12.75; nonaffiliates, $17. Subscriber category: highway operations, capacity, and traffic control (IVA).

Improving Public Transit Options for Older Persons, Volume 1: Handbook; Volume 2: Final Report

TCRP Report 82

The elderly population in the United States will increase significantly by 2030. Mobility will be crucial to this population's continued independence and quality of life. This two-volume report addresses future transportation challenges generated by an increasingly older society and describes exemplary transportation services and innovative alternatives that enable older persons to maintain their independence. Research includes a literature review, analyses of large-scale databases, focus groups with older persons, expert interviews with transit agency representatives, and case studies of best practices.

2002; 144 pp. (in 2-volume set); TRB affiliates, $27; nonaffiliates, $36, for 2-volume set. Subscriber categories: public transit (VI); planning and administration (IA).

e-Transit: Electronic Business Strategies for Public Transportation, Volume 3: Using the Internet for Transit Training and Certification

TCRP Report 84

A hyperlinked electronic report presented as *CRP-CD-27*, Volume 3 of the *e-Transit* title, investigates the potential of web-based training (WBT) as a means of providing effective, high-quality training to the transit industry. The report concludes that WBT would be beneficial, particularly in training a dispersed and diverse staff with differing areas and levels of expertise. A panel of subject-matter experts with experience in transportation training, WBT, and intelligent transportation systems was a primary source of information.

2003; 2 pp. plus CD-ROM; TRB affiliates, $11.25; nonaffiliates, $15. Subscriber category: public transit (VI).

Strategies for Increasing the Effectiveness of Commuter Benefits Programs

TCRP Report 87

Designed to help transportation agencies improve commuter benefits to meet employer needs and to increase participation, this report (*a*) explains how commuter benefits work, (*b*) describes which employer characteristics contribute to successful programs, (*c*) presents marketing messages and promotion tactics, (*d*) reviews barriers and how to overcome them, and (*e*) provides guidance on how to develop an effective program. Included are 10 appendixes with legal and technical information on commuter benefits and additional details on research.

2003; 131 pp.; TRB affiliates, $15.75; nonaffiliates, $21. Subscriber category: public transit (VI).

Long-Term Pavement Marking Practices

NCHRP Synthesis 306

Pavement markings are an important means of communicating information to drivers. Variations in structure, policies, and climate, have contributed to a range of differences in pavement marking practices. This Synthesis documents long-term pavement marking practices (the ways that transportation agencies select, specify, apply, maintain, and remove pavement markings) and research

in the United States and Canada. Best practices and new technology for managing pavement marking systems are described, along with decision-making processes; driver needs, retroreflectivity requirements, and ways of communicating information to drivers; crashes related to pavement markings; material selection criteria; specifications and practices; materials; inventory management systems; and performance evaluations.

2002; 154 pp.; TRB affiliates, $14.25; nonaffiliates, $19. Subscriber categories: design (II); operations and safety (IV).

Owner-Controlled Insurance Programs
NCHRP Synthesis 308
Highway construction projects are becoming increasingly complex, and the roles assumed by designers, project managers, contractors, and subcontractors are changing. The result is ambiguity in responsibilities, especially concerning safety. This Synthesis examines controlled insurance programs—specifically, owner-controlled insurance programs (OCIPs), which cover the interests of the project owner, construction manager, contractors, and consultants under one insurance arrangement. The report provides a brief history of OCIPs, state department of transportation experiences, contractor issues, and risk controls, and offers guidance on how to choose and develop an OCIP and on how to operate under one.

2002; 133 pp.; TRB affiliates, $14.25; nonaffiliates, $19. Subscriber categories: planning and administration (IA); design (II); materials and construction (IIIB).

Diversity Training Initiatives
TCRP Synthesis 46
This Synthesis covers diversity training initiatives in transit systems, identifying where programs and plans have been placed, who has accountability and oversight, and what practices have been successful. Case studies provide diversity perspectives from the viewpoints of both management and employees.

2003; 59 pp.; TRB affiliates, $11.25; nonaffiliates, $15. Subscriber category: public transit (VIA).

Travel Demand and Land Use 2002
Transportation Research Record 1805
Community-oriented neighborhoods and convenient public transportation alternatives to automobile ownership are among the topics presented. Other studies illustrate the economic impact on land value of properties adjacent to light rail services, the regional transportation effects of city-edge malls, the use of microsimulation to improve the behavioral realism of travel models, and more.

2002; 160 pp.; TRB affiliates, $48; nonaffiliates, $36. Subscriber category: planning and administration (IA).

Assessing and Evaluating Pavements 2002
Transportation Research Record 1806
Part 1 of this three-part volume addresses pavement strengths, flexibility, and falling-weight deflections. Part 2 examines ways to monitor and detect changing pavement conditions with example test results from Virginia and North Carolina. Part 3 focuses on surface properties, including ride quality assessment, user perception, and road surface texture.

2002; 167 pp.; TRB affiliates, $48; nonaffiliates, $36. Subscriber category: pavement design, management, and performance (IIB).

Traveler Behavior and Values 2002
Transportation Research Record 1807
Papers address commuter issues such as the impact of road closings on travel time, route choice behavior, and the rescheduling of activities after a reduction in automobile availability. Other studies present a lifestyle analysis on leisure travel patterns and influences in the decline of mobility in Sao Paolo, Brazil.

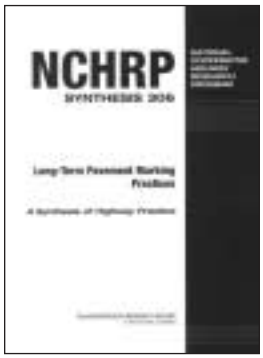
2002; 182 pp.; TRB affiliates, $50; nonaffiliates, $37.25. Subscriber category: planning and administration (IA).

Soil Mechanics 2002
Transportation Research Record 1808
This four-part volume begins by focusing on geotechnical instrumentation with lateral pile load tests and an evaluation of the soil stiffness gauge. Part 2 includes papers on deep soil mixing techniques and tire-shred embankment monitoring. Part 3 addresses issues involving seismic warning systems and separation layer performance, and Part 4 presents research on durability, loading capacity, and other bridge foundation issues.

2002; 191 pp.; TRB affiliates, $43; nonaffiliates, $32.25. Subscriber category: soils, geology, and foundations (IIIA).

Design and Rehabilitation of Pavements 2002
Transportation Research Record 1809
Rigid pavement design, flexible pavement design, and pavement rehabilitation are topics presented in this three-part volume. Papers include findings on the stress response of concrete pavement, rapid roughness progression, the effects of temperature on pavement life, impacts of alternative truck configurations, performance of ultrathin whitetopping pavements, and more.

2002; 227 pp.; TRB affiliates, $66; nonaffiliates, $49.25. Subscriber category: pavement design, management, and performance (IIB).



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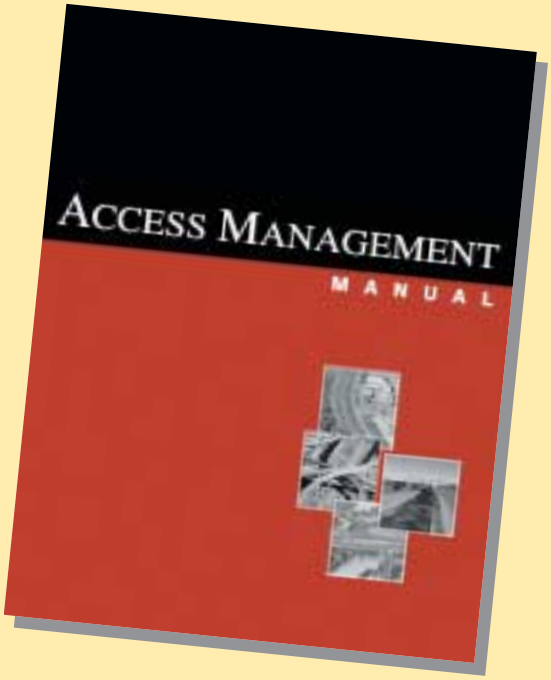

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