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PHOTO: GETTY IMAGES/MARK JOSEPH

Cover: Truck spreading salt on city street in Chicago, Illinois

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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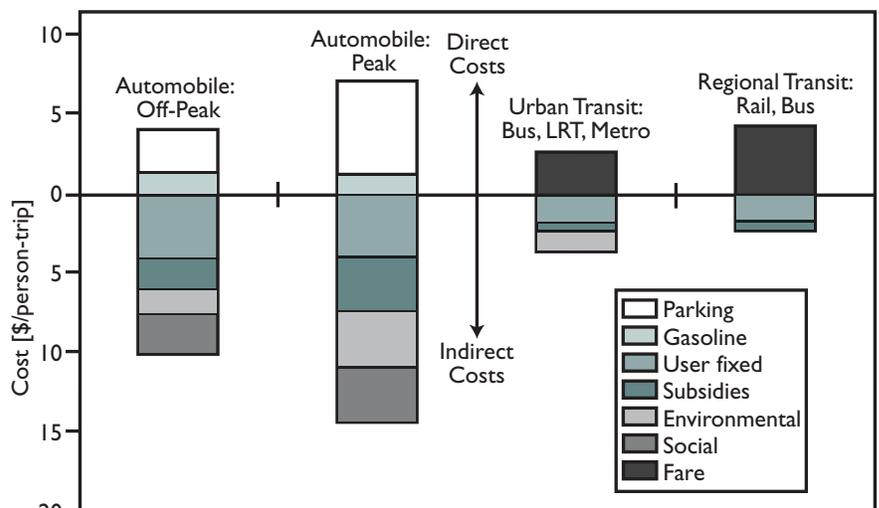


PHOTO: PANAMA CANAL AUTHORITY

The March–April 2004 *TR News* offers feature articles on military deployment and the U.S. transportation system; the potential of fast ferries in deployment; the new management model for the Panama Canal; and shipboard automatic identification systems. Plus, a pictorial section presents highlights from the 2004 TRB Annual Meeting.

Container ships on the Panama Canal; maritime traffic has benefited from improvements in safety and traversal time.

CORRECTION: The Point of View article, “Livable Cities: Will Transportation Professionals Answer the Challenge?” by Vukan R. Vuchic (*TR News*, November–December 2003, pp. 22–26), refers to a figure that “compares user costs—both fixed and out of pocket—for automobiles and transit.” The omitted figure is reproduced below. In the same article, the title of Reference 6 is presented incorrectly in the text; the correct title, as shown in the reference list, is *Avoiding the Collision of Cities and Cars*. Apologies are extended to the author and readers for the editorial errors.



Typical structure of total costs of urban travel by different modes.



Go Light with the Salt, Please

Developing Information Systems for Winter Roadway Safety

MARCIA BRINK AND
MELANIE AUEN

Brink is Communications Manager, Center for Transportation Research and Education, Iowa State University, Ames. Auen is with Bonestroo, Rosene, Anderlik & Associates, Inc., St. Paul, Minnesota.

Preventing snow and ice from bonding to pavement is easier than breaking the bond. Anti-icing programs therefore treat roadways with chemicals before a winter storm to prevent a snow or ice bond from forming.

Anti-icing is superior to postevent deicing strategies in helping to keep winter roads clear of snow and ice, enhancing motorists' safety and mobility during and after winter storms. State and local agencies using anti-icing strategies also gain pocketbook benefits—anti-icing requires lighter and fewer applications of chemicals, saving significant costs in materials, staff time, and equipment wear and tear.

Because of the safety and economic benefits, researchers and users alike are focusing on improving

the technologies that support anti-icing. One of these technologies, road weather information systems (RWIS), is critical in pinpointing the brief window of time before the onset of a winter weather event—a snowstorm, a light drizzle turning to sleet, or even a heavy roadway frost—when anti-icing chemicals must be applied to be effective.

The Federal Highway Administration (FHWA) has established an international, pooled-fund consortium to take the lead in setting and promoting an agenda for RWIS-related research and implementation. Known as Aurora, the consortium comprises transportation agencies, universities, and other organizations with a stake in improving winter roadway maintenance.

Aurora's mission has taken on a new urgency.

Recent research in Canada has spotlighted another, often overlooked benefit of anti-icing programs: less salt on the roadway results in less salt runoff into the adjoining environment.

Toxic Substances

Environment Canada, the Canadian government agency responsible for environmental protection, conducted a 5-year, comprehensive scientific assessment of the environmental impacts of road salts that contain inorganic chlorides, such as sodium chloride, calcium chloride, potassium chloride, and magnesium chloride. The study found that high concentrations of road salts commonly enter the environment through roadway melt water and through seepage from mismanaged salt storage facilities and snow disposal sites.

Although not directly harmful to humans, the road salts can have harmful effects on the aquatic environment, plants, and animals. The Canadian Ministers of the Environment and of Health therefore recommended adding road salts to Schedule 1 of Canada's Environmental Protection Act in 1999.

In response, Environment Canada has proposed management measures to minimize the impacts of road salt on the environment without compromising road safety. The proposed measures, "Code of Practice for the Environmental Management of Road Salt," were published for public comment in the September 20, 2003, issue of *Canada Gazette*.

One critical strategy that Environment Canada has proposed is to reduce the negative impacts of road salts by "delivering the right amount of road salts in the right place at the right time." Anti-icing programs undoubtedly will play a critical role in implementing this strategy, because the process generally uses significantly less salt—and returns roads more quickly to normal winter driving conditions—than traditional deicing methods.

Although the effect of road salt on the environment has been the focus of extensive research in the United States, the conclusions have been contradictory or uncertain. The findings of Environment Canada's study, and the agency's resulting action, could have significant repercussions in the United States, where salt is the chemical most frequently used to control ice and snow on roadways.

For example, the Iowa Department of Transportation (DOT)—recognized as a national leader in implementing anti-icing programs—still relies on salt-intensive deicing strategies when storm intensity exceeds snow and ice control capabilities. Each year, Iowa DOT places an average of 170,000 tons of sodium chloride, 7 million gallons of salt brine, 30 tons of calcium chloride, and 100,000 gallons of liquid calcium chloride on the state's highways and Interstates.

These figures do not include the road salt applied on city streets and county roads. Most of Iowa's local agencies, which own 90 percent of the state's roadway system, continue to implement postevent strategies, particularly deicing or friction-enhancing winter maintenance strategies, which use much more salt than anti-icing strategies require.

The results of Environment Canada's study increase the importance of implementing effective anti-icing strategies at every level of government. This will involve improving the accessibility, affordability, understanding, and coordination of anti-icing programs, the comprehensibility of their data, and the supporting technologies.

RWIS and Anti-Icing

As highway agencies in Iowa and other Snowbelt states have discovered, an anti-icing program is only as good as an agency's ability to predict the onset of winter weather events accurately. National Weather Service forecasts are not sufficiently site-specific and do not include all the data necessary to provide the accurate, real-time storm prediction and road temperatures that make anti-icing strategies effective.

RWIS is an essential tool in a successful anti-icing program. Using pavement and atmospheric sensors and communication systems, RWIS collects and delivers roadway and weather condition data to decision makers in the maintenance garage and even behind the wheel of the snowplow.

Pavement sensors monitor conditions such as surface temperature and status (wet or dry), as well as the amount of chemicals on the roadway. Atmospheric sensors monitor several factors, including air temperature, wind direction, and wind speed. Some RWIS include probes installed below the ground surface to monitor soil temperatures, which also can affect the state of the precipitation on the roadway.



Photo: Iowa DOT

Aurora's work with RWIS technologies and decision-making support systems can help road workers apply the minimum amount of salt necessary to keep roads safe and passable through winter snows.

Photo: Iowa DOT



Nearly 50 RWIS towers punctuate Iowa's landscape along Interstate and primary highways.

The data from a system of RWIS sensors along a highway network—especially along trouble spots—help maintenance personnel know when and how fast a winter weather event is approaching. The RWIS data indicate the kind of precipitation likely, where the precipitation will fall, the length of time before the precipitation will freeze on the roadway, and other information that will help to decide when to apply the minimum amount of chemicals to be effective.

Systematic Approach

Improvements in RWIS technologies have vastly enhanced the effectiveness of anti-icing programs. Some of the challenges of optimizing RWIS include developing standards for data collection and transmission; translating hard data into information meaningful to winter maintenance crews; reducing the cost of data collection but improving data accuracy and reliability; and training data users.

The Aurora consortium is taking on these challenges systematically. Aurora serves as a catalyst for RWIS research and deployment by developing a research agenda, soliciting proposals to conduct

research, and providing champions to oversee and launch the projects.

Aurora members are international leaders in RWIS research, technology, and deployment. Many are affiliated with the American Association of State Highway and Transportation Officials' (AASHTO) Snow and Ice Pooled-Fund Cooperative Program (SICOP) and other programs focused on developing and coordinating winter maintenance technologies (see sidebar, page 6).

Since its establishment in 1996, Aurora has made significant contributions to RWIS and related systems, especially in improving and standardizing RWIS architecture. For example, Aurora projects have championed the development of standards and protocols for RWIS communications and have promoted standardized methods for testing the accuracy and consistency of pavement sensors.

Current projects are yielding practical tools for agencies looking to develop or improve anti-icing programs. In particular, three projects promise useful products or results: computer-based RWIS training, collecting condition data with audio and video technologies, and testing the accuracy of temperature sensors.

Demystifying the Data

Even when logically organized and presented through communications software, the hard data collected by RWIS are generally difficult for most maintenance supervisors and staff to decode and use. With the recent release of a sophisticated, but user-friendly, computer-based training (CBT) program, the ability of maintenance personnel to interpret RWIS data and effectively implement winter maintenance operations is taking a giant leap forward.

Related Resources Clearing a Way

The National Cooperative Highway Research Program (NCHRP) recently completed Project 6-13, *Guidelines for Snow and Ice Control Materials and Methods*, to help maintenance managers select appropriate strategies and tactics for specific winter storm conditions. NCHRP has distributed the report to state departments of transportation. In combination with the results of NCHRP Project 6-16, *Guidelines for the Selection of Snow and Ice Control Materials to Mitigate Environmental Impacts*—now in progress—the agency report will provide a complete winter maintenance handbook for managers.

Supplementing RWIS data with real-time friction measurements may be useful for managers allocating resources for snow removal in real time. NCHRP Web Document 53, *Feasibility of Using Friction Indicators to Improve Winter Maintenance Operations and Mobility*, provides practical insights.*

NCHRP Project 6-15, *Testing and Calibration Methods for RWIS Sensors*, in progress, will assemble best practices and produce practical guidelines to ensure the reliable operation of RWIS sensors in the field.

*http://gulliver.trb.org/publications/nchrp/nchrp_w53.pdf



Computer-based training (CBT) improves accessibility and acceptance of road weather information systems (RWIS) for winter maintenance personnel. In new CBT program developed by GanTek Multimedia and copyrighted by AASHTO, “Jake,” a 3-D animated character, walks users through program’s features and functions.

The CBT helps take the guesswork out of RWIS-based decisions. Available on CD-ROM, the interactive training program offers clear information and safe, nonthreatening practice in decision making through scenario-based exercises and tutorials. Users can proceed at their own pace, focus on specific topics, and evaluate their learning while proceeding through the modules.

Three levels of training modules address the particular needs of snowplow operators, maintenance managers, and winter maintenance policy makers. For example, maintenance managers learn how to make network-level decisions, such as when and where to deploy anti-icing equipment or how much chemical will be required. Operators learn how to override the snowplow’s automated systems when necessary to fine-tune chemical placement, as pavement conditions change from mile to mile or from hill to valley. Policy makers learn how to analyze the effectiveness of anti-icing strategies deployed under various weather conditions to improve future anti-icing decisions.

Of the 34 Snowbelt states, 31 are supporting the project and have received a generic version of the CBT for use during winter 2003–2004. Agencies can customize the CBT with regional weather information or

Friends in Cold Places

An Interconnected Winter Maintenance Community

Critical research and deployment initiatives to enhance winter roadway maintenance in the North American Snowbelt form an intricately interconnected web. What happens in one program affects the strength, direction, and effectiveness of others.

Taking the Lead

In the late 1980s and early 1990s, the Operations Research initiative of the Strategic Highway Research Program (SHRP) launched explorations of new technologies and applications for enhancing winter roadway maintenance. For example, SHRP stimulated the first systematic U.S. investigation of anti-icing strategies and supporting technologies.

In 1993, SHRP concluded its research phase and entered a 3-year implementation phase. Implementation succeeded through a “lead states” approach, with various states championing the deployment of SHRP findings or products. Following that model, the first circle in the web of winter maintenance initiatives consists of the lead states for various aspects of winter maintenance research.

When the lead states program concluded in 2000, several state agencies that had championed anti-icing recognized the need to continue with research, development, and deployment initiatives involving critical road weather information systems (RWIS); several research universities joined in the call. With Canadian and Swedish partners, private organizations with a stake in RWIS, state agencies, and universities,

FHWA established Aurora. As a result, the RWIS strand of winter-maintenance research has continued to change and grow.

International Influences

During SHRP implementation, state and federal organizations became more interested in investigating advances in winter maintenance operations around the world. In 1994, FHWA, AASHTO, and TRB sponsored an international winter maintenance scanning tour of Japan, Germany, and Austria. Participants in the tour brought an abundance of ideas back to the United States that influenced the direction of winter roadway maintenance research and implementation, including RWIS.

For example, European countries had been deploying RWIS in denser patterns than in the United States, which led U.S. researchers to analyze more carefully the optimum number and locations of RWIS stations in a statewide system. In addition, Japan and many European nations already were making RWIS data available to motorists at rest areas and travel information sites—a service that started only recently in the United States.

In Japan, experts from the national weather service were assigned to traffic management centers. Reading the atmospheric and road condition data provided by RWIS, the weather forecasters were able to monitor weather and road conditions and provide accurate and reliable data for operational traffic management decisions, such as setting an appropriate enforced speed limit on the freeway.

organizational requirements and can update the program to incorporate changing technology or practices.

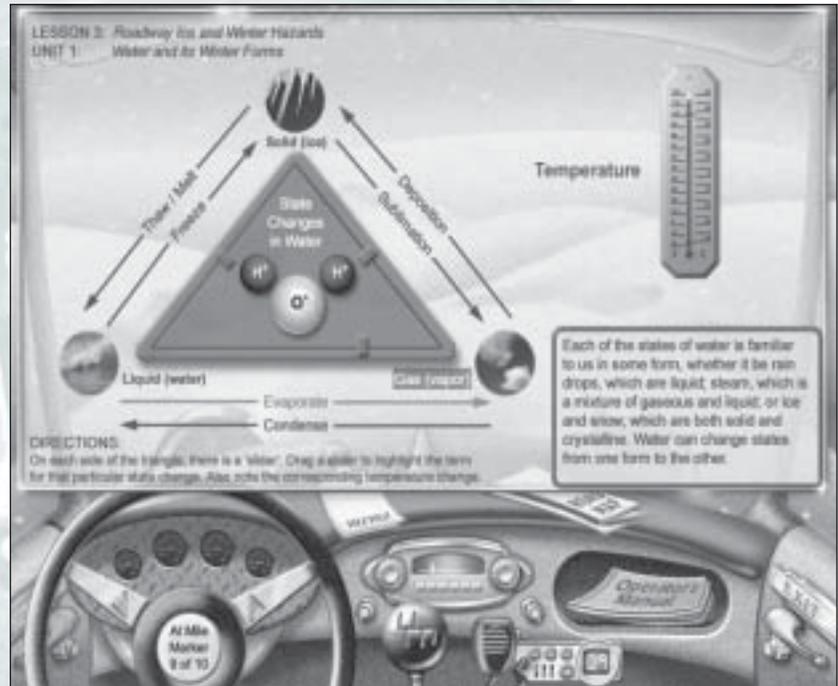
A metric version of the CBT is nearing completion for use in Canada. The American Public Works Association and the National Association of County Engineers will receive a generic version.

SICOP has championed the development and beta-testing of the CBT, which was initiated and contracted through Aurora (see box, page 6). Leland Smithson, SICOP coordinator and past chair of Aurora, believes the CBT will be critical in improving the accessibility and acceptance of RWIS.

“It’s one thing for central office decision makers in state agencies to implement anti-icing programs,” Smithson observes. “It’s another for field supervisors and snowplow operators to buy into the new programs and make them truly effective.”

Seeing, Hearing, Believing

The Swedish National Road Administration (SNRA), a member of Aurora, recently completed research investigating the effectiveness of audio and visual sensors to supplement traditional pavement sensors. The research has found that visual and audio sensors can provide more detail on surface conditions and, combined with other RWIS data,



CBT lessons on anti-icing and RWIS incorporate multimedia, with narration, sound effects, 3-D animation, and digital video.

Widening Web

Inspired by the success of the international scanning tour, and taking stock of the variety of programs and agencies adding to the web of winter maintenance research, AASHTO established the Winter Maintenance Policy Coordinating Committee (WMPCC) in 1994 to oversee and coordinate the states’ winter maintenance initiatives. Consisting of representatives from AASHTO, FHWA, the American Public Works Association, the National Association of County Engineers, and TRB’s Winter Maintenance Committee, WMPCC has a unique, big-picture perspective on winter maintenance research and implementation initiatives. FHWA, for example, keeps the committee up to date on the winter maintenance programs it sponsors—including Aurora—so that member groups can monitor the activities and coordinate their own.

Another RWIS-based FHWA initiative under development is the Maintenance Decision Support System (MDSS) project. MDSS uses an ensemble of forecast and road condition prediction models, with inputs from real-time RWIS data and other weather data, to forecast road conditions along each plow route. MDSS also generates recommended treatment plans for each route.

In winter 2003–2004, the second consecutive field test of MDSS is being led by the National Center for Atmospheric Research in Boulder, Colorado, and Iowa DOT, with support from staff at Iowa State University’s Center for Transportation Research and Education in Ames; the National Oceanic and Atmospheric Administration’s Forecast Systems Laboratory in Boulder; Massachusetts Institute of Technology’s Lincoln Laboratory in Lexington; and the

Cold Regions Research and Engineering Laboratory in Hanover, New Hampshire.

Maintenance personnel, however, need to understand the implications of RWIS data to adjust the MDSS as conditions warrant. Computer-based RWIS training, therefore, is a critical thread in the web of winter maintenance.

The RWIS thread weaves around nearly every aspect of winter transportation. Not only does RWIS benefit winter maintenance personnel, but it also benefits travelers. FORETELL™, a program under development, offers detailed and timely road weather information via the Internet, allowing travelers and winter maintenance personnel immediate access to accurate road weather and condition information.

FORETELL incorporates intelligent transportation systems with advanced weather prediction systems and integrates atmospheric and road condition information from several available sources, including local input from RWIS. FORETELL is being tested in the Mississippi Valley region and New England.

The Snow and Ice Pooled-Fund Cooperative Program (SICOP) is the funding and programming arm of WMPCC. WMPCC tracks research around the country, looking for overlaps and gaps in research; SICOP actively champions and promotes the development of new winter maintenance technologies. Because of WMPCC’s big-picture perspective, SICOP can take a systems approach to the projects it champions, pursuing technologies that enhance and support the entire web of snow and ice maintenance technologies, programs, and activities.

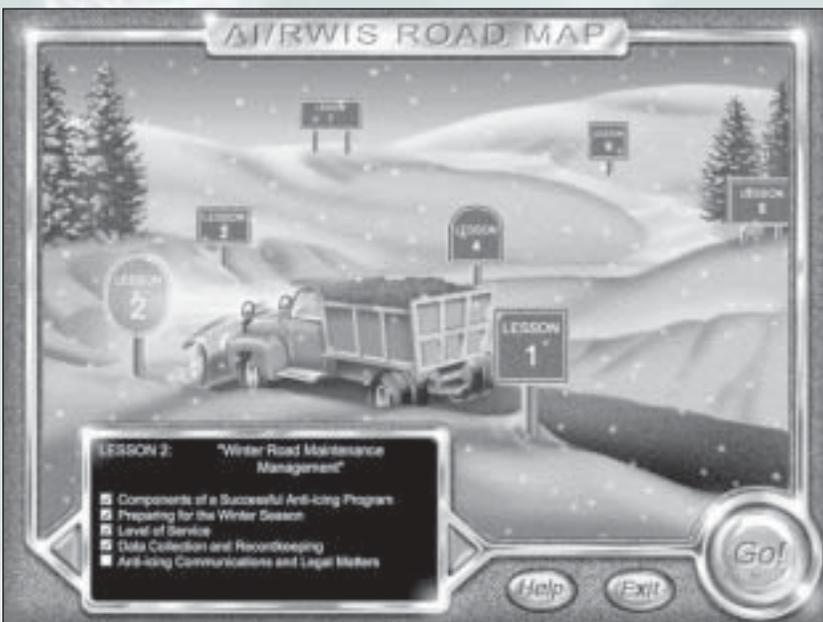
—Marcia Brink and Melanie Auen



CBT program's "scenario room" presents users with problems and exercises and evaluates anti-icing decision-making skills.

ultimately can help construct a more accurate picture of road conditions.

The premise is straightforward. Computer software can be programmed to recognize road conditions by sight and sound. The sound of a car passing on a wet or snow-covered road is different from the sound of the same car when the roadway is dry, at least to a highly sensitive microphone or a highly trained ear.



Main menu of CBT on anti-icing and RWIS is presented as a road map.

Using microphones and computer software, Swedish researchers are analyzing, identifying, and cataloging the different sounds of passing cars under various roadway conditions. The software compares real-time sounds against the catalog to identify current conditions.

The video component of this project works in a similar way. A video camera records a roadway section under various conditions, and computer software analyzes and catalogs the visual characteristics that identify each condition. The video camera then takes pictures of a section of roadway at given times throughout the day. Condition identification software matches characteristics in the real-time images with those in preidentified images, determining the current road condition.

Through the first phase of the project, video and audio components together have identified road conditions effectively and accurately. The video component of the second phase of the SNRA project has incorporated infrared cameras for nighttime video sensing to extend the operating hours of the visual system. Combining image and RWIS data has produced reliable results. A third phase will move the test site to a new location to acquire more data.

Trusting Sensor Data

Excluding vendor reports, documentation of the accuracy or variation in readings of RWIS pavement temperature sensors is scarce. An Aurora member, Wisconsin DOT, is championing a project to determine both the accuracy and the variation in sensor models, whether in-pavement or mobile. The result will resemble a consumer report, comparing RWIS sensors.

The temperature of the pavement and of the atmosphere is a crucial component of any RWIS, and slight variations can affect significantly the behavior of chemicals applied to a roadway. When the pavement temperature hovers near the freezing point, a few degrees can mean the difference between wet roads and icy roads.

All of the temperature sensors in an RWIS network, therefore, must provide consistently accurate readings. If the accuracy of the temperature sensors at different RWIS sites within a network varies even slightly, winter maintenance personnel will have difficulty gaining consistent results from anti-icing strategies, which are based in part on pavement temperature readings.

The first goal of the project is to develop a method for determining the true, or baseline, pavement temperature. Outputs of sensors manufactured by different vendors will be compared with the baseline

temperature of pavements under various conditions, and the sensors' accuracy in each condition will be evaluated. Sensors were placed in the test bed during summer 2003, and tests will be run during winter 2003–2004.

When the project is completed in summer 2004, agencies that are planning to install a system of temperature sensors, or to expand or upgrade a current system, will have a practical resource for comparing models.

Protecting the Environment

The primary goals of agencies that deploy winter roadway maintenance operations are to enhance safety for winter travelers and to reduce maintenance costs. With Environment Canada's renewal of concern about the effect of road salts on the environment, however, agencies are adding another goal: to minimize the amount of road salts that seep into the roadside environment. The Aurora coalition, working to optimize weather information systems and to enhance the effectiveness of operations that rely on RWIS data, will help agencies meet these objectives.

For updates on RWIS computer-based training, contact Leland Smithson, AASHTO SICOP coordinator, Iowa DOT, 515-239-1591, Leland.Smithson@dot.state.ia.us.

For information about participating in Aurora, contact Joe Holt, Chair, 615-532-3825, joe.holt@state.tn.us.

Websites

Aurora

www.aurora-program.org/

Canada: Proposed Code of Practice for the Environmental Management of Road Salt (*Canada Gazette*, September 20, 2003)

<http://canadagazette.gc.ca/partI/index-e.html>

Environment Canada: Actions on road salts

www.ec.gc.ca/nopp/roadsalt/en/index.cfm

FHWA: *An Introduction to RWIS Standards*

www.ops.fhwa.dot.gov/weather/Publications/RWIS_brochure.pdf

FHWA: *Manual of Practice for an Effective Anti-Icing Program: A Guide for Highway Winter Maintenance Personnel*

www.fhwa.dot.gov/reports/mopeap/mop0296a.htm

FHWA: Strategic Highway Research Program

www.fhwa.dot.gov/winter/roadsvr/icebro.htm

National Cooperative Highway Research Program: RWIS-related projects

www.TRB.org/ (see NCHRP, All Projects, Area 6: Snow and Ice Control)

Salt Institute: Winter Roadway Safety

www.saltinstitute.org/30.html

Snow and Ice Pooled-Fund Cooperative Program

www.sicop.net/

Swedish National Road Administration: Audio and visual sensors

www.rwis.net/roadcond/Limsskogen/Limsskogen.htm

Study Proposes National Research Program for Roadway Safety in Severe Weather

Recent advances in meteorology and roadway technology could improve the response to weather-related hazards that impede road travel, such as snow, rain, and flash floods, according to a report released in January by the National Research Council (NRC) of the National Academies. The NRC Committee on Weather Research for Surface Transportation: The Roadway Environment recommends that the federal government establish a national road weather research program, with the Federal Highway Administration (FHWA) coordinating the efforts of the weather and surface transportation research communities.

Adverse weather is associated with more than 1.5 million vehicle accidents each year, resulting in about 800,000 injuries and 7,000 fatalities. Drivers endure more than 500 million hours of weather-related delays annually on highways, and severe weather phenomena create logistical challenges for traffic managers, law enforcement officials, and emergency managers.

To improve safety and efficiency, information about how weather is affecting roads must be gathered and communicated effectively to motorists and to those who build, maintain, and operate the nation's roads. The study committee, convened through the Board on Atmospheric Sciences and Climate in the NRC Division on Earth and Life Studies, in conjunction with TRB, recommends the establishment of regional research centers to develop technologies to monitor, predict, and communicate the effects of weather on road conditions.

The new technologies could be installed and tested in demonstration corridors along two U.S. Interstates, according to the report. These research efforts should lead to nationwide improvements in products and services that mitigate the effects of weather on roads.

FHWA would coordinate the proposed research program, with the National Oceanic and Atmospheric Administration as a key partner. The committee estimates that the program would require an annual budget of \$25 million for 15 years.

The research program should stimulate interactions among federal, state, and local governments, the private sector, and academia. Private companies already are working to develop tools to help road maintenance officials make timely and cost-effective decisions about treating roads to prevent icy conditions. Real-time traffic data collected by states also could be used to help determine the effects of weather on traffic flow.

The report points to potential improvements from intelligent transportation systems, which apply detection and communication technologies to roadway transportation. The initiative calls for equipping vehicles and roadways with instruments that measure road and atmospheric conditions and that alert drivers immediately to poor road conditions.

FHWA sponsored the study. The committee's report, *Where the Weather Meets the Road: A Research Agenda for Improving Road Weather Services*, is on press; to order, contact the National Academies Press, telephone 202-334-3313 or 1-800-624-6242, or go to www.nap.edu.

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Market research is spreading among state departments of transportation (DOTs), transit agencies, and other public organizations—but not to sell transportation services in the same way as movies, soft drinks, or fast food. Agencies are employing market research techniques to understand public perceptions of products and services, to enhance performance monitoring and accountability, and to match services with available resources.

Transportation agencies are tracking public satisfaction, developing long-range plans, forecasting travel patterns, and analyzing alternative improvements through market research. These efforts are helping agencies to focus on key services, to reduce costs, and to plan investments. As Karla Rains, Director of Market Research at Minnesota DOT, has noted, “Market research has become a key element of our business philosophy.”

Defining Market Research

Public agencies are adopting market research practices widely used in the private sector. For businesses and corporations, market research is an ongoing activity that plans for, collects, and analyzes data relevant to decision making. Market research helps to identify and test new products and services, to assess consumer sensitivity to different pricing levels, and to determine satisfaction with products and services.

The author is Associate Director, Texas Transportation Institute, Texas A&M System, College Station. A member of the TRB Technical Activities Council and Chair of the Policy and Organization Group, she also serves on several standing committees, a task force, and a project panel.



There are two basic types of market research techniques: qualitative and quantitative. The difference between the two relates to the statistical validity of the information generated, which affects the ability to draw inferences to the population as a whole.

In general, qualitative techniques—such as focus groups—involve small numbers of people typically not selected at random. Quantitative methods, on the other hand, involve randomly selected samples, so that all individuals within a given population group have an equal chance of selection. Examples of quantitative market research techniques include telephone surveys, mail surveys, and intercept surveys—that is, personal interviews at specific locations.

The key is to match the appropriate market research method to the issue under consideration, the information desired, the project's scope, and the available resources. Many projects employ several methods. Most start with background research, assembling focus groups to explore the topic and to guide the design of survey questions. Surveys conducted via telephone, intercept, or mail may provide more detailed and statistically reliable data.

Approaches and Costs

The growth of public-sector market research applications has both internal and external influences. Internally, agencies are cultivating an orientation to the customer, with a focus on identifying and providing key products and services, enhancing performance monitoring and accountability in delivering the services, and matching services to available funding and staff resources. External influences include federal and state legislation, the increased scrutiny of public

agency performance by special interest groups, and the National Quality Initiative undertaken by highway industry groups in conjunction with the Federal Highway Administration and the American Association of State Highway and Transportation Officials.

Market research should not be confused with public involvement and outreach. Market research and public involvement have elements in common, but different objectives. Market research systematically collects, analyzes, and uses qualitative and quantitative information for decision making about transportation products and services. In contrast, public involvement ensures that all elements of the population have the opportunity to participate in the development of—and to comment on—the plans, policies, and programs of transportation agencies.

State DOTs and other transportation agencies employ a variety of organizational structures in conducting market research. Some adopt a centralized approach, with a market research unit or group coordinating all activities. Others are decentralized, with departments conducting market research as needed on projects. Many state DOTs and other public agencies rely on professional firms, local universities, transportation institutes, and related groups that specialize in market research and related activities to assist with specific projects.

The costs associated with different market research techniques vary. Focus groups are on the lower end of the cost scale, typically ranging from \$4,000 to \$8,000 each, depending on the target group, the length of the session, the level of detail in the discussion, and the geographical area covered. Telephone surveys are at the higher end, averaging approximately \$40,000 to \$60,000 for a 10-minute survey of 1,000 individuals. Factors influencing telephone surveys include the target population, the number of call-backs attempted, the length of the questionnaire, and the geographical area.

The following examples from several state DOTs, a regional planning agency, and a transit agency highlight common applications of market research in transportation planning, policy making, and performance monitoring.

Customer Satisfaction

State transportation agencies that conducted surveys in the 1990s focused on customer satisfaction with services, the development of programs to improve low-rated services, and the monitoring of performance levels. Customer surveys may focus on a specific topic—such as roadway maintenance or pavement conditions—or may cover a range of services and facilities provided by the transportation agency. Focus



Minnesota DOT held town meetings in summer 2002 to listen to the public's views and expectations about the department's long-term statewide transportation plan. Minnesota DOT Director of Communications Lucy Kender listens to citizens in St. Cloud.



St. Cloud residents participating in Minnesota DOT transportation dialogues broke into small groups to discuss policies and provide feedback. (Right) Abigail McKenzie, Minnesota DOT Director of Statewide Planning and Analysis, listens to discussion.

groups and mail and telephone surveys are commonly used in customer satisfaction programs.

Many states have implemented ongoing customer satisfaction programs. The initial survey results provide a benchmark to measure changes.

“We initiated an ongoing customer tracking assessment in 1997 using focus groups and telephone surveys,” states Dave Huft, Research Engineer at South Dakota DOT. “We have continued these efforts every two years. The results are vital to our strategic planning process and performance measurement initiatives.”

The ongoing studies assess public opinion of the importance and the quality of South Dakota DOT’s products and services, as well as identify actions to improve performance and the public perception of the performance. South Dakota DOT contracts with market research firms to conduct the assessments, including the interviews, focus groups, and telephone surveys, and the Office of Research in the Division of Planning and Engineering coordinates the market research activities.

The surveys and the targeted audiences have evolved. The most recent surveys have added specific customer segments, such as leisure travelers, farmers, emergency vehicle operators, and freight carriers and shippers but continue to include members of the state legislature in the samples of state residents. South Dakota DOT uses the results from focus groups, interviews, and surveys to develop recommendations and actions for its annual strategic plan.

“The department has been able to target specific areas for improvement based on the survey results,” Huft notes. “The public appears to notice the improvements, as ratings on several key performance measures were higher in the 2002 surveys.”

Other state agencies are turning to the DOT for advice: “Because of the success of the program, the department was asked to conduct a motor carrier

services customer satisfaction assessment for the South Dakota Highway Patrol,” Huft reports. “The concern was that safety and weight enforcement efforts were overly aggressive. The assessment will lead to significant improvements in the motor carrier safety program.”

Long-Range Plans

In another application of market research techniques, state DOTs and transportation agencies have gained input for developing long-range transportation plans. Focus groups, stakeholder interviews, and telephone, mail, and online surveys have helped identify priorities, rank potential projects, gauge interest in proposed policies and funding mechanisms, and obtain feedback. These market research techniques often are coordinated with larger public participation programs that may include public meetings, newsletters, online information, and other outreach activities.

Minnesota DOT developed its 20-year policy plan, *Moving Minnesota 2003: Moving People and Freight to 2023*, by combining market research and public involvement techniques. Although the techniques have different objectives and levels of validity, the information collected was valuable in shaping plans, policies, and programs.

Minnesota DOT obtained input and feedback from residents on the 10 policies in the draft plan through a variety of methods, including focus groups, public meetings promoted as “transportation dialogues,” surveys at the Minnesota State Fair, and responses to online surveys on the Minnesota DOT website. The focus groups represented different population segments, including immigrant groups and minority populations that may have been underrepresented in previous efforts.

The transportation dialogues were held in each Minnesota DOT district. The meetings started with a short presentation about the plan and the 10 guid-



ing policies. Participants then broke into small groups to discuss the policies and provide feedback.

The Minnesota DOT booth at the state fair, which spans 10 days at the end of August, included a display on the policy plan. Minnesota DOT staff was available to discuss the plan and to answer questions. Approximately 4,300 fairgoers completed a survey at the booth; Minnesota DOT recorded and analyzed a random sample of 1,000 of these surveys.

The Minnesota DOT website provided information on the policy plan. The “Get Involved” section

of the site included an online survey with questions similar to those on the state fair survey.

“The different market research and public involvement methods helped the department obtain input and comments from a range of individuals,” comments Rains. “The department uses market research in other ways—for example, to track customer perceptions of services and facilities, and in special studies focusing on snow removal practices, rest stops, traveler information services, and other specific projects.”



Drivers along TX-6 South participated in travel forecasting surveys in fall 2002. Contractors for Texas DOT randomly pulled over drivers in Brazo County to complete the surveys, which lasted an average of 3 to 4 minutes for personal vehicles and 6 minutes for commercial vehicles. In total, more than 2,500 drivers in personal and commercial vehicles participated.



Travel Forecasting

State DOTs and metropolitan planning organizations (MPOs) also conduct surveys to obtain information for travel forecasting and travel demand models. The results provide data on personal and commercial travel for input into the models used in transportation planning.

Travel forecasting programs typically rely on surveys that cover households, workplaces, external travel, truck travel, and special trip generators, such as major airports, colleges and universities, military bases, and amusement or entertainment facilities. Mail, telephone, and intercept surveys gain information from user groups and market segments.

Texas DOT, for example, conducts an ongoing travel survey program to update the data for travel demand modeling in the state’s major metropolitan areas. Travel demand modeling is critical for long-range transportation plans, corridor and area-specific plans, and air quality plans.

The department has a 10-year program to conduct full sets of travel surveys in 14 regions, which include all of the state’s 25 MPOs. The travel surveys represent the joint efforts of Texas DOT staff, researchers from the Texas Transportation Institute (TTI), consultants, and other groups. Texas DOT and TTI personnel jointly develop the questionnaires and the procedures for conducting each survey. Texas DOT uses a request-for-bids process to select and contract with consulting firms to conduct the surveys.

The survey methods vary. The external travel surveys, for example, obtain information on the characteristics of personal and vehicle trips through the region, as well as to and from the region. The procedure involves stopping vehicles at specific roadway locations and interviewing the drivers. The surveys are conducted at key locations in the outbound direction of travel, with the assumption that outbound trips mirror inbound trips. In addition, 24-hour directional traffic classification counts are completed at each location, and vehicle classification counts are recorded during the survey period.

The external travel surveys follow procedures established by Texas DOT. The consultants develop a traffic control plan, which includes hiring local law enforcement personnel to assist with traffic control. A uniformed police officer must be present at all times during the survey. The general procedure is to narrow traffic to one lane and to wave one to three vehicles randomly out of the traffic lane to the shoulder, where the drivers are interviewed. The vehicles then move back into the traffic lane, and additional vehicles are pulled over.

“With rapid growth in most metropolitan areas in the state, the results from all the travel surveys provide critical data for travel forecasting,” observes Charlie Hall, Travel Survey Program Manager for Texas DOT. “The information helps focus transportation investments in areas with growing demands.”

Corridor and Special Projects

Market research frequently is part of specific corridor projects or special programs. Focus groups and telephone, mail, intercept, and online surveys obtain information from residents and commuters about transportation alternatives and the introduction of new services. Combinations of techniques, such as focus groups followed by telephone and intercept surveys, may obtain feedback on options under consideration, possible changes in operations, and other project elements.

Market research was an important part of a 2-year study conducted by the San Diego Association of Governments (SANDAG) and the California Department of Transportation (Caltrans) on the potential expansion of the I-15 FasTrak program to the future I-15 managed lanes project. The project would allow single-occupant vehicles to continue to use the managed lanes for a fee, while high-occupancy vehicles (HOVs) would travel for free. The managed lanes also include bus rapid transit (BRT).

The market research assessed public attitudes and concerns about the I-15 FasTrak program and the proposed managed lanes, BRT, and value-pricing elements. Market research techniques included focus groups, stakeholder interviews, intercept surveys, and a telephone survey. The various tasks were performed by market research firms as part of the consulting team that assisted in the overall I-15 planning study coordinated by SANDAG and Caltrans.

Three focus groups obtained general insights into attitudes and opinions about the current demonstration and the proposed project elements. One focus group comprised travelers in the I-15 general-purpose lanes, one consisted of express lane users, and one was made up of transit riders.

Interviews were conducted with 4 elected officials, 15 senior agency managers, and 6 public interest or advocacy group members to identify opinions and concerns related to the current and proposed project elements. The interviews elicited opinions on the current and proposed projects, perceptions of community attitudes, and thoughts on additional outreach efforts.

Intercept surveys gathered opinions concerning the proposed project elements from two major user groups: 50 transit riders and 50 carpoolers at park-and-ride lots and major transit stops along the corridor. Finally, a telephone survey of 800 peak-period commuters—600 drivers in the general-purpose lanes and 200 FasTrak customers—obtained statistically valid information on attitudes and opinions.

“The results from the focus groups and surveys were beneficial in fine-tuning the proposed elements for I-15 managed lanes,” says Heather Werdick of SANDAG. “The same techniques will be used for a similar study exploring future options in the I-5 corridor.”

Performance Monitoring

Transportation agencies are using market research as part of performance monitoring evaluations. Examples include on-board surveys of transit riders, surveys of HOV lane users and nonusers, and surveys for specific projects. Although all types of market research techniques are valuable in ongoing performance monitoring programs, transit agencies typically employ intercept surveys of passengers on vehicles and at stations or stops.

The San Francisco Bay Area Rapid Transit (BART) District conducts rider satisfaction surveys every 2 years as part of its goal of achieving excellence in customer service. The survey questionnaires, completed by riders on randomly selected cars, assist in tracking trends in customer satisfaction, identifying areas for improvement, and gauging the importance of different services.

The surveys include general questions addressing customer satisfaction. Riders also rank BART performance on 44 specific service characteristics, covering items such as on-time arrival, hours of operation, train cleanliness, and parking availability at stations. BART’s Marketing and Research Department conducts the surveys with the assistance of a market research firm.

BART uses the survey results in several ways. A comparison of the results with those from previous years identifies trends in customer satisfaction, as well as responses to actions BART has taken to address lower-ranked items.



Caltrans and the San Diego Association of Governments used focus groups, stakeholder interviews, intercept surveys, and a telephone survey to assess public opinion of the potential expansion of the I-15 FasTrak program. Under the project, single-occupant vehicles could continue to use the managed lanes for a fee, while high-occupancy vehicles would travel for free.



A statistical technique is used to derive the relative impact a factor has on BART customer satisfaction. The resulting data are plotted on a quadrant chart showing both importance and rating. The information can assist in targeting areas for ongoing improvements and in identifying emerging issues. The survey results are reported to the elected Board of Directors, posted on the website, and made available to riders and the public through other media.

In the years between on-board surveys, BART conducts a telephone survey of a sample of respondents to the intercept survey. The telephone survey tracks key satisfaction measures and provides an opportunity to gather customer opinions on current issues, such as implementing wireless communication in tunnels and underground stations.

“BART operates in a competitive environment—78 percent of BART customers say they have a ready alternative for their trips,” notes Bob Lockhart, Principal Research Projects Analyst. “Customer input lets us focus efforts on areas that contribute most to maintaining a high level of customer satisfaction and thus retain current passengers and attract new riders.”

Ongoing Market Research

Market research is here to stay at transportation agencies around the country. The research plays an important role in helping many transportation agencies track customer satisfaction, develop long-range plans, forecast travel patterns, introduce new products and services, and reduce or eliminate services.

Transportation agencies have become savvier in applying market research techniques, realizing the benefits of different methods. The public accepts and values market research and expects public agen-

cies to obtain customer input on policies, new products and services, and levels of satisfaction.

The internal and external factors influencing the adoption of transportation market research will continue. Transportation agencies always will need to match services to available resources, to maintain accountability to the public and to policy makers, and to focus on key products and services.

The public, policy makers, and special interest groups will continue to hold public agencies accountable for the delivery of desired products and services. Market research helps agencies stay attuned to the needs of customers and to match external expectations with internal resources.

The Transportation Research Board (TRB) is playing an important role in facilitating research, sharing information, and assisting with technology transfer related to transportation market research (see box, below). TRB's efforts will continue as market research becomes more integrated within transportation agencies.

Websites

- Advertising Research Foundation
www.thearf.org
- American Association of Public Opinion Research
www.aapor.org
- American Productivity and Quality Center
www.apqc.org/
- American Statistical Association
www.amstat.org
- Bay Area Rapid Transit, 2002 Customer Satisfaction Study
www.bart.gov/about/reports/customersatisfaction.asp
- Council of American Survey Research Organizations
www.casro.org
- Marketing Research Association
www.mra-net.org

TRB Activities Support Transportation Market Research

TRB is supporting several activities to assist transportation agencies in applying market research techniques. The National Cooperative Highway Research Program (NCHRP) and the Transit Cooperative Research Program (TCRP) have sponsored the following recent projects:

- ◆ TCRP Report 36, *A Handbook: Using Market Segmentation to Increase Transit Ridership*, 1998;
- ◆ TCRP Report 37, *A Handbook: Integrating Market Research into Transit Management*, 1998;
- ◆ NCHRP Report 487, *Using Customer Needs to Drive Transportation Decisions*, 2003; and
- ◆ NCHRP–American Association of State Highway and Transportation Officials Report 8-36, Task 5, *Transportation Planning Market Research Notebook*, 2003.

In addition, TRB committees are exploring the use of market research and improving the state-of-the-art survey methods. Committees in the Policy and Organization, Planning and Environment, and Public Transportation Groups of the TRB Technical Activities Division have been instrumental in developing research problem statements, sponsoring annual meeting and conference sessions, and sharing information on market research efforts. For example, the Public Transportation Marketing and Fare Policy Committee sponsored a session at the 2003 Annual Meeting on transit management and marketing issues.

Transportation Agencies Meet Fiscal Challenges

The Transportation Research Board's
2003 Field Visit Program

In what many believe is the worst fiscal crisis since World War II, states responded to a third consecutive year of reduced revenues. The National Governors Association and the National Association of State Budget Officers reported that 37 states were forced to trim approved budgets by nearly \$14.5 billion—the largest reduction recorded by the 27-year-old fiscal survey.

State departments of transportation (DOTs) and other transportation agencies have dealt with budget problems in a variety of ways beyond reductions in staff and in spending. Transportation Research Board (TRB) staff found that transportation agencies are developing and deploying innovative approaches to meeting today's transportation needs. For example, state DOTs are

- ◆ Changing procurement laws to permit design-build, best value procurement, job order contracting, and other innovative approaches;
- ◆ Applying more sophisticated technology in the collection and analysis of data;
- ◆ Integrating many data sources into databases to support more comprehensive analyses of transportation programs;
- ◆ Deploying alternatives to conventional materials and construction methods to build structures more efficiently and with greater durability;
- ◆ Accelerating the delivery of completed projects to minimize the inconvenience and costs to the traveling public and adjacent businesses;
- ◆ Using asset management to integrate management systems for maintenance, pavements, bridges, road weather, and traveler information supported by geographic referencing;
- ◆ Developing total storm management techniques for winter services so that the state and contractors can integrate and coordinate responses to changing weather conditions and traffic characteristics; and
- ◆ Addressing freight transportation in highway planning, multimodal systems, and multijurisdictional regions and corridors.

These and other innovations are described in the following sections.

TRB'S 2003 FIELD VISIT PROGRAM

Institutional Issues**Management and Leadership**

States are reeling from the economic slowdown, which reduced income tax revenues and decreased funding for transportation initiatives. Moreover, reauthorization of the federal funding in the Transportation Equity Act for the 21st Century (TEA-21) is in limbo. This double blow has required strategic allocation of resources to maintain the condition, safety, and convenience of transportation systems for users.

Economic concerns, however, are only one managerial hot-button issue. Efforts to flatten the organizational structures in state DOTs, coupled with early retirement programs and the aging of top management, have produced a crisis of succession. More than 50 percent of the state transportation agency workforce will retire in the next 10 years, including many in upper management. With few middle managers to promote, many state DOTs must begin succession planning.

TRB Special Report 275, *The Workforce Challenge*, highlights issues in recruiting, training, and retaining qualified workers in the transportation industry. Acknowledging state fiscal conditions, the report recommends that agencies position human resources activity strategically to meet future needs, not to fill current vacancies.

Top management therefore must target funds for education and training to prepare the future workforce. All too often, however, professional development budgets are among the first cut. States are rethinking this approach, to ensure that staff has the tools to handle upcoming transportation challenges.

TRB's Field Visit Program

Specialists in the Transportation Research Board's Technical Activities Division identify current issues, collect and generate information on the issues, and disseminate the information throughout the transportation community. The TRB Annual Meeting, TRB-sponsored conferences and workshops, standing committee meetings and communications, publications, and contact with thousands of organizations and individuals provide TRB staff with information from the public and private sectors on all modes of transportation.

A major source of this information is the annual field visit program. TRB staff meets on site with representatives of each state department of transportation and also with representatives of universities, transit and other modal agencies, and industry. The objectives of the field visit program are to

- ◆ Identify problems and issues of importance to the department and other organizations visited,
- ◆ Provide assistance and information to help the organization address the problems and issues,
- ◆ Identify problems and issues that TRB should address to assist transportation organizations, and
- ◆ Identify activities that TRB should continue or undertake, to provide the best service to sponsors and other customers.

In May 2003 top officials from 27 states met at a Chief Executive Officer (CEO) Leadership Forum sponsored by the American Association of State Highway and Transportation Officials (AASHTO), the Federal Highway Administration (FHWA), and TRB, to discuss common organizational challenges and opportunities. The forum focused on three shared concerns: strategic leadership, systems operations, and program delivery.

The state DOT leaders developed action plans to share strategic themes, performance measures, benchmarks, and best practices; to cultivate public support for DOT programs; to identify core competencies for transportation officials; and to develop organizational models for more effective operations. The state visits confirmed that CEOs are focusing on these common concerns and that TRB can be the vehicle for sharing effective strategies.

Legal Issues

Legal concerns are prevalent throughout transportation agency operations. Recurrent issues include the following:

Security

Each curtailment or restriction of transportation services raises a question about infringements on individual civil liberties. According to the U.S. Supreme Court, if federal funding is involved, service benefits should not be terminated without a hearing. The TRB Legal Resources Group is responding to requests to research and clarify this issue.

Tort Liability

The federal highway safety program, codified in 23 USC 409, requires the collection of data, including collision reports. The law prohibits use of these data in damage lawsuits against highway agencies, but state courts often have resisted. In *Guillen v. Pierce County*, the Washington Supreme Court declared a major part of Section 409 unconstitutional. The U.S. Supreme Court reversed that ruling in January 2003, explaining the rationale and purpose of the section. The Guillen decision is helping state and local governments obtain more favorable results in court when applying Section 409 to protect the federal safety improvements program.

Emerging Technology

Transportation professionals are involved in significant legal issues over high technology. The bankruptcies of technology and communications companies have prompted reviews of intellectual property and bankruptcy laws. With more transportation services relying on intelligent transportation systems (ITS)



Washington (D.C.) Metropolitan Area Transit Authority provides wheelchair accessibility in 93 percent of its active fleet of 1,442 buses. Buses are on order that will bring the fleet up to 100 percent.

incorporating communications technologies, legal issues also have involved the Federal Communications Commission and the laws that govern communications providers.

Infrastructure Renewal

Faced with reductions in workforce and increased public demands for quicker project delivery, many public agencies have made radical changes to procurement laws to permit experimentation with design-build, best value procurement, job order contracting, and other innovative practices, turning away from the low-bid system that helped build modern infrastructure. New procurement systems create new challenges for construction attorneys, changing the legal landscape and introducing new legal issues.

Transit Law

The Americans with Disabilities Act (ADA) requires the provision of transit services to the elderly and disabled. As the nation grays, the demand for paratransit service increases, but local agencies are experiencing greater shortfalls in funding.

Advocates of ADA are calling for stricter adherence to the regulations. Agencies argue that their services “come close” to the regulatory requirements and constitute “a large part of the budget.” ADA advocates maintain that the regulations imply strict liability, with “zero tolerance,” and that the services are a civil right.

Employment

Employment and labor-related issues persist as major

concerns for agency officials. Sexual harassment, compliance with the ADA requirements, and the labor protection provisions in Section 13(c) of the Federal Transit Act are among the issues dominating transportation employment and labor law. TRB released several reports on these issues in 2003, including Transit Cooperative Research Program Legal Research Digest 19, *Impact of the Americans with Disabilities Act on Transit Operations* (August 2003) and Selected Studies in Transportation Law, Volume 6, *Transit Labor—13(c) Decisions* (2003).

Planning

For years the transportation planning community has heard so many calls to break through the “silos” isolating the different sectors of transportation that many planners do not want to hear the word silo. Nonetheless, three trends continue in most transportation agencies:

- ◆ Professionals within the silos are facing increasingly complex issues,
- ◆ Coordination among the silos has increased in importance, and yet
- ◆ Breaking out of the isolation has become increasingly difficult.

All transportation professionals have encountered an increase in the issues, concerns, and communities to involve in decision making. The trend cuts across modes and is accelerated by the goal of establishing a multimodal system.

TRB'S 2003 FIELD VISIT PROGRAM



PHOTO: THE MASSACHUSETTS TRANSIT AUTHORITY

The Central Artery/Tunnel Project, also known as the Big Dig, in Boston, Massachusetts, is expected to reduce congestion and improve mobility, but the project has exemplified “project scope creep” with its growing price tag and completion delays.

Transportation planners must consider the growing number and variety of positive and negative effects from the transportation system. The list of new transportation planning considerations is well documented and includes environmental justice, air quality issues, and effects on land use.

Transportation programmers face added difficulties in programming for large projects because of financial constraints and the difficulty of assembling large amounts of money. “Project scope creep”—the gradual increase in the activities included in a project—and the accompanying cost increases are difficult to predict and to accommodate. Project creep affects projects of all sizes and types, including nonmotorized projects and transit projects.

Nonetheless, in responding to the increased responsibilities, transportation professionals are developing more and more connections among the silos. Discussions with transportation agency staff yield two clear impressions. First, transportation planning professionals are committed to their jobs and to the increased responsibility for environmental stewardship, capacity increases, and other tasks. Second, they continue to develop and implement innovative approaches to overcome the many obstacles to doing the job they want to do.

Environment

Executive Order 13274, Environmental Stewardship and Transportation Infrastructure Project Review, issued in September 2002, emphasized transportation project delivery combined with good stewardship of the environment. In December 2002, FHWA Administrator Mary Peters established the Vital Few Goals, a set of agencywide performance expectations for improving the quality and timeliness of the environmental review process.

In 2002, FHWA identified five Exemplary Ecosystem Initiatives, adding three more in 2003:

- ◆ Arizona’s Comprehensive Approach to Wildlife Protection and Habitat Connectivity on the State Route 260 Project,
- ◆ Nevada’s Washoe Lake Wetland Mitigation Area, and
- ◆ New Hampshire’s Route 101 Ecological Protection and Enhancement Features.

These and other successful projects around the country are providing a strong foundation and a rich literature for environmental streamlining, and the experience has yielded three key lessons:

- ◆ Agencywide commitment to environmental streamlining and to strong relationships with stakeholders are the two first steps to success.
- ◆ Education and training of DOT staff, stakeholder staff, consultants, and interest groups must be ongoing.
- ◆ Communication with and among stakeholders is critical at all phases, from project planning to operations.

State DOTs are finding new and creative ways to achieve environmental streamlining goals.



FHWA is considering ways to balance transportation project delivery with good stewardship of the environment.

Data and Information Technologies

Freight Data

States, metropolitan planning organizations (MPOs), and metropolitan areas face substantial challenges in obtaining and using appropriate freight transportation data. Agencies had to make decisions with data from the 1997 Commodity Flow Survey (CFS) for multimodal freight activity patterns, while waiting for the release of the 2002 CFS data at the end of 2003.

The new data may offer less of the geographic detail needed by agencies than the 1997 version offered, because of reductions in the 2002 survey sample. Some agencies with sufficient funding may purchase private-sector freight data. Funding local or regional freight data collection programs to supplement the national data programs are a substantial cost for agencies, as are data modeling and synthesis efforts to estimate the geographic detail required for freight flows.

Urban Data

The users of personal travel data at the metropolitan and state levels also are waiting for major data sets. The 2000 decennial census data are now becoming available, along with the geographic details useful to transportation planners.

Of particular interest is the Census Transportation Planning Package, a special tabulation paid for by states and MPOs that includes journey-to-work data. Another data source for travel patterns is the National Household Travel Survey, jointly collected by the Bureau of Transportation Statistics and FHWA.

State Data Programs

Statewide data programs reflect industry trends, integrating many data sources to support more comprehensive analyses of transportation programs. With budget pressures during the economic downturn, departments are looking to make the widest use of available data.

Departments also are striving to align data collection and analysis with DOT priorities and to demonstrate value for program delivery. Initiatives such as transportation system performance measurement and asset management accentuate the need for data sharing and integration.

Geographic Information Systems

Geographic information systems (GIS) are gaining use; most DOTs have units that manage applications.¹ Many are moving away from an orientation to mapping, to set up an enterprise organizational structure with staff performing technical support.

¹ A summary of GIS in state DOTs by the AASHTO GIS for Transportation Task Force is posted at www.gis-t.org/yr2003/2003_GIST_Summary.htm.

Web technologies are a key to supporting more users and broader applications of GIS. The required technical interoperability has increased emphasis on data sharing and integration.

Information Technology

State DOT information technology (IT) activities also are affected by reductions in resources and funding. The technology priority for most state DOTs is to maintain a stable IT environment, replacing old hardware (personal computers, servers, and network and infrastructure upgrades) as necessary to keep applications and business functions operating.

Upgrades of business software applications and of AASHTOWare—AASHTO's technical service program for software development—are priorities. New applications are focusing on operations to improve efficiency and reduce IT costs, particularly through the integration of systems. Few large IT projects are starting up.

Aviation

Commercial aviation capacity has not been a front-burner issue for the public, but planners are aware that capacity is likely to regain attention as soon as travel returns to the levels that prevailed before September 11, 2001. Although generating public concern and funding for the enhancement of airport capacity may be difficult, planners are aware that acting now is imperative, because of the long lead times for infrastructure development.

Low passenger volumes, a related concern, translate into a diminished Aviation Trust Fund and reduced revenues for capacity-enhancing projects. Safety and capacity enhancement remain major goals for the Federal Aviation Administration.



Some states may decide to halt airport improvement programs and decline federal matching grants because of state budget crises. Major cuts in the Essential Air Service program are under consideration.

TRB'S 2003 FIELD VISIT PROGRAM



PHOTO: DURSI/HEINRY OF PORTLAND, MAINE

Airport managers are continuing critical runway development projects to address congestion and delays they believe will return once the recession ends; (above) the proposed runway expansion at Pittsfield Municipal Airport in Massachusetts.

State Aviation

The state budget crisis is the overriding concern for state aviation directors. Some states are selling off aircraft. Fiscal year 2004 is expected to require deeper cuts in budgets.

Some states may decide to halt airport improvement programs (AIP) and refuse federal AIP grants, because state and local funds may be insufficient to meet the required 10 percent matching share. The Bush Administration and Congress also are considering major cuts in the Essential Air Service program.

States maintain concerns about aviation security, and most have taken steps to prohibit the unauthorized use of general aviation aircraft. Nonetheless, the deepest concerns seem to arise from the possibility of unfunded mandates for security.

Major Airlines

The major airlines do not expect to return to a full-year, industrywide profit until 2005. With financing highly leveraged, the airlines remain ultrasensitive to external shocks and are uncertain about growth.

The legacy network carriers—such as United Airlines and American Airlines—have reduced fleets and personnel. At the same time, others—such as AirTran, Frontier, and JetBlue—have announced substantial aircraft orders.

Although increasing, passenger demand is nearly one-third below 2000 levels. Weak traffic and low prices have driven passenger revenue down to levels not seen since the mid-1990s.

Cargo also remains weak, with freight volumes 5 percent below 2000 levels and mail volumes down 45 percent. Grounding aircraft and seeking labor concessions have been primary tactics for cutting costs.

Regional Airlines

In general, the regional airlines have been profitable and are growing. Their size and flexibility allows a quick match of capacity to demand. Lower labor costs, fast turnarounds, high use, and lower breakeven load factors contribute to the flexibility. Trading older turboprops for newer jets has been another plus.

Airports

Security and the airlines' economic problems remain foremost among many airport managers' concerns. The airport segment of the aviation industry is experiencing much the same financial pressures as the airlines during the post-September 11 recession. Reductions in passenger volume and flight frequency have reduced revenue, leading to rescheduled capital spending, cost reductions, and other expense-saving measures until the industry recovers.

Airport managers believe that when the recession ends, the congestion experienced throughout the U.S. aviation system during the summers of 2000 and 2001 will return. Accordingly, airports prone to major delays are continuing with critical runway development projects, and airport managers are urging progress on key National Airspace System modernization projects to address congestion and delay.

General Aviation

As with the major airlines and airports, security and funding are the principal challenges facing the general aviation industry. General aviation is on the verge of profiting from the advanced and sophisticated technologies that have benefited airlines and upscale business aircraft.

Freight Systems

Except for freight trains at grade crossings and trucks on the highways, freight transportation tends to be invisible to the general public. Long considered relevant only to the private sector, freight transportation is gaining attention in most state DOTs.

State decision makers are beginning to understand the importance of freight transportation to state and local economies and the need for public-sector involvement in some aspects of freight. Many state planners and analysts face a steep learning curve, however, in comprehending the forces that drive private-sector decision making and how to coordinate public- and private-sector planning and investment processes.

In the past, states handled investments in ports, freight railroads, and airports that benefited freight movements through programs and processes separate from highway programs. Many states now are recognizing the need to address freight transportation in the context of highway planning, multimodal systems, and multijurisdictional regions and corridors.



PHOTO: WILBER SMITH ASSOCIATES

The I-10 Freight Corridor Study assessed traffic flow and safety concerns.

Freight is important to state economies. For example, in California, where one in every seven jobs is connected to international trade through the seaports, concerns are growing about the transportation system's ability to handle growth in container traffic, which is projected to triple by 2020. California's 10 most congested highways are also the major gateways for international freight moving through the state, and the rail freight system will reach capacity in the next few years.

Other states face similar problems on a smaller scale. Although private freight railroad systems have streamlined operations for efficiency and cost considerations, capacity concerns are increasing.

Truck volumes also are pushing the capacity limits on many Interstates. For example, truck freight in Ohio, a large manufacturing state, is valued at \$1.3 trillion, ranking third nationwide. Truck miles traveled in Ohio have grown by 89 percent in the last 25 years and are expected to increase by another 60 percent in the next 20 years. Trucks now comprise about one-fifth of Interstate traffic volumes and will increase to one-quarter by 2020.



Truck traffic on Ohio highways has grown dramatically over the last 25 years and is expected to increase in the next 20 years. Ohio DOT is addressing the short- and long-term issues of freight transportation by participating in a six-state Upper Midwest Freight Corridor Study that seeks solutions through multistate, multijurisdictional, public-private partnerships.

Heavy truck volumes on Interstates are common in many areas. Arizona reports that 40 to 50 percent of traffic on I-40 consists of trucks; trucks are 60 percent of the volume on I-40 between Little Rock, Arkansas, and Memphis, Tennessee, with many heading to or from a large intermodal yard in West Memphis.

Freight corridor studies are under way in many areas. Sponsored by eight state DOTs—California, Arizona, New Mexico, Texas, Louisiana, Mississippi, Alabama, and Florida—the I-10 Freight Corridor Study was completed in 2003. The study assessed the importance of freight on I-10 to the economy of the states and the nation, looked for impediments to traffic flow and safety, and evaluated strategies to facilitate freight flow within the corridor.

The six-state Upper Midwest Freight Corridor Study aims at establishing a regional approach for improving freight transportation through multistate, multijurisdictional, public-private partnerships that will address short- and long-term issues.

State decision makers also are working on other freight-related issues, such as tools for cross-modal investment analysis, innovative funding mechanisms, mainstreaming freight considerations to the attention of transportation professionals and the public, and measures for evaluating public investments in freight facilities and services.

Highways

Many states are completing highway designs with the assistance of contractors, because of reductions in state workforces and increases in the need for designs to meet the demands of construction programs. The integration of design data through GIS and the Global

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Positioning System is contributing to the timelier production of design plans.

Design-build contracting is increasing in frequency and value as more states have passed supporting legislation, overcoming liability concerns, and are initiating, completing, and monitoring the results of pilot projects. In general, states report savings from decreases in the number of change orders and from shorter durations for projects.

Context-sensitive design has evolved into context-sensitive solutions and has gained the attention of the public, designers, traffic operations personnel, and other practitioners. Many states are developing best practices for effective public involvement, tapping into the growing portfolio of case histories.

Pavement Design

States are applying more sophisticated technology in the collection and analysis of pavement condition data—for example, infrared and laser equipment, videostreaming, and advanced computer software. As a result, pavement management systems have more reliable data for prioritizing projects and resources.

Rapid, cost-effective testing for pavement mix design is allowing more routine use of new mix designs in the field. Many states are reporting full implementation of the Superpave® mix design, and several others are adapting the mix design—for example, by adjusting the restricted zone in aggregate gradation specifications.

States are preparing for implementation of the new AASHTO Pavement Design Guide. Many are developing implementation plans, but adoption may follow the model of the Superpave mix design implementation—that is, several states may take the lead, with educational efforts complementing experience.



PHOTO: NATIONAL ASPHALT PAVEMENT ASSOCIATION

Many states have fully implemented the Superpave mix design.



PHOTO: NORTH CAROLINA DOT

States are constructing bridges with high-performance concrete, which is more durable than conventional materials.

Bridge Design

The load and resistance factor design (LRFD) method for bridges and other structures is increasing in use as the 2007 implementation deadline approaches, but adoption is not uniform. Many states are working to meet the LRFD calibration and substructure requirements. Pressed to move projects into construction, DOTs are challenged to find time for training engineers in the new method.

States are looking for alternatives to conventional materials and construction methods to build structures more efficiently and with greater durability. High-performance concrete, structural fiber-reinforced plastics, improved precast concrete production and steel fabrication, and innovative construction techniques are increasing in use. Material and design specifications are in development, including identification of appropriate projects and locations.

Materials and Construction

Resurfacing, reconstruction, and rehabilitation of the infrastructure have become the major activities in construction, and the public expects timely completion of projects. Reducing project delays is a major focus for most state DOTs, and a few have taken the initiative to find ways to accelerate delivery of completed projects to minimize the inconvenience and costs to the traveling public and adjacent businesses.

New Jersey and Texas DOTs will be hosting Accelerated Construction Technology Team (ACTT) work-

shops in summer 2004. Initiated by the TRB Task Force on Accelerating Innovation in the Highway Industry, ACTT was pilot-tested in Indiana and Pennsylvania in 2003 and is now an FHWA and AASHTO activity.²

Texas plans to use the ACTT procedures in reconstructing two major Interstate freeways serving downtown Dallas. The New Jersey ACTT will work on a major bridge improvement project. Other states have expressed interest in ACTT workshops to assist in key reconstruction projects.

Utility relocation is one of the primary causes of project delays in most states. Tennessee is seeking state legislation to address the problem. The legislation would allow the DOT either to reimburse the utility company for relocating the equipment before the project begins or to include utility relocation in the project contract.

Every year, more states must hire consultants for construction engineering and inspection, as workloads exceed what the in-house workforce can handle. Tennessee is starting to use consultants on one project in each region. In some state DOTs, the reduced workforce may lack the training and experience to manage large projects. North Dakota cites more claims and arbitration because of contracting, and Iowa reports difficulty in achieving standards of quality.

All states are working to improve the durability of the constructed infrastructure. California DOT (Caltrans) has taken the lead in addressing moisture sensitivity issues in hot-mix asphalt. Working with several cosponsors, Caltrans convened experts from around the country to a seminar to discuss moisture sensitivity in asphalt pavements and to develop a

strategic plan or “road map” for mitigating the problem. TRB has published a report on the seminar.³

Early bridge deck cracking, alkali-silica reactivity, longitudinal joint compaction, and segregation in asphalt pavements are issues for a few states. Hawaii joined the small group of states using stone matrix asphalt. Virginia is exploring self-consolidating concrete, a technique developed and used in other countries.

Soils, Geology, and Foundations

More state DOTs are developing inventories of rock-fall hazard areas along transportation corridors; Hawaii is the latest to join the group. The primary objective is to assist in planning and budgeting with limited resources.

Hawaii DOT investigated 400 potential rock-fall sites, assessing the risks and developing hazard ratings. According to the study, addressing the state’s rock-fall hazard areas requires an estimated \$20 million, indicating the magnitude of resources required nationwide to prevent rock falls and landslides.

A recently completed National Cooperative Highway Research Program (NCHRP) project developed a method for assessing the condition of buried metal tension systems, such as rock bolts, in geotechnical applications. Workshops have presented the method and related findings at regional and state geotechnical meetings. Some states are considering the method to assess the condition of rock reinforcements along highway corridors.

How to identify subsurface cavities near transportation corridors—for example, abandoned under-

² See TRB Circular E-C059, Accelerated Highway Construction: Workshop Series Summary, <http://gulliver.trb.org/publications/circulars/ec059.pdf>.

³ Moisture Sensitivity of Asphalt Pavements: A National Seminar, is available in print and CD-ROM from the TRB Bookstore, www.TRB.org/bookstore/.



Photo: Chicago DOT

Crews working on Chicago’s Wacker Drive had to tackle a complicated design in constrained workspace.

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ground mines or sinkholes—and how to mitigate the problems that may arise remain concerns. TRB has established an Abandoned Underground Mines Subcommittee and a Geophysics Subcommittee to provide a forum for technology transfer. A workshop on abandoned underground mines, cosponsored by the subcommittee, convenes in April 2004 to facilitate the exchange of information among practitioners.

Other ongoing efforts are focusing on advances in LRFD, geophysical methods for subsurface investigation, databases to store the vast amount of information collected in field investigations and tests, and tools to assess compacted soils and intelligent compaction systems, which provide a system for quality assurance.

Highway Maintenance

Safety for the traveling public and road workers remains the priority in maintenance operations. Improving the efficiency and effectiveness of the procedures can reduce workers' time on the roadway. Temporarily closing roadway sections to perform maintenance also can reduce exposure to hazards.

One agency is exploring electronic data sharing by adjoining jurisdictions, to improve work zone traffic flow efficiency and safety. Other agencies are evaluating smart work zone technologies, decision tools for work zone speed controls, vehicle detection and information display technologies to provide real-time decision information to drivers in work zones, and posting work zone information on the Internet for motorist trip planning.

State DOTs are applying asset management principles to integrate systems for maintenance, pavements, bridges, road weather, and traveler information supported by geographic referencing. The maintenance management systems have retained planning, budgeting, and resource management functions but are



Bridge deterioration is captured on digital photography during inspection process.



PHOTO: ENERGY ABSORPTION SYSTEMS, INC.

Total storm management techniques for winter services include bridge anti-icing systems.

adding roadway feature inventories, condition assessments, customer input from complaint and survey systems, workload planning and forecasting, statistical sampling for quality assurance, and performance measures. Interface development, however, must establish common data definitions across agency units, handle a variety of location reference systems, and gain management support to underwrite the costs.

States are developing and implementing pavement preservation programs—part of asset and pavement management efforts—to extend service life and reduce deficiencies. One challenge is determining the right time to apply the right treatment for maximum benefit; another is evaluating performance not from how long the treatment lasts but from the extended service life imparted to the pavement.

Development and implementation of bridge management systems is on the agenda as states restore deficient and functionally obsolete structures. Digital photographs from bridge inspections are proving helpful in making condition comparisons and in planning maintenance repair activities. Several states establishing preventive maintenance programs have noted the needs for an “owner’s manual” to maintain new bridges, for the sharing of best practices in bridge element maintenance and repair, and for improved non-destructive testing to assess structural conditions.

Total storm management techniques for winter services are in development to integrate and coordinate state and contractor efforts in response to changes in

storm and traffic characteristics. States also are investigating several technologies, including automatic vehicle location for snowplows, bridge anti-icing systems, indexes to measure winter weather severity, salt reduction and frost forecasting models, performance measures, and noncorrosive and corrosion-reducing treatments for deicing, for example with agricultural additives.

The Road Weather Management Program of FHWA's Office of Transportation Operations is supporting development of a prototype winter road Maintenance Decision Support System (MDSS). MDSS will provide decision makers with information on predicted weather and roadway conditions and will identify appropriate treatment scenarios that rely on available local resources.

Agencies are integrating environmental considerations into maintenance operations and activities such as winter services, storm water runoff, pavement sweepings and marking materials, vehicle and equipment maintenance, alternative fuel programs, and environmental awareness training. Best management practices are needed to support improved environmental stewardship. One state is exploring modifications to its Adopt-a-Highway program to allow corporate sponsors that adopt an interchange to pay a provider for mowing and litter removal.

Highway Operations

Transportation agencies are applying operations measures to address a variety of issues: unacceptable and costly congestion; nonrecurring delays; increases and changes in travel demand, such as expanded peak hours and more freight movements for just-in-time delivery; reconstruction and maintenance of roadway facilities while maintaining traffic flow; the security of critical transportation structures; traffic incidents; weather and special events; and emergencies.

Addressing Congestion

FHWA estimates that traffic congestion causes 5.7 billion person-hours of delay annually in the United States. Temporary disruptions that reduce the vehicle-carrying capacity of the roadway and the reliability of the transportation system are the source of approximately half of this congestion.

According to FHWA, the three main causes of non-recurring congestion are incidents ranging from a temporarily disabled vehicle to an overturned truck containing hazardous material (25 percent of congestion), work zones (10 percent of congestion), and weather (15 percent of congestion). This unexpected congestion affects the scheduled personal activities of travelers and the timely distribution of goods and manufacturing materials by shippers.

Focused management of temporary traffic disruptions can reduce the impacts and return the system to capacity. Many state DOTs therefore are committing resources to strategies for mitigating unexpected congestion, such as traffic incident management, work zone management, road weather management, special events traffic management, and congestion mitigation.

Roughly half of the congestion experienced by Americans occurs daily, as the demand for highway travel exceeds capacity. In most urban areas, congestion persists for many hours. Recent operations innovations include the following:

- ◆ **Managed lanes.** Managed high-occupancy vehicle lanes provide preferential treatment for buses, car-pools, and vanpools and employ other management strategies—such as pricing, access for additional user groups, and controlled access—to maintain free-flow speeds and promote full use of the facility.

- ◆ **511 traveler information.** In mid-2000, responding to a petition by U.S. DOT, the Federal Communications Commission designated 511 as the national telephone number for traveler information. Nineteen 511 services now operate around the country, serving an estimated population of more than 50 million.

- ◆ **Adaptive signal control.** Several agencies have implemented systems that adjust to traffic fluctuations in real time.

- ◆ **Corridor management.** Many states are deploying traffic management systems at the corridor level, applying real-time data from surveillance systems to coordinate the operation of freeways with arterial street networks.

- ◆ **Roundabouts.** Roundabouts are attracting attention as an alternative to signalized intersections or diamond interchanges. Advocates cite the safety advantages of roundabouts in comparison with signal-controlled intersections. Major issues and concerns, however, are the safe movements of pedestrians—particularly seniors and those with impaired vision—and of bicycles; the design of multilane roundabouts; and signalization at high-volume roundabouts.

Real-Time Information

Accurate and real-time systemwide transportation information is critical to operations. Travelers need reliable system data to make informed decisions about travel mode and route. Traffic managers need reliable data to evaluate system performance; determine incident location for response; make informed decisions about diverting traffic in response to an incident; implement evacuations if necessary; and inform drivers about conditions ahead and alternative routes.

A few state DOTs have decided that instrumenting the roadway network for systemwide surveillance is



States are attempting to mitigate traffic congestion with construction solutions such as roundabouts (above, in Alexandria, Virginia). Pedestrian and bicycle safety and the signalization at high-volume roundabouts are issues of concern.

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not necessary. Instead, these states are focusing on improving interfaces with the 911 emergency reporting system and are relying on cellular telephone reports of crashes and other incidents to identify locations and response needs.

Organizing for Operations

For operational tools and techniques to achieve full potential, the many jurisdictions responsible for transportation in an area or region must work together. Traditionally, the primary focus of public transportation organizations has been on capital projects to increase system capacity, not on continuous systems management and operations. A total system management approach would incorporate system management and operations into the transportation planning and decision-making processes.

TRB therefore has created the Committee on Regional Transportation System Management and Operations to examine ways to maximize transportation system performance in metropolitan areas. The committee's scope will include coordinated and integrated decision-making approaches to operations and the harmonization of operations with planning, construction, preservation, and maintenance of transportation facilities.

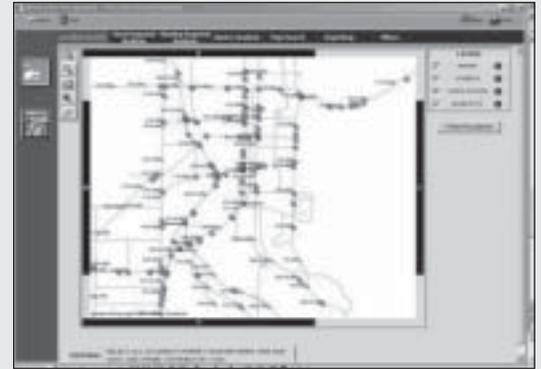
Highway Safety

Traffic deaths increased in 2002—a total of 42,815 compared with 42,196 in 2001. Deaths in passenger cars, light trucks and vans, and motorcycles also rose in 2002, but bicycle, pedestrian, and railroad grade-crossing fatalities declined.

U.S. DOT, AASHTO, the Governors Highway Safety Association, and others have adopted the goal of reducing highway deaths to a rate of 1.0 per 100 million vehicle-miles by 2008. State DOTs are implementing the AASHTO Strategic Highway Safety Plan. Guidebooks for 6 of the 22 strategies in the plan were published as NCHRP Report 500: *Run-off-the-Road Collisions; Unsignalized Intersection Collisions; Head-On Collisions; Trees in Hazardous Locations; Collisions Involving Unlicensed Drivers and Drivers with Revoked or Suspended Licenses; and Aggressive Driving Collisions*. The remaining guidebooks will be published in the coming year.

States have grappled with making crash data available in an accessible and meaningful way. A major consideration is linking databases for crashes, roadway inventories, drivers, vehicles, and emergency medical services, trauma units, and hospitals.

Utah DOT has developed a website that provides crash data through maps. By delimiting areas of the roadway system map using the computer screen cursor, a user can access crash data for that specific area—for example, a corridor, county or city, urban or suburban



Utah DOT provides online maps that track crashes involving drunk driving, inclement weather, and traffic trouble spots.

area, rural area, or specific intersection. The web crash data are readily available to DOT safety, engineering, planning, and district staff, as well as to users in MPOs, state and local police agencies, and others.

Oklahoma has developed a Geographic Resource Intranet Portal, an enterprise architecture system that brings together many data sources and reports. The architecture allows various offices to access crash data through a single, DOT-wide system.

The National Highway Traffic Safety Administration expanded CODES (Crash Outcome Data Evaluation System), a probabilistic software that links crash data with trauma unit and hospital data. The software now can link nonmedical databases to crash data.

“Click It or Ticket” campaigns, which combine focused enforcement with paid and public service media announcements, are proving successful in increasing seat belt use. For example, Texas Transportation Institute found that Texas DOT's campaign in 10 urban areas increased seat belt use by more than 8 percent in one year. In Washington State, seat belt use rose to 94.75 percent, the highest level in the United States, and the Washington Traffic Safety Commission attributed much of the gain to “Click It or Ticket” programs.

In 2002, 41 percent of crashes—a total of 17,419—involved alcohol, a growing trend since 2000. The National Transportation Safety Board has identified one group for particular attention—hard-core drinking drivers, who make up approximately 1 percent of the driving population, are involved in 27 percent of alcohol-related crashes.

Safety-conscious planning (SCP) continues to develop in response to a TEA-21 requirement. SCP forums convene the diverse partners working in highway and transit safety and transportation planning to learn about each other's activities, discuss data and resources, and create an action plan to include safety as a deciding consideration in transportation planning.

South Carolina, Arizona, Iowa, and several states in the Mid-America Regional Council planned or held SCP forums, and California and Ohio DOTs held internal forums. Eight forums, including one international, are planned for 2004.

Marine and Intermodal Transportation

Security, the environment, congestion, and safety were among the port issues discussed during 2003 field visits. An overall challenge is the integration of the marine transportation system into the overall transportation system. The projected growth in freight volumes and concerns about air quality and congestion suggest that more attention be given to increasing the use of water and rail links.

The Port Authority of New York and New Jersey (PANYNJ) has launched a port inland distribution network, a two-state initiative to relieve highway congestion and free up space at PANYNJ marine terminals. One of the first components of the network is a weekly barge shuttle, subsidized by a federal grant, on the 150-mile route between the coastal terminals and the Port of Albany, New York.

Financing security improvements and the effect of new security requirements on day-to-day operations are major concerns. The U.S. Coast Guard has estimated that implementing security for U.S. ports will cost approximately \$1 billion in the first year and \$5 billion over 10 years. The port security grant program, funded through the Department of Homeland Security and administered by the U.S. Maritime Administration, provides only a fraction of the funds needed by large and small ports for security enhancements.



Container crane was installed at the Port of Albany to support flows on Port Inland Distribution Network.

PHOTO: SEMO PORT AUTHORITY



Legislation in California aims at reducing emissions from idling trucks at Port of Long Beach. The National Resources Defense Council has developed a “green port” model that outlines best practices for operations.

The International Ship and Port Facility Security Code, introduced by the International Maritime Organization (IMO), provides a framework for the application of global standards of security for the marine industry. Several major port operators, including the Port of Houston, have partnered in the Smart and Secure Tradelanes initiative, a global security network deploying advanced security practices, business processes, and technologies to improve the security and efficiency of container movements.

Other key topics for ports are how to address pollution attributed to vessels, container yard equipment, trucks, and rail locomotives, and how to tackle the environmental challenges of dredging and vessel operations. Southern California ports have installed electrical outlets so that ships at berth can shut down engines and rely on shoreside power.

Port authorities also have taken steps to re-engine trucks and vessels to reduce emissions. Legislation in California aims at reducing emissions from trucks idling at marine terminals and ports. The South Coast Air Quality Management District enforces the law, and a grant program assists truckers replacing or retrofitting engines. The National Resources Defense Council has developed a “green port” model that outlines best practices for operations.

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Trucks carrying hazardous materials are transported by ferry between Detroit, Michigan, and Windsor, Canada, taking the trucks off highways and the Ambassador Bridge.

Complying with environmental needs while meeting the needs of commercial navigation continues to be a challenge for inland waterways, particularly for the Missouri River. In the Great Lakes region, attention is focused on preventing the introduction of non-indigenous aquatic species, which can affect native species adversely. IMO has established voluntary guidelines for ballast water management, which have been adopted by the U.S. Coast Guard and are mandatory in California.

Rail

Many states view intercity rail passenger service as a critical element of the transportation network and one that can relieve congestion in other modes. One-quarter of the states financially support the intercity rail passenger corridor services provided by Amtrak, and two-thirds of the states—some singly and some in corridors or networks—are planning rail services that may relieve highway and airline congestion. These planned passenger services generally would operate at incrementally higher speeds on rail lines mostly owned and operated by private freight railroads.

States are concerned that if adequate federal support does not continue for intercity passenger rail, excessive contributions from the states will be necessary. Many rural states rely on long-distance trains for access to remote areas but cannot provide additional financial support.

Several states are making substantial investments in intercity passenger rail to allow for higher-speed operations. For example, California is investing in incrementally higher-speed operations and is considering a dedicated high-speed system linking large population centers.

Illinois is contributing state funds for track and train control improvements in the Chicago–St. Louis, Missouri, corridor, in conjunction with a positive train

control demonstration project funded by the Federal Railroad Administration and the Association of American Railroads. Illinois is part of the nine-state Midwest Regional Rail Initiative, which is working to improve the speed, frequency, reliability, and accessibility of passenger rail services.

Two major issues confronting states involved in intercity passenger rail are (a) funding for operations and capital investment and (b) access to freight railroad tracks. Freight railroads in turn are facing capacity constraints in many corridors—even without the addition of passenger trains—and are concerned about the liability issues associated with passenger operations.

Many states continue to invest in freight rail improvements, for economic development and to maintain access for commodities appropriate for shipment by rail. For example, Wisconsin lends approximately \$5 million each year under the Freight Railroad Infrastructure Improvement Program to assist industries in making use of rail freight, primarily for bulk commodities.

State agency funding decisions for passenger and freight rail improvements are complicated by the lack of cross-modal investment tools to analyze expenditures on alternative solutions, locations, or corridors; to justify public investment in private railroad property; and to measure the performance of previous investments.

Public Transportation

Fiscal constraints at the state level extended to many local governments and special districts, which provide or fund transit. By mid-2003, long-term borrowing rates were rising, constraining local agency bonding capacity and adding to loan and lease costs.

After six straight years of increases dating back to the mid-1990s, a majority of large, medium, and small transit agencies reported ridership declines in 2002 and 2003 (see article, page 40). Light rail ridership,

however, increased by 1.9 percent, reflecting new system startups. Overall transit ridership is expected to increase as the economy continues to improve.

Transit agencies are implementing new services, system expansions, technologies, and equipment. Despite long lead-times, large capital programs are now in service or under consideration.

In California, the Bay Area Rapid Transit District opened an extension to San Francisco International Airport (SFO) in June. The \$1.45 billion project included four new stations and a link to SFO, plus an intermodal facility for rail transit, commuter rail, bus, and parking. The 8.7 miles of double track connect to a new international terminal and to an airport tram system serving all terminals, parking, rental cars, and airport support facilities.

In Southern California, the Los Angeles County Metropolitan Transportation Authority (LACMTA) opened the 13.7-mile Metro Gold Line, offering light rail transit service between Los Angeles and Pasadena, in July. LACMTA also extended the Metro Rapid Bus system in December 2002—with the 11.9-mile Vermont line and the 10.5-mile South Broadway line. By 2008, 24 rapid bus lines will be operating in metropolitan Los Angeles.

The New York Metropolitan Transit Authority's (MTA) Metro-North is upgrading commuter rail lines serving Connecticut. These large projects include 72 route-miles of track in New York and Connecticut, as well as stations, electrification, fleet replacement, maintenance, and rehabilitation. Dual-mode locomotives operate on a direct-power third rail into Grand Central Station and on catenary alternating current on the Connecticut lines.

More systems are installing alternative fuel propulsion systems, such as liquid natural gas or hydrogen. CTTransit in Hartford, Connecticut, is testing hybrid buses powered by an internal combustion, clean-diesel



The Bay Area Rapid Transit completed a \$1.45 billion project to connect to the San Francisco International Airport and an intermodal facility for rail transit, commuter rail, bus, and parking.



Electric storage system of a hybrid gas–electric bus, now being tested by CTTransit in Hartford, Connecticut.

engine with a generator, electric storage system, and two electric motors.

More bus systems are improving accessibility and acquiring accessible vehicles. The MTA's New York City Transit, for example, is fully accessible with a fleet of 4,500 wheelchair-accessible vehicles.

The stalled reauthorization of the federal-aid highway and transit program contributed to the financial uncertainty for transit systems. Transit system budgets also had to reckon with enhancing system security against terrorism, coping with severe weather events, and resolving union–management disputes:

- ◆ The 2003 President's Day Weekend snowstorm covered much of the East Coast from Washington, D.C., to New England with 2 feet or more of snow, affecting transit.

- ◆ Hurricane Isabel struck the Middle Atlantic region in September, closing the Washington, D.C., Metro system completely for the first time ever.

- ◆ In November 2003, the fourth week of a union strike closed down Los Angeles MTA bus and rail service, affecting more than 400,000 daily riders.

- ◆ Transit services in San Diego, California, had to cope with forest and brush fires in the eastern foothills and mountains.

For public transportation, 2003 was a year of accomplishment and progress, tempered by uncertainties manmade and natural.

CALENDAR

TRB Meetings
2004**April**

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

14–16 8th International Level Highway–Rail Crossing Symposium*
Sheffield, United Kingdom

21–23 Workshop on Abandoned Underground Mines*
Tucson, Arizona

May

3 Workshop on International Trade Data
Washington, D.C.

5–6 2nd National TRB–APTA Bus Rapid Transit Conference
Denver, Colorado

5–7 Marine Board Spring Meeting
San Diego, California
Joedy Cambridge

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

26–28 8th International Conference on Applications of Advanced Technologies in Transportation*
Beijing, China

June

7–9 6th International Symposium on Snow Removal and Ice Control Technology
Spokane, Washington

27–30 North American Travel Monitoring Exposition and Conference 2004
San Diego, California

July

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

August

22–24 Performance Measures to Improve Transportation Systems: 2nd National Conference
Irvine, California
Kimberly Fisher

29–Sept. 1 6th National Meeting on Access Management
Kansas City, Missouri
Kimberly Fisher

September

14–17 Structural Materials Technology: Nondestructive Evaluation–Nondestructive Test for Highways and Bridges*
Buffalo, New York
Stephen Maher

22–24 9th National Conference on Transportation Planning for Small and Medium-Sized Communities: Tools of the Trade
Colorado Springs, Colorado
Kimberly Fisher

26–29 2nd International Conference on Accelerated Pavement Testing*
Minneapolis, Minnesota
Stephen Maher

October

14th Equipment Management Workshop
Minneapolis, Minnesota

19–22 2nd International Conference on Bridge Maintenance, Safety, and Management*
Kyoto, Japan

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

24–27 16th National Rural Public and Intercity Bus Transportation: Celebrating the Silver—Going for the Gold
Roanoke, Virginia
Peter Shaw

November

1–2 National Household Travel Survey Data Users Workshop
Washington, D.C.

16–18 7th Marine Transportation System Research & Technology Coordination Conference
Washington, D.C.

18–20 Conference for Research on Women's Transportation Issues
Chicago, Illinois

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. Meeting listings without TRB staff contacts have direct links from the TRB calendar web page.

*TRB is cosponsor of the meeting.

NEW TRB SPECIAL REPORT

Cybersecurity of Freight Information Systems

A Scoping Study

JOCELYN N. SANDS

The merger of electronic information systems with transportation infrastructure is transforming the freight industry. Although expected to increase private and public benefits, the new and more fully integrated freight information systems may be vulnerable to cyberattack.

The U.S. Department of Transportation (DOT) therefore requested the National Research Council (NRC) of the National Academies to review trends in the use of information technology in the freight transportation industry and to assess the vulnerabilities to cyberattacks. NRC formed the Committee on Freight Transportation Information Systems Security (see box, page 35), under the Transportation Research Board and the Computer Science and Telecommunications Board.

The committee's charge was to recommend the scope for a study that would

- ◆ Describe the communication and information systems in U.S. freight transportation;
- ◆ Summarize ongoing and emerging information- and communication-based processes and technology improvements affecting transportation, shipping, and logistics;
- ◆ Review industry practices that address security; and
- ◆ Identify and summarize potential vulnerabilities in the interconnection, interface, and integration of new transportation information systems.

An important issue to consider is how to protect industry information needed to assess vulnerabilities.

TRB Special Report 274, *Cybersecurity of Freight Information Systems: A Scoping Study*, outlines options for a full study to assess the challenges to cybersecurity in freight transportation information systems and to develop a strategy for reducing the vulnerability to cyberattacks. Because the federal government transferred many security functions

performed by U.S. DOT to the Department of Homeland Security (DHS) after the start of the study, the committee addressed the recommendations and comments to DHS as well as to U.S. DOT.

Industry Attributes

The committee found that the development of designs and strategies for the security of freight transportation computer systems must be sensitive to several characteristics of the industry:

- ◆ The diversity of the many modes involved in freight transportation makes it difficult to develop a uniform security design. The steps taken must be evolutionary, tailored to the different sectors of the industry, and developed on a case-by-case basis to address identified vulnerabilities. A focused, evolutionary



A team of U.S. Customs and Border Patrol inspectors reviews manifest information to determine which containers are best suited for search.



TRB Special Report 274, *Cybersecurity of Freight Information Systems: A Scoping Study*, is available from TRB (see Publications Order Form in this issue).

process for identifying and prioritizing security enhancements will be necessary.

◆ The information system for freight transportation is an amalgamation of company-to-company information systems, constructed and integrated to increase efficiency of operation. The system design, however, is not uniform, not specified, not documented, not evaluated, not tested, and not subject to configuration control. These characteristics make the analysis and evaluation of security designs extraordinarily difficult.

◆ Cyberattacks on the freight transportation industry would have consequences not only for the industry itself, but also for industry customers, the general public, and government policies on imports.

The committee concluded that measures to reduce the vulnerability of the freight transportation industry to cyberattack should take into account industry scale and fragmentation, public-private interactions, information systems complexity, and challenges in coordination.

Types of Threats

The committee focused on three forms of cyberattacks on transportation and logistics networks: denial of service, hazardous material shipments, and weapons of mass destruction.

Denial of Service

In a denial-of-service attack—a direct attack on an information system—a perpetrator gains entry into a large number of unprotected computers on the Internet and programs the units to access selected websites simultaneously, so that the computers controlling the websites crash. Although individual freight companies may not be vulnerable to a denial-of-service attack, the industry's interconnected information

systems and increasing reliance on the Internet suggest the potential for widespread damage.

Hazardous Materials

Hazardous materials shipments are potential targets for terrorists trying to harm people or to acquire materials for making weapons. Terrorists could hack into information systems and identify and track hazardous material shipments, facilitating an attack at high-consequence locations. For example, a terrorist could seize control of railroad switches or signals to cause an accident or commandeer the supervisory control and data acquisition system of a pipeline network carrying dangerous material.

Weapons

Terrorists trying to import and export weapons of mass destruction could exploit vulnerabilities in transportation information systems to disguise shipments and elude stringent security measures.

Vulnerabilities and Technologies

Potential vulnerabilities to cyberattacks on freight transportation information systems may arise from many sources, including the interconnection of systems, increased reliance on the Internet for communications, and the emergence of decentralized systems.

Interconnection of Systems

Large transportation organizations have created enterprisewide systems. Smaller companies create federated or cooperative interconnected systems to increase competitiveness with larger organizations.

In addition, regulatory requirements, some in response to post-September 11 homeland security concerns—like the U.S. Customs Automated Manifest System—are driving the interconnection of commercial and government systems. Carriers, importers,



Computer systems used to handle freight logistics may be vulnerable to cyberterrorism.

exporters, and manufacturers are submitting more information electronically to the government.

Electronic documents, such as bills of lading and letters of credit, can be altered or counterfeited easily if not protected. Although the transportation sector follows electronic data interchange standards, authentication technologies generally have not been incorporated into emerging systems. The growing web of interconnected information systems is increasing efficiency across transportation modes but can become more susceptible to denial-of-service attacks, improper use, and unauthorized access.

Internet Communications

The Internet increasingly has become the primary communication method for transportation partners, carriers, and customers. Virtual private network technology incorporates encryption and other security mechanisms into remote user-to-system and system-to-system communications via the Internet, but only by prearrangement among a small number of systems. In general, the lack of a widely accepted encryption infrastructure impedes improved security.

Decentralized Systems

System architects have been shifting the design of information systems from primarily centralized systems toward decentralized systems—networks that operate without central control, like the Internet. The most significant challenge for large-scale, decentralized systems is the development of an infrastructure to authenticate all of the users from all of the systems.

Other Developments

The committee report also addresses the cybersecurity implications of radio frequency identification tags, electronic sensors, electronic seals, wireless communication devices, cryptography, smart cards or tokens, and biometric devices.

Study Plan

The report presents a study plan comprising five specific tasks.

1. Determine the chief vulnerabilities of freight transportation information systems. This task would identify and describe main information systems and their role in normal operations. The objective would be to develop a detailed system description in a format appropriate for security analyses, including a cost analysis for countering specific types of vulnerabilities.

2. Review industry and government practices addressing information technology security. This would look at how the vulnerabilities and risks identified in Task 1 are being addressed.

Committee on Freight Transportation Information Systems Security

Robert E. Gallamore (*Chair*), Director, Transportation Center, Northwestern University

A. Ray Chamberlain (*Vice Chair*), Regional Manager, Parsons Brinckerhoff, Inc.

Frank J. Anstett, Manager, Infrastructure Security, Raytheon Technical Services Co.

Samuel H. Banks, Senior Vice President, U.S. Customs Modernization Project, Sandler and Travis Trade Advisory Services

Richard A. Holmes, Jr., General Director, Security and Quality Assurance, Union Pacific Railroad

Barry Horowitz, Professor, University of Virginia, Department of Systems and Information Engineering

John L. King, Professor and Dean, University of Michigan

Lars Kjaer, Vice President, World Shipping Council

Art Kosatka, Chief Executive Officer, TranSecure, LLC

Steven J. Lambright, Vice President, Savi Technology

Daniel Murray, Director, Technology Research, American Transportation Research Institute

Alan F. Spear, President, MRC Investigations (USA), Inc.

Frank M. Pittelli, President, Navius Technologies, LLC

Karen Ryan Tobia, Manager, Technology Planning, Port Commerce Department, Port Authority of New York and New Jersey

3. Determine the potential for information technology-related security enhancements in the sector. Current and emerging technologies should be evaluated for use in addressing security gaps and deficiencies. Strategies to make promising security measures more attractive also should be considered in this task.

4. Analyze policies to reduce cyber vulnerability. The government's role in developing and disseminating information should be examined, along with the government's participation in joint public-private initiatives for the security of information technology systems.

5. Assess the economic impact of new security measures in the freight transportation industry. This task would assess cybersecurity measures that are of high value in public protection but that may not significantly benefit the company that implements them.

The author is Research Associate, TRB Division of Studies and Information Services. Alan T. Crane, Senior Program Officer, NRC Board on Energy and Environmental Systems, served as Study Director for this project, assisted by Steven Woo, Program Officer, NRC Computer Science and Telecommunications Board.



“ANALYZE THIS!”

Taking the Guesswork out of Broken-Back Culvert Analysis

KEVIN DONAHOO AND ROLLIN HOTCHKISS

Donahoo is Hydraulics Engineer, Nebraska Department of Roads, Lincoln; Hotchkiss is Associate Professor and Director, Albrook Hydraulics Laboratory, Washington State University, Pullman.

For many years, highway designers at the Nebraska Department of Roads (NDOR) have faced the difficult task of building culverts at locations that have an inlet substantially higher than the outlet. This requires the construction of “broken-back” culverts, which have either one or two breaks in the vertical alignment (Figure 1).

The hydraulic performance of these culverts, however, has been unpredictable. Field inspections of broken-back culvert installations did not reveal many clues about performance. Some locations experienced scour—the loss of sediment—at the outlets; in others, silt had plugged the entire outlet section; and yet other locations had neither scour nor sedimentation.

Problem

Broken-back culverts effectively control head-cut erosion, which occurs when a stream bed drops in elevation along a slope and undercuts the banks, progressing in an upstream direction and leading to collapse. The steep first section of a broken-back culvert, however, causes high velocities of water at the outlet, as well as possible scour in the downstream channel. The design guidelines in the Nebraska Road Design Manual were not extensive enough to produce uniformly successful results at the installations.

A key design problem was hydraulic jump, an almost instantaneous rise in the water surface with the change from a shallow, rapid flow to a deeper, tranquil flow. Tranquil flow at the culvert outlet reduces the potential for erosion. Roughness within the culvert barrel and deeper water at the outlet are conditions that may cause hydraulic jump.

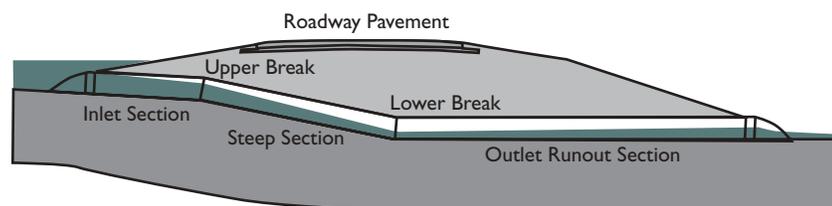


FIGURE 1. Double broken-back culvert.



Downstream view showing the canyon at the rim. Severe erosion was occurring just beyond the vegetation.

An easy-to-use design method drawing on hydraulic principles was necessary to improve broken-back culvert design and resolve the following critical questions about performance:

- ◆ What is the culvert’s outlet velocity?
- ◆ Which segment of the culvert determines the hydraulic capacity?
- ◆ How much does the flow accelerate in the steep section?
- ◆ How much does the flow slow down in the outlet runout section?
- ◆ How will the culvert perform with a range of flows?
- ◆ What conditions would cause hydraulic jump within the culvert barrel?

Solution

Rollin Hotchkiss and Jeffrey Shafer conducted research at the University of Nebraska to develop the Broken-Back Culvert Analysis Program (BCAP) for NDOR. The program automates the procedures for designing and analyzing a broken-back culvert.

BCAP uses energy equations to compute the water surface profiles (WSP) for each section within the culvert. For each WSP computation, the program also tests if conditions would cause a hydraulic jump.

Hydraulics laboratories at the University of Nebraska–Lincoln and at Washington State University performed the testing. The laboratories constructed model culverts and assessed the accuracy of BCAP in predicting headwater depth, outlet depth, the location of a hydraulic jump, and the hydraulic jump length.

BCAP predictions for inlet headwater and outlet depths matched up with experimental observations. Predictions of the location and length of a hydraulic jump were less satisfactory, but within acceptable limits.

Application

Two locations along Highway 26 in western Nebraska collect and discharge runoff that flows over a canyon rim into the canyon (see photo, page 36). The soils are sandy and noncohesive, subject to severe erosion. The flow could reach a peak of 85 cubic feet per second.

In 2000, after a BCAP analysis of the design alternatives, a 3.5-foot diameter, single broken-back culvert was installed. The steep section is 62 feet long with a vertical drop of 26 feet, followed by a 33-foot flat runout section.

To maximize the reduction in velocity in the runout section, corrugated metal was used. BCAP analysis had indicated that the roughness of the corrugated metal would reduce the velocity from 30 feet per second at the lower breakpoint to approximately 17 feet per second at the outlet (Figure 2).

To eliminate erosion, the length of the runout section was extended to 75 feet, which went beyond the right-of-way. A riprap basin was required to keep the runout section within the right-of-way.

BCAP links directly to the Federal Highway Administration's HY-8 Energy Dissipator Module, used to design protections against scour. Since completion of this project in March 2000, erosion has been minimal or nonexistent.

Benefits

Designers at NDOR now have a practical method for analyzing broken-back culverts. Before, a longhand solution for a single design alternative would take many hours, even for a designer with knowledge of hydraulic theory. BCAP provides instant analysis for a quick comparison of several design alternatives.

The BCAP research project provided opportunities to learn more about the hydraulics in steep culverts and to make the findings accessible and useful to the practicing engineer. Approximately 100 highway designers at NDOR have used BCAP on 160 to 200 projects per year to design and analyze hundreds of broken-back culverts. Each project typically comprises two or three broken-back culverts but may include as many as 10.

In addition, more than 1,000 individuals have downloaded the program free of charge from the NDOR web-

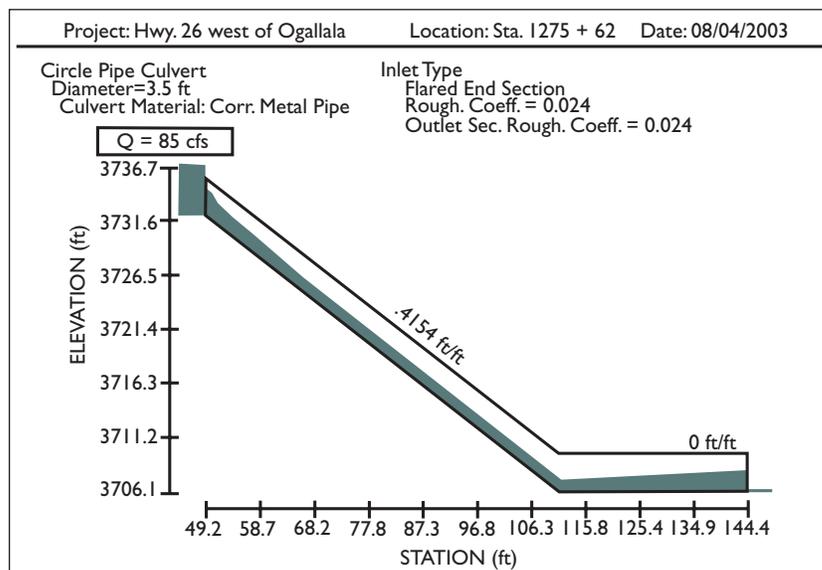


FIGURE 2. Plot from BCAP showing the cross section of the single broken-back culvert used in the case study. The computed water surface profile is shown in color. The computed headwater depth is shown at the inlet. The flow enters the steep section at critical depth and steadily accelerates to shallow, rapid flow. The velocity is highest at the lower break. From that point, with a flat outlet runout section, the pipe roughness slows the velocity from 30 feet per second to 17 feet per second at the outlet.

site (<http://doroads.nol.org/roadway-design/>). BCAP also is on the Hydraulic Engineering Software Reference List (www.fhwa.dot.gov/bridge/hydssoft.htm).

For further information contact Rollin H. Hotchkiss, Associate Professor and Director, Albrook Hydraulics Laboratory, Civil and Environmental Engineering Department, Washington State University, P.O. Box 642910, Pullman, WA 99164-2910, telephone 509-335-1927, e-mail rhh@wsu.edu; or Kevin Donahoo, Hydraulics Engineer, Roadway Design Division, Nebraska Department of Roads, 1500 Nebraska Highway 2, Lincoln, NE 68509-4759, telephone 402-479-4725, e-mail kdonahoo@dor.state.ne.us.

EDITOR'S NOTE: Appreciation is expressed to G. P. Jayaprakash, 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).

John W. Fischer

Congressional Research Service

John W. Fischer provides information about transportation policy to members of Congress and their staffs. Lately, his work has focused on the operation of the transportation trust funds and, particularly, the debate over reauthorization of federal surface transportation programs, which Congress is considering this year. As a specialist in transportation at the Congressional Research Service (CRS), a division of the Library of Congress, Fischer analyzes the policy and technical research published by TRB and a host of other sources, and synthesizes them for policy makers in the legislative branch.

Fischer has authored many CRS and congressional reports about surface transportation legislation, aviation legislation, airline industry competition and structural change, relations between the U.S. and international aviation communities, high-speed surface transportation, and the competitive status of U.S. commercial aircraft manufacturing in international



“At [the Congressional Research Service], I’m never absolutely sure what I’ll be doing from day to day. Congress sets and resets our agenda constantly.”

markets. In particular, his reports have covered the Intermodal Surface Transportation Efficiency Act (ISTEA), the National Highway System, the Transportation Equity Act for the 21st Century (TEA-21), the trade dispute between Airbus and Boeing, and the policy effects of railroad deregulation.

Unlike other transportation practitioners and researchers, Fischer cannot readily list all of his professional accomplishments. Because CRS provides Congress with research that is nonpartisan and sometimes confidential, Fischer cannot disclose the contents of all of his reports or whether the recommendations and analyses have had an impact on legislation. Fischer, however, accepts that constraint with ease.

“What I like about CRS is that, while I do get to do some long-term research, most of the time I’m never absolutely sure what I’ll be doing from day to day,” Fischer said. “Congress sets and resets our agenda constantly. As a result, I’ve never had a chance to get bored by a single subject.”

In his career with CRS, Fischer has written reports on nearly every transportation mode, but within TRB he is best known for his work on aviation topics. He has served on several TRB aviation committees during the past 20 years, and he chaired the Aviation Section from 1994 to 2001.

Since 1992, Fischer has provided all TRB aviation chairs and committees with semiannual or annual briefings on key transportation legislation and issues. He also has provided crucial leadership during the development of two aviation task forces from initiation to their eventual status as the committees on Aviation System Planning and on Environmental Impacts of Aviation.

Fischer has provided leadership for TRB technical activities committees in implementing new actions, developing procedural changes, guiding the organization and development of specialty conferences, and steering the production of significant publications, such as state-of-the-art reports and circulars. The Transportation Research Circulars he has edited have covered a range of aviation issues, including regulation, safety, manufacturing developments, on-time flights, and airport planning.

Fischer lightheartedly tells people that he has a long history in transportation. During summer break in high school, he painted STOP and SLOW pavement markings on roads for the Township of Clarkstown Highway Department in New City, N.Y. The following summer, in 1966, Fischer ran a jackhammer as a bridge maintenance crew member on the New York State Thruway. While attending Lafayette College in Easton, Pennsylvania, during the late 1960s, Fischer was a part-time truck driver.

Fischer first considered transportation as a career when he was serving in the U.S. Army. After graduating from college in 1970, Fischer spent three years stationed in Germany. His assignment as the unit’s motor officer provided an unexpected firsthand education in logistics management.

After returning to the states, Fischer enrolled at American University in Washington, D.C., and earned a master’s degree in public administration with a concentration in transportation in 1976. He spent the next year as a transportation consultant for Roy Jorgensen Associates in Gaithersburg, Maryland, before heading to CRS in 1977. Fischer worked as a transportation analyst until he was promoted to transportation specialist, his current position, in 1985. He served as CRS section head for industry analysis and transportation from 1986 to 1994.

While attending American University in the mid-1970s, Fischer befriended the late Prof. Edward Margolin, a longtime TRB participant. Margolin urged Fischer to attend the TRB Annual Meeting in 1976, and he has participated in every meeting since. In the early 1980s, the late Jim Gorham, a colleague of Margolin’s, recruited Fischer as secretary of a TRB task force that later became the Committee on Aviation Economics and Forecasting. Fischer chaired the committee from 1988 to 1994.

“My recent appointment as an emeritus member of that committee is, I hope, proof that Jim chose me wisely,” he reflects. Fischer is thankful for the support he has received in his career: “I have always tried to repay those who helped me at the beginning of my career by offering assistance to those starting out in the field,” he notes. “There is nothing more important to me than making sure that individuals have a fair shot at advancement.”

Michael M. Sprinkel

Virginia Transportation Research Council

With a career spanning more than 30 years in bridge and concrete materials research for the Virginia Transportation Research Council (VTRC) and with steady involvement in TRB, Michael M. Sprinkel is committed to seeking highway construction solutions that lower cost, increase the life of materials, and reduce congestion. Sprinkel, Associate Director at VTRC, has played a critical role in the development and implementation of prefabricated bridge elements that can be mass-produced—saving construction time and money; and of polymer and hydraulic cement concrete overlays that can be used for constructing bridge protection systems with little inconvenience to the traveling public.

Sprinkel attributes the success of these projects to collaboration: working with state and industry officials, participating in associations, and attending nearly every TRB Annual Meeting since 1973.



“Making progress through research requires the identification of problems that if solved will result in major impacts.”

“Making progress through research requires the identification of problems that if solved will result in major impacts,” Sprinkel notes. “Moreover, materials and construction practices must be refined to provide the desired results. State departments of transportation (DOTs) must work with material suppliers, contractors, and associations to benefit from their expertise and create a united movement. Annual presentations and publications of progress at TRB also are necessary, to inform and educate attendees and to get input and support from as many DOTs and as much of industry as possible.”

Sprinkel started at VTRC in 1972 as an engineer trainee, after graduating from the University of Virginia, where he earned bachelor’s and master’s degrees in civil engineering. He became a registered Professional Engineer in 1976.

Around that time, he began working with Virginia DOT and the precast and prestressed concrete industry to develop and implement prefabricated bridge elements. In 1985, Sprinkel authored National Cooperative Highway Research Program (NCHRP) Synthesis 119, *Prefabricated Bridge Elements and Systems*. He chaired an NCHRP Project Panel on Rapid Replacement of Bridge Decks, from 1993 through 1998, and currently chairs the NCHRP Project Panel on Full-Depth, Precast-Concrete Bridge Deck Panel Systems.

“We recognized that the quality of the concrete used in bridges should be better when placed and cured under controlled conditions in a precast plant,” Sprinkel said. “In addition, we could see cost savings associated with mass-producing elements and accelerating the construction. Finally, with the increase in traffic and the number of bridges that need rehabilitation and replacement, prefabricated bridge elements minimize on-site construction time and associated delays to the motorist.”

In the early 1970s, concrete overlays became an option for extending the life of bridge decks subject to corrosion from chloride ion. Sprinkel worked with suppliers to develop flexible polymer materials that were thermally compatible with the concrete decks. By the end of the 1980s, Virginia DOT had selected a polymer overlay that is still in use. A key factor was the development and implementation of specifications that require the contractor to test the overlay for bond strength—a well-bonded overlay can perform for 20 years or more.

Sprinkel also has worked with materials suppliers and contractors to develop concrete overlays that require short lane closure times. In 1986, Virginia DOT constructed a high early strength latex-modified concrete overlay, which required only 24 hours before traffic could resume. The 1988 TRB paper and presentation received the K.B. Woods Award for research in the design and construction of transportation facilities.

Sprinkel has continued to work with industry to develop and improve concrete overlays. In 1997, Virginia DOT first constructed a very early strength, latex-modified concrete overlay. With calcium sulfoaluminate and dicalcium silicate cement substituted for portland cement, the overlay achieves sufficient strength for traffic in only 3 hours.

“The overlay saved considerable money normally required for the traffic control for long lane closures,” Sprinkel comments. “Compared with conventional concrete overlays, which require weeks of lane closure for construction, inconvenience to the motorist was greatly reduced.”

For TRB, Sprinkel has served as secretary and chair of the Committee for Polymer Concretes, Adhesives, and Sealers; member of the Committee for Steel Bridges; secretary of the Committee for Construction of Bridges and Structures; secretary, chair, and now emeritus member of the Committee for Mechanical Properties of Concrete; and current chair of the Concrete Section.

Sprinkel is a Fellow of the American Concrete Institute and a member of the Post-Tensioning Institute, the International Concrete Repair Institute, the Precast–Prestressed Concrete Institute, the American Society of Civil Engineers, and the American Society for Testing and Materials. Sprinkel says his 32-year relationship with TRB, however, has been the most rewarding.

“The TRB Annual Meeting is the most significant meeting on transportation research,” he asserts. “Problems are not problems and solutions are not solutions if they are not being discussed at the annual meeting.”

NEWS BRIEFS



The center arch of bridge, built on the banks of the Mississippi River, is positioned over permanent piers with a mere 7 to 8 inches of clearance; barges then were sunk to drop the arch into place.

Wisconsin Floats Bridge into Position

In a rare civil engineering feat, the Wisconsin Department of Transportation (DOT) successfully floated the fully constructed arch of a bridge across the Mississippi River and connected it to its permanent piers. Instead of constructing the entire bridge to span the river, Wisconsin DOT opted to build the 475-foot-long, 2.8 million pound steel central arch section along the riverbanks and then move it on three barges to where the 2,573-foot bridge will soon stand.

The new two-lane bridge, expected to be fully constructed in November 2004, will carry eastbound traffic on US-14/61 and WIS-16 to downtown La Crosse; the adjacent two-lane Cass Street Bridge then will carry only westbound traffic heading to Minnesota. The December 18, 2003, installation, webcast live on www.dot.wisconsin.gov with audio and video feeds, demonstrated the technological ingenuity of the 11-month, \$40-million construction project.

At the onset of the daylong installation process, tug boats pulled the three barges on which the arch rested into the channel and swung the entire structure around to an east-west orientation. When the structure was 50 feet from the bridge, cables were connected to move the arch into place over the permanent piers. One million pounds of water then was pumped to sink each barge and lower the arch onto the pier caps. After the arch was connected to the bridge, the barges were pulled away.

The new four-lane highway will provide relief to rush hour congestion that frequently had backed up on the bridge and into the city. By improving traffic flow for the approximately 19,000 vehicles that cross the current bridge daily, the Mississippi River Bridge

project is expected to reduce the crash rate, which is considerably higher than the statewide average on comparable roadways. The projections of growth in average daily traffic to 28,000 vehicles by 2024 made the project vital. The new bridge also provides safer travel for bicyclists and pedestrians, with a bike lane and sidewalk.

For more information go to www.dot.wisconsin.gov/projects/d5/mriver/index.htm.

Mass Transit Adjusts to Slow Economy

The 2½-year economic downturn has sent a ripple effect through mass transportation agencies, which are suffering from fewer riders, decreased government funding, and reduced services and staff, according to an American Public Transportation Association (APTA) report released October 2003. In surveys conducted in the summer 2002 and again in 2003, a majority of large, medium, and small transit agencies reported ridership declines—following six straight years of continuous increases dating back to the mid-1990s.

APTA, an international advocacy organization representing the transit industry since 1882, sent questionnaires to 350 bus and train agencies in the United States and Canada. The survey was performed to determine the impact of the economic downturn on transit ridership and finance; 104 responses were received.

APTA concluded that the transit industry—particularly large urban transit agencies—was heavily hit by corporate layoffs that reduced work-related transit trips. Fare revenues dropped, compounded by decreases in state and local government contributions and increases in premiums for property and liability insurance. As a result, 54 percent of transit systems reported an increase in operating deficits, even with the implementation of cost-cutting tactics.



To head off budget deficits, mass transit agencies have had to freeze hiring, raise fares, delay projects, and reduce services.

Administrative services suffered the most from cost reductions. To head off deficits, 73 percent of respondents reduced administrative costs—many by delaying capital projects and implementing hiring freezes and staff reductions. Nearly one-quarter reported having to defer maintenance. Many agencies dipped into reserve funds to increase operating revenues. Nearly half of the transit systems increased fares—some for the second straight year—and the remainder expected to raise fares soon.

When cutting services and increasing revenues were not sufficient to reduce budget deficits, transit systems resorted to reducing services—44 percent provided less frequent bus and train services and 22 percent reduced fleet size. Higher percentages of large transit agencies cut administrative expenses, increased fares, and reduced services.

Service reductions, although not desirable for many systems, are expected to continue until economic conditions bring notable gains. APTA reported that more transit agencies reduced services and cut expenses in 2003 than in 2002; however, ridership declines slowed last year, an indication of possible economic recovery.

View the report, *Impact of the National Economic Slowdown on Public Transportation*, at www.apta.com/research/info/online/econimpactsurvey.cfm.

Updated Guidelines for Traffic Control Devices

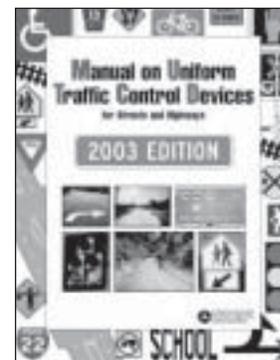
The Federal Highway Administration (FHWA) has released new standards and guidance for traffic control devices in an effort to increase safety and mobility for elderly and highway drivers, pedestrians, and bicyclists.

The recommendations are included in the 2003 update of the *Manual on Uniform Traffic Control Devices* (MUTCD), used nationwide by state and local transportation agencies in the design and placement of traffic signs, signals, and pavement markings.

The new MUTCD includes recommendations for increased letter size on street signs and turn-path pavement markings at intersections, to help older drivers. The new manual also offers guidance for handling highway accidents, including use of fluorescent pink signs to alert drivers to traffic incidents, crash sites, closed exits, and detours; and travel reference signs to assist drivers and emergency responders in reporting and locating breakdowns and crashes. These signs would be posted at shorter intervals than current mileposts and would be particularly beneficial in urban areas.

Other recommendations would ensure pedestrian safety, including use of “animated eyes,” electronic signs that mimic back-and-forth eye movements, reminding pedestrians to look both ways before crossing (a concept that was demonstrated in a TRB ITS-IDEA project); “countdown signals” that post the time remaining to cross a street safely before the traffic light turns; and crosswalk markings and “in-street” pedestrian signs that alert drivers to crosswalk activity. Recommendations targeted at visually impaired pedestrians include the use of barriers for safe navigation of walkways and audible devices to communicate sign information. The manual also recommends new bicycle lane markings and symbols to improve safety for cyclists.

For more information go to <http://mutcd.fhwa.dot.gov/>.



PEOPLE IN TRANSPORTATION

Sussman Honored for Contributions to University Education and Research



The Council of University Transportation Centers (CUTC) honored former TRB Executive Committee Chair Joseph Sussman with an award in recognition of distinguished contributions to university transportation education and research. The JR East Professor in the Department of Civil and Environmental Engineering and the Engineering Systems Division at the Massachusetts Institute of Technology, Sussman was cited by CUTC for his “lasting impact on the transportation field.”

Author of the graduate textbook, *Introduction to Transportation Systems*, Sussman has developed and taught courses on a range of subjects and has written extensively on the philosophy and design of transportation research. His research on railroad service reliability, operations, and risk assessment has had an impact on the railroad industry in the United States and Japan, and his work in intelligent transportation systems has helped to build the U.S. national program.

Sussman has made a sustained contribution to TRB and has played a key leadership role in its committee activities for many years. He received TRB’s 2001 Roy W. Crum Distinguished Service Award for outstanding achievement in transportation research.

NEWS BRIEFS



Chicago Transit Authority vehicle, which ran on liquefied propane gas in 1959, on display at the Smithsonian.

Transportation Exhibit Opens at Smithsonian

The Smithsonian National Museum of American History in Washington, D.C., has installed a major new exhibit, *America on the Move*, a multimedia educational presentation of transportation's role in the nation's development. The exhibit showcases nearly 20 vignette settings—supplemented by multimedia technology and 300 historical artifacts—to create the sights, sounds, and sensations of transportation in the United States from 1876 to the present.

Among the vintage vehicles on display are a 1950s Chicago Transit Authority mass transit car, a 260-ton, 90 ft. locomotive, and a 1903 Winton, which was the first car driven across country. The exhibit explores several historical moments in transportation, including the coming of the railroad to a California town in 1876, the role of the streetcar and the automobile in creating suburbs outside of cities, and the transformation of a U.S. port through the

introduction of containerized shipping in the 1960s.

For more information, visit the exhibit website at <http://americanhistory.si.edu/onthemove/visit/>

Hazmat Guide Assists with Security Plans

The Federal Motor Carrier Safety Administration (FMCSA) has published a guide for motor carriers and shippers developing the security plan required for hazardous materials transportation. Prompted by the September 11, 2001, terrorist attacks, the U.S. DOT's Research and Special Programs Administration issued new regulations requiring that persons, who offer certain types and quantities of hazardous materials for transportation or transport in commerce, must implement a security plan and training.

FMCSA's *Guide to Developing an Effective Security Plan for the Highway Transportation of Hazardous Materials* provides motor carriers with sufficient background to understand the nature of threats against hazardous materials transportation, the means to identify specific vulnerabilities, and an approach to address the vulnerabilities. The handbook does not provide a comprehensive list of security measures to implement but shows how to determine appropriate measures. The guide also reviews the required components of a training program and how to develop one.

For more information and to read the full report, go to www.fmcsa.dot.gov/safetyprogs/hm/Security_Plan_Guide.htm.

Center to Research Terror Risks for Infrastructure

The U.S. Department of Homeland Security has selected the University of Southern California (USC) as a research center to assess terrorism risks, particularly from attacks targeted at critical infrastructure systems such as transportation, electrical power, and telecommunications. The center will perform risk analyses of the economic consequences of terrorist threats and events, and will develop tools for planning responses to minimize casualties during terrorism emergencies.

USC's Homeland Security Center for Risk and Economic Analysis of Terrorism Events will apply expertise in natural disasters, system safety, and nuclear threats and will research advanced computer modeling and cybersecurity. Former TRB Transportation Network Analysis Committee Chair Randolph Hall of the USC School of Engineering, and Detlof von Winterfeldt of the USC School of Policy, Planning, and Development, will head the center.

INTERNATIONAL NEWS

High-Tech Device Improves Concrete Pavement Inspection

The Ontario Ministry of Transportation (MTO) is evaluating the performance of the magnetic imaging tool (MIT) scan, a state-of-the-art device to measure the alignments of dowel and tie bars in concrete pavements. The bars connect concrete pavement slabs, and correct positioning is vital for the pavement's long-term durability. The MIT scan provides a straightforward and reliable way to determine if the bars are properly installed.

Developed in Germany in the late 1990s, the MIT scan determines the exact vertical and horizontal position of dowel and tie bars in portland concrete cement pavements. Preliminary results from an MTO field trial in summer 2003 indicate that dowel bar depth measurements provided by the MIT scan match up with measurements obtained through coring, with less than 3 percent variation.

The MIT scan has four main components: the measuring device, the rail gliding system, the system computer, and the evaluation software, MagnoNorm™ and MagnoProof™. The system computer is attached to the hood of the measuring device, which is placed on fiberglass-fortified plastic rails to measure a transverse joint. The device is pulled manually over the rails to complete the scan, using pulse-induction. The MagnoNorm software computes the position of each dowel and tie bar, and MagnoProof provides a color graphic representation of each bar's position in comparison with the norm.

Summarized from MTO's November 2003 issue of Road Talk. For further information visit www.mto.gov.on.ca/english/.



The transverse joint on Canada Route 115 measured by magnetic imaging tool device. (Published and reprinted with permission of the Ontario Ministry of Transportation.)

TRB HIGHLIGHTS

Technical Activities Division Restructures

The TRB Technical Activities Division has reorganized its approximately 200 standing committees into 11 groups. Six of these groups, consisting of approximately 150 committees, address functional components of transportation, with a major focus on highways. Each of the remaining five groups concentrates primarily on a specific mode, including public transportation, rail, marine, aviation, and freight systems.

Members and friends of the more than 200 standing committees work with the division's staff of specialists and TRB representatives in each state, more than 150 universities, and 35 transit agencies, to identify research needs and to share information on research and issues of interest. The combined functional and modal structure of the reorganization is designed to create a synergy among the groups so that the standing committees can address a variety of specific and crosscutting transportation research issues.

"By bringing more players to our decision-making table, we are already seeing dividends

in our ability to sponsor joint activities that can address the myriad of critical and crosscutting issues that we face in transportation," said Anne Canby, Chair of the TRB Technical Activities Council.



Canby

"The reorganization will enhance TRB's ability to meet the needs of our sponsors, members, and the transportation community at large," comments TRB Executive Director Robert E. Skinner, Jr.

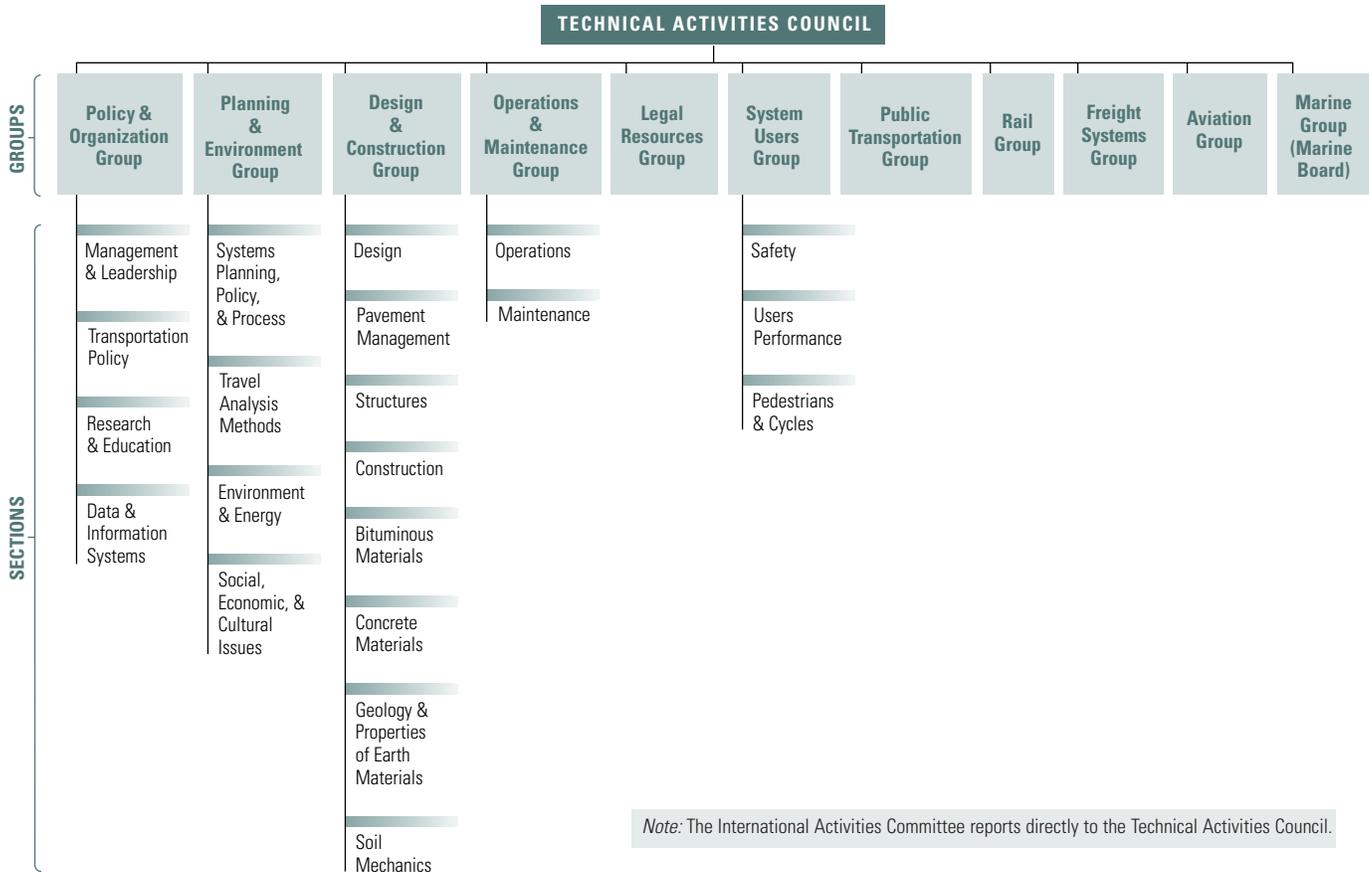
A significant amount of input on the organization of the standing committees was generated through surveys and discussions as part of the division's Quality Improvement Program, initiated in 2001. In March 2002, a summit of division leaders recommended the reorganization of groups and sections according to the inherent matrix structure of transportation.

The Technical Activities Council and staff evaluated options within the context of the division's mission, goals, and guiding

principles. As a result, the division has undertaken the following actions:

- ◆ Established groups to represent more directly nonhighway modes, planning and environment, policy and organization, and systems users;
- ◆ Enhanced the communications among groups, sections, and committees;
- ◆ Refined the roles of the council, groups, and sections;
- ◆ Described a variety of mechanisms to address critical and crosscutting issues;
- ◆ Made it possible for individuals who are not in TRB leadership to search committees by major topic area and keywords;
- ◆ Developed provisions for organizational flexibility and new ways to integrate thinking on common issues;
- ◆ Continued strict criteria for forming new committees and for continuing committees; and
- ◆ Expanded outreach to more diverse and young participants.

New Organization of TRB Technical Activities Division Standing Committees



TRB HIGHLIGHTS

Study Identifies Need to Monitor Marine System

The U.S. Department of Transportation (DOT) should assume leadership in assessing and improving the performance of the nation's entire marine transportation system, according to a policy study report released by TRB in January.

Special Report 279, *The Marine Transportation System and the Federal Role: Measuring Performance, Targeting Improvement*, contains the recommendations of the study committee, appointed by the National Research Council (NRC) of the National Academies and convened through the TRB Marine Board. The committee calls on U.S. DOT to develop regular reports on the condition, performance, and use of the marine transportation system to help identify ways to improve the efficiencies of security, environmental protection, and safety of the system.

Many public and private entities share responsibility for providing critical infrastructure and services of the system, which consists of hundreds of ports, thousands of waterway terminals, and tens of thousands of shippers and carriers. Duties are widely dispersed among agencies and are not well coordinated, the committee notes.

The lack of centralized information could lead to the neglect of problems and to missed opportunities for solutions. Problems include insufficient capacity of highways and railroads that connect to the major ports to handle container traffic, delays in modernizing the infrastructure of inland waterways, and the absence of comprehensive efforts to strengthen the safety and security of ports and transportation operations.

The committee recommends that U.S. DOT model the reports on the biennial Conditions and Performance reports developed by the Federal Highway Administration and the Federal Transit Admin-

COOPERATIVE RESEARCH PROGRAMS NEWS

Recommending Safe, Credible Speed Limits

Appropriately set and enforced speed limits are essential for managing speeds and improving highway safety. Residents, drivers, public officials, enforcement officers, and engineers, however, do not agree on how to determine a reasonable and safe speed, contributing to unrealistic and inconsistent speed limits. TRB Special Report 254, *Managing Speed: Review of Current Practices for Setting and Enforcing Speed Limits*, recommended development of an expert system to advise and assist practitioners in setting speed limits in speed zones.

The University of North Carolina, Chapel Hill, has received a \$300,000, 2-year contract [National Cooperative Highway Research Program (NCHRP) Project 03-67, FY 2003] to develop a knowledge-based, expert system for recommending enforceable, credible speed limits in speed zones. The expert system will be used by traffic engineers to analyze specific segments of all types of roads—from rural local roads to urban freeways. The project does not include statutory limits that apply to a category of roads within a jurisdiction. Part-time and temporary speed limits, such as school zones and work zones, also are outside the scope of the project.

The system will recommend speeds that should enhance safety and efficiency. The system also will reduce the number of unrealistically low speed limits that draw on enforcement resources but do not improve safety, perhaps decreasing safety by widening the distribution of speeds. The project will help engineers justify the recommended speed to the



University of North Carolina, Chapel Hill, is creating a system to determine safe and efficient speed limits.

body responsible for setting speed limits and to the public.

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

Developing Freeway Performance Measures

To serve the traveling public effectively, most transportation agencies set objectives for freeway system performance and rely on statistical measures to determine whether or not these objectives are being met. Two data sources can be leveraged to support performance measurement: data that freeway traffic management systems collect for operating the facility and data that planning departments also collect on system performance.

Consistent performance measures are fundamental to developing nationwide statistics that make sense. Consistent performance data also would benefit transportation researchers.

Cambridge Systematics of Cambridge, Massachusetts, has been awarded a \$300,000, 2-year contract (NCHRP Project 03-68, FY 2003) to develop a guide on the effective use of freeway performance measures for operating the system and for meeting the information needs of local, regional, and national users.

Each group of users has different information needs that may be best addressed by different performance measures. For example, the manager in charge of operating the freeway needs to judge the effectiveness of different control strategies. The traveler and freight carrier wants to understand the condition of the system, to adjust trips or anticipate congestion. Emergency responders need to identify the best route to a site and reduce response time. Transportation administrators, planners, and designers want to be able to take a longer-term view of a facility's performance and use the measures to determine how best to allocate the agency's resources.

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

istration. The reports would portray current conditions and performance, and assess the funding levels and investments required to improve the system.

The committee finds that U.S. DOT should urge Congress to reinvest all user-generated revenues into the marine transportation system. Currently, only part of the money collected from maritime commerce is used to improve marine transportation, such as modernizing locks and dams and maintaining channel depth and width.

The report concludes that the nation's transportation systems are becoming increasingly integrated and that federal policies for one mode of transportation are affecting all others. The report urges Congress to provide federal decision makers with a more flexible and balanced set of tools for making national transportation investments and policy.

Special Report 279, The Marine Transportation System and the Federal Role: Measuring Perfor-

mance, Targeting Improvement is available on the TRB website, www.TRB.org/publications/sr/sr279.pdf.

Report Offers Guidance on Intelligent Systems Standards

Investments in intelligent transportation systems (ITS) in general, and in the development and deployment of standards to facilitate ITS adoption in particular, are a wise and appropriate use of government funds, according to a policy study report released by TRB in January. According to the study committee appointed by NRC, many transportation professionals share the view that ITS technology can improve the performance of surface transportation systems and yield significant benefits to system users and the nation as a whole.

TRB Special Report 280 reviews the ITS Standards Program of U.S. DOT and includes a critique of the program's strategy for introducing ITS standards. Under the
(continued on next page)

Safety of Lane Widths, Right Turn Lanes Under Review

Urban and suburban rights-of-way often are limited, so that roadway width must be put to optimal use. Wider lanes are thought to maximize safety and operational capacity, but narrower lanes may be better suited for some low-speed applications, particularly for pedestrians.

Channelized right turns, common in urban areas, significantly reduce emissions from idling vehicles and enhance intersection capacity and operations. Conflicts between vehicles and pedestrians, however, increase at channelized right turns, because the driver's attention is focused on the cross-street traffic.

Right-turn deceleration lanes reduce rear-end collisions and improve arterial capacity. Several states have established application and design criteria for right-turn deceleration lanes near driveways and intersections, but the criteria vary widely. Information



Midwest Research Institute is developing design criteria for right-turn deceleration lanes, addressing concerns about placement of bicycle lanes and handling of pedestrian paths.

is needed about the design and placement of bicycle lanes and the handling of adjacent pedestrian paths at locations with right-turn deceleration lanes.

Midwest Research Institute of Kansas City, Missouri, has received a \$450,000, 2-year contract (NCHRP Project 03-72, FY 2003) to develop design guidance that addresses the safety and operational tradeoffs for motorists, pedestrians, and bicyclists when selecting lane widths and channelizing right turns, and when using right-turn deceleration lanes for driveways and unsignalized intersections. The project is intended to address urban and suburban arterials and collectors with speeds of 45 mph or less. Also included are considerations for pedestrians of all ages and those with a variety of impairments, such as blindness.

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

Assessing Success of Context-Sensitive Design

Traditional methods for measuring the success of transportation projects have focused on cost, schedule, capacity, mobility, and safety. These measures do not provide transportation agencies and project managers with the information to assess the success of projects in the contemporary context-sensitive environment. Consequently, there is a need to research and define performance measures to complement those in use or under development that support the transportation-project planning, design, and implementation process.

TransTech Management, Inc., of Washington, D.C., has received a \$100,000, 1-year contract [NCHRP Project 20-24(30), FY 2003] to propose model performance measures for the implementation of context-sensitive design. The project will complement ongoing benchmarking efforts.

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

TRB HIGHLIGHTS

current system, U.S. DOT provides funds to the professional and trade groups that devise the ITS standards.

In the report, the committee recommends improvements to the ITS Standards Program. Recognizing that implementing the committee's various suggestions will require funds and professional resources that may exceed what is available to the standards program, the committee provides seven specific recommendations.

- ◆ Explanations are needed to clarify why certain standards have been selected for federal support and how those standards are expected to contribute to achieving program goals. The committee suggests limiting the number of standards being developed with federal support.

- ◆ Standards supported by the U.S. DOT Joint Program Office (JPO) must be applied if they are to be effective. Clearer reporting of the progress of the standards programs—and of ITS deployment generally—is needed.

- ◆ Standards developers should adhere to the sequence of stages, including testing, formal adoption, JPO assessment of readiness for deployment, and postadoption support.

- ◆ Rulemaking should be used sparingly or not at all.

- ◆ JPO should support activities to make standards development and deployment effective over the longer term, through testing, verification capability, training, and maintenance. Early adopters should be compensated for the higher costs they incur.

- ◆ JPO should be more involved in the standards development process.

- ◆ U.S. DOT should consider expanding the standards program to services that span the interface between in-vehicle and roadside infrastructure subsystems.

Special Report 280, Development and Deployment of Standards for Intelligent Transportation Systems, is available on the TRB website, www.TRB.org/publications/sr/sr280.pdf.

Research Database Gains Postings and Users

Since its launch a year and a half ago, TRB's Research in Progress (RiP) Database has cataloged transportation research projects from nearly every state department of transportation, as well as from several federal agencies, universities, Canada, and other foreign countries. RiP's web traffic, meanwhile, has spiked with more than twice as many users as it had one year ago, including thousands of international visitors each month from as far away as Saudi Arabia, Singapore, and the Netherlands.

RiP enables users to browse more than 6,600 new, current, and recently completed transportation research projects, crossing all modes and with topics ranging from security, maintenance, environment, and design. Since the launch, the database has added 2,173 projects, and since November 2002, 4,929 records have been modified. Forty-one states have submitted RiP records, including nine that posted for the first time in December 2003.

COOPERATIVE RESEARCH PROGRAMS NEWS *(continued)*

Assuring Profitability of State DOT E-Business

Electronic business (e-business) uses information technology to change the way in which organizations operate. Some state DOTs are conducting e-business by communicating information about their activities and providing products and services over the Internet to customers, suppliers, and other DOTs. With supportive business models, e-business also can offer DOTs opportunities in public-private partnering, contracting, procuring, and a variety of other functions.

Although e-business holds promise for improving service to DOT customers and reducing costs, many initiatives have consumed resources without creating commensurate value. Particularly when budgets are tight, new initiatives must contribute to accomplishing an agency's mission effectively and efficiently.

Booz-Allen & Hamilton of McLean, Virginia, has been awarded a \$150,000, 1-year contract [NCHRP Project 20-24(19), FY 2002] to present a conceptual design for one selected e-business application. The project must demonstrate how state DOTs have profitably incorporated e-business into their business practices.

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



Users can find out what agencies and universities are doing and can initiate collaboration or avoid duplication. Registered users can modify research postings and can access more detailed contact information. More than 20,000 users viewed the site in December 2003, compared with 9,000 the previous December. Individuals from 37 states used RiP in October and November 2003.

For more information go to the RiP website at <http://rip.trb.org>.

Synthesis Studies Hit Fast Track

In 2003 the Studies and Information Services Division of TRB published a record number of synthesis reports under the sponsorship of the Cooperative Research Programs (CRP). The 23 syntheses, up from 19 in 2002, examine current practice and knowledge in key highway and transit topics, such as system engineering for traffic signal systems, performance measures for highway segments and systems, strategies for managing truck traffic, and real-time bus arrival information systems.

Topics for the NCHRP and TCRP studies are selected annually by highway and transit committees of CRP. Each synthesis report is researched and written by a consultant experienced in the topic area, under the guidance of an expert panel. Synthesis reports are among the TRB products most highly valued by practitioners, said Stephen Godwin, Director of Studies and Information Services.

In 2003, TRB implemented several innovations to make the publishing process more efficient. TRB held topic panel start-up meetings beginning in August instead of September; switched from 15-month to 12-month consultant contracts; organized an initial teleconference between each consultant and oversight panel, allowing issues to be resolved early; set a firm date for the second panel meeting at the close of the first meeting; switched to Internet surveys to gather information, expediting the survey process and improving response rates; and used freelance editors during peak demand. Synthesis reports are published electronically on the TRB website, as well as in hard copy.

IDEA Project Benefits Blind Transit Riders

A Transit Innovations Deserving Exploratory Analysis (IDEA) Project has provided a cost-effective solution for guiding transit riders with impaired vision through the complex process of purchasing a ticket from fare vending machines. A ticket machine with concise audio instructions, which complement the tactile instructions and guides, was developed by KRW, Inc. of Alexandria, Virginia, in collaboration

Civil Engineers Honor TRB Leader

The American Society of Civil Engineers (ASCE) honored TRB Executive Director Robert E. Skinner, Jr., with the 2003 James Laurie Prize during the ASCE Annual Convention in Nashville, Tennessee, November 15. Named after the first ASCE president, the award is given annually to a society member who has made a definite contribution to the advancement of transportation engineering in research, planning, design, or construction. Commenting on the award, Skinner said that research is vital for the development of new technologies, better methods, and creative management processes in transportation systems. Skinner has served as TRB executive director since 1994, after heading up the Division of Studies and Information Services.



Skinner

with Tri-County Commuter Rail Authority in South Florida and the National Federation of the Blind of Florida, and was supervised by TRB's Special Programs Division. During the 3-month testing phase, many sighted customers also decided to use the machine's audio functions.

For a copy of the user guide and the final report for the Transit IDEA Project 29, Fare Machine Tactile/Audio Instruction System, send an e-mail to dirvin@nas.edu.



Transaction data recorded during the 3-month evaluation period of audio-enhanced transit ticket machines implemented at Tri-Rail.

Implementing Sustainable Urban Travel Policies

OECD Turpin. Letchworth, United Kingdom: 2003; \$75; 92-821-0305-6

This report examines the experiences of 11 European countries (including Russia) and the United States in designing and implementing sustainable urban travel policies. A series of national reports is included with an analytical synthesis that draws lessons for the design of successful policies, appropriate institutional and financial frameworks, and innovative partnerships for effective consultation and implementation.

Mega Projects: The Changing Politics of Urban Public Investment

Alan Altshuler and David Luberoff, Brookings Institution Press. Washington, D.C.: 2003; 339 pp.; \$54.95 hardcover 0-8157-0128-4; \$22.95 paperback; 0-8157-0129-2.

Coauthors Altshuler—recipient of TRB's Roy W. Crum Distinguished Service Award—and Luberoff document and analyze how major public projects in American metropolitan areas have been conceptualized, funded, and completed during the past 50 years. The findings are presented in the context of classic debates about the nature of business–government relations in urban governance and about the interactions between local decision making and national governance, policy, and economic production.

A Century of Innovation: Twenty Engineering Achievements That Transformed Our Lives

George Constable and Bob Somerville. Joseph Henry Press. Washington, D.C.: 2003; 248 pp.; \$45 hardcover; 0-309-08908-5.

The National Academy of Engineering and a consortium of professional engineering societies present the 20 most significant engineering triumphs of the 20th century. Included are the automobile, the airplane, and highways, which are credited with drastically changing travel and the mobility of Americans. Each chapter pro-

vides the history of the engineering achievement, supplemented by timelines and photographs, and features a personal reflection by a notable engineer involved with the achievement.

The Use of Imagery in Transportation**Planning: A Guidebook**

Shenandoah Mountain Geographics, Inc. Washington, D.C.: 2003; 118 pp.; \$25 (plus two CDs for \$10 each);

Shenandoah Mountain Geographics, under contract to the Volpe National Transportation Systems Center and with technical support from the Federal Highway Administration, has developed a guidebook on the uses of imagery in transportation planning. The guidebook presents key concepts in remote sensing, offers examples of the use of imagery in activities supporting transportation planning, identifies procedures for effective project management, and provides information about integrating the imagery and the derived products into geographic information systems.

Two CD-ROMs supplement the book: the first is an executive overview of the role of imagery in transportation planning; the second contains four training videos that present technical aspects of imagery in transportation planning.

Advances in Transportation Studies

Aracne Editrice. Rome, Italy: 2003; 100 pp.; approx. \$160 (4 issues; contact benedet@uniroma3.it for subscription); 88-7999-600-2.

This quarterly international journal contains research papers on road and highway engineering, with a focus on the safety, effectiveness, efficiency, and sustainability of transportation. Topics include design standards and regulations, human factors in facilities design, geometry, facilities construction, pavement design and management for safety improvements, and environmental impacts. The title debuted in November 2003.

The books on this page are not TRB publications.
To order, contact the publisher listed.



TRB PUBLICATIONS

Transportation, Energy, and Environmental Policy: Managing Transitions, VIII Biennial Asilomar Conference

Transportation Research Board Miscellaneous Report

Papers examine sustainable urban transport in the 21st century, efforts toward zero emissions for fossil fuels, strategies for introducing hydrogen into transportation, the market for fuel cell auxiliary power units for heavy-duty diesel vehicles, and European initiatives to reduce fuel consumption and carbon dioxide emissions. The conference convened in Asilomar, California, September 11, 2001, but because of the terrorist attacks, many sessions were postponed until the TRB 2002 Annual Meeting.

2003; 284 pp.; TRB affiliates: \$31.50; nonaffiliates: \$42; 0-309-08571-3

Design of Highway Bridges for Extreme Events NCHRP Report 489

This report recommends a design procedure to accommodate loads and combinations on highway bridges during extreme events. The procedure is consistent with the uniform reliability methodologies and approach of the *AASHTO LRFD Bridge Design Specifications*. Included are four new extreme-event load combinations that maintain a consistent level of safety against failure caused by scour in conjunction with live load, wind load, vessel collision, and earthquake. Appendixes are included on a CD-ROM.

2003; 174 pp. plus CD-ROM; TRB affiliates, \$26.25; nonaffiliates, \$35. Subscriber category: bridges, other structures, and hydraulics and hydrology (IIC).

Crash Experience Warrant for Traffic Signals NCHRP Report 491

A process for estimating the safety effects of installing or removing traffic control signals is described with recommendations for an improved crash-experience warrant for the *Manual on Uniform Traffic Control Devices*. The process can be used in engineering studies to determine whether a traffic signal will improve the overall safety of an intersection.

2003; 50 pp.; TRB affiliates: \$14.25; nonaffiliates: \$19. Subscriber category: highway operations, capacity, and traffic control (IVA).

Bus Rapid Transit, Volume 1: Case Studies in Bus Rapid Transit TCRP Report 90, Volume 1

Bus rapid transit (BRT) improves mobility at a low

cost, through incremental investment in a combination of bus infrastructure, equipment, operational improvement, and technology. Volume 1 identifies the potential range of BRT applications and provides planning and implementation guidelines and system descriptions. Twenty-six case studies of BRT systems in cities in North America, Australia, Europe, and South America examine design features, operating practices, institutional arrangements, costs, benefits, and system relevance. The case studies are included on a CD-ROM.

2003; 54 pp. plus CD-ROM; TRB affiliates: \$21.75; nonaffiliates: \$29. Subscriber category: public transit (VIA).

Economic Benefits of Coordinating Human Service Transportation and Transit Services TCRP Report 91

The net economic benefits of various practices for coordinating human service transportation and general public transit are examined. The research provides quantitative estimates of the practices and identifies innovative and promising methods of coordination. Included is an overview of the basic coordination concepts and strategies that may enable transportation operators to achieve significant economic benefits.

2003; 173 pp.; TRB affiliates: \$18.75; nonaffiliates: \$25. Subscriber category: public transit (VIA).

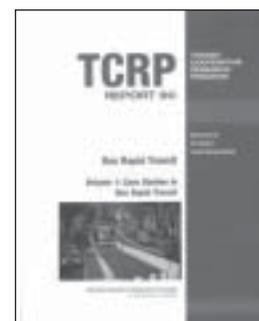
State DOT Outsourcing and Private-Sector Utilization

NCHRP Synthesis 313

Outsourcing by state departments of transportation (DOTs) is a topic of great interest for the public and private sector. As demands on state workforces have increased, outsourcing has provided the public sector a means to complete programs and services once provided in-house. Correspondingly, outsourced services have developed into a substantial market share of some private-sector businesses.

An update of *NCHRP Synthesis 246: Outsourcing of State Highway Facilities and Services*, provides state DOTs with the most current information about outsourcing and acquaints the private sector with the factors for deciding whether to outsource. The synthesis also explains how to determine the success of outsourcing operations.

2003; 42 pp.; TRB affiliates, \$10.50; nonaffiliates, \$14. Subscriber category: planning and administration (IA).





Strategies for Managing Increasing Truck Traffic
NCHRP Synthesis 314

Increases in truck traffic pose many challenges for transportation organizations that construct, operate, and maintain the transportation system. Challenges include safety, rapid deterioration of the infrastructure, degradation of the environment, truck noise and emissions, productivity losses from congestion, and impediments to economic development.

This synthesis documents recent efforts by U.S. transportation agencies to manage truck traffic. The report identifies the challenges addressed, the planning activities undertaken, the management strategies being considered, the factors influencing the selection of strategies, and the benefits and costs of various strategies.

2003; 83 pp.; TRB affiliates, \$12; nonaffiliates, \$16. Subscriber categories: highway operations, capacity, and traffic control (IVA); safety and human performance (IVB).

**Corporate Culture as the Driver of
Transit Leadership Practices**

TCRP Synthesis 47

Transportation agencies are facing an ever-changing workforce, more sophisticated technology, a shifting economy, and the most diverse population to date. For these agencies to anticipate and respond effectively to public expectations in a highly competitive work environment, it is essential to attract, develop, and retain strong leadership.

This synthesis documents practices for developing leadership, and reports on innovative approaches to problems in today's work environment. The report provides descriptions of workplace cultures and values, and presents case studies of lessons learned in hiring, developing, evaluating, and retaining leadership teams.

2003; 91 pp.; TRB affiliates, \$12.75; nonaffiliates, \$17. Subscriber category: public transit (VI).

Geology and Properties of Earth Materials 2003
Transportation Research Record 1821

The first part of this two-part compilation examines seasonal effects on pavement performance. Topics include effects of agricultural equipment on pavements in South Dakota, correcting highway thawing problems in Washington State, Alaskan frost-thaw, and a joint Paris-Quebec study to forecast frost and frost heave. Part 2 addresses soil testing and data collection concerns, such as the dissipation patterns after sand deposit liquefaction, models to predict moisture flow in soil, and a Japan Highway Public Corporation study to evaluate the stability of cut slopes on the Chuo Expressway.

2003; 114 pp.; TRB affiliates, \$33; nonaffiliates, \$44. Subscriber category: soils, geology, and foundations (IIIA).

**Transportation Security and
Infrastructure Protection**

Transportation Research Record 1822

In response to the terrorist attacks of September 11, 2001, and other security threats worldwide, this volume presents studies examining various aspects of security operations in transportation. Among the paper topics are case studies of the antiterrorism security measures for surface transit systems in London, Paris, and Tokyo; a vulnerability assessment of highway, bridge, airport, rail, transit, and intermodal infrastructure of New Mexico; and an evaluation of transit system emergency preparedness for the New York City and Washington, D.C., systems.

2003; 55 pp.; TRB affiliates, \$27.75; nonaffiliates, \$37. Subscriber category: planning and administration (IA).

**Pavement Rehabilitation and
Accelerated Testing 2003**

Transportation Research Record 1823

Part 1 highlights state projects in whitetopping, hot-mix asphalt overlay, and precast prestressed concrete pavement, along with research on the long-term performance of rigid pavement rehabilitation, flexible pavement maintenance, and flexible pavement rehabilitation treatments in the Specific Pavement Studies. Part 2 examines accelerated pavement testing, specifically the performance of dowel bar retrofitted concrete pavement under heavy-vehicle simulator loading.

2003; 162 pp.; TRB affiliates, \$36; nonaffiliates, \$48. Subscriber category: pavement design, management, and performance (IIB).

**Highway Maintenance Safety,
Support, and Services**

Transportation Research Record 1824

This three-part compilation covers highway work zone safety, maintenance management, inclement weather and nighttime services, signs, and markings. Among the issues cited are speed reduction strategies, law enforcement pullout areas, traffic queues in high-volume urban roadways, retro-reflectance of pavement markings and traffic signs, and winter road-maintenance operations.

2003; 155 pp.; TRB affiliates, \$36; nonaffiliates, \$48. Subscriber category: maintenance (IIIC).

**Railroad Research: Intercity Passenger
Transportation, Track Design and Maintenance,
and Hazardous Materials Transport**

Transportation Research Record 1825

Papers in this volume address the risk of derailment in the transportation of hazardous materials, the effect of heavy axle loads on the fatigue life of

steel bridges, and strategies for the crashworthiness of rail passenger equipment. Other papers focus on the precast span method of constructing high-speed rail bridges in Korea and on the pricing of commuter, intercity, and freight train services.

2003; 74 pp.; TRB affiliates, \$29.25; nonaffiliates, \$39. Subscriber category: rail (VII).

Intelligent Transportation Systems and Vehicle-Highway Automation 2003

Transportation Research Record 1826

Studies present the potential for high-tech, time-efficient methods of highway travel, including an assessment of an advanced traveler information system in Washington, D.C., and an evaluation of the California plan for statewide intelligent transportation systems. Other papers consider the tracking of anonymous vehicles for real-time traffic surveillance and performance, and the development of an in-vehicle dilemma zone warning system.

2003; 59 pp.; TRB affiliates, \$28.50; nonaffiliates, \$38. Subscriber category: highway operations, capacity, and traffic control (IVA).

Highway Pavements and Structures Maintenance and Security

Transportation Research Record 1827

Part 1 of this Record addresses the integration of preventive pavement maintenance into statewide programs, the development of a structural condition index to support rehabilitation decisions, and the use of robotic machines for highway crack sealing. Part 2 gathers research findings on structural maintenance, including the implementation of virtual reality into routine bridge inspection. Part 3 assesses the vulnerability of highways, bridge overpasses, and steel bridge beams to terrorist attacks.

2003; 74 pp.; TRB affiliates, \$29.25; nonaffiliates, \$39. Subscriber category: maintenance (IIIC).

Pedestrians and Bicycles 2003

Transportation Research Record 1828

This two-part volume focuses on the safety and convenience of pedestrian and bicycle travel in urban and rural areas. Among the pedestrian research topics covered in Part 1 are methods to reduce traffic speeds in high-pedestrian rural areas, an analysis of North Carolina's guidelines for school walk zones, and an examination of pedestrian safety with a raised median and redesigned intersections. Part 2 covers the safety of intersections for cyclists and preferred commuter bicycle routes.

2003; 132 pp.; TRB affiliates, \$34.50; nonaffiliates, \$46. Subscriber category: safety and human performance (IVB).

Bituminous Binders 2003

Transportation Research Record 1829

Papers include an assessment of the effects of styrene butadiene styrene modification on the cracking resistance and healing characteristic of coarse-graded Superpave® mixtures; a determination of whether asphalt mixtures correlate better with mastics or binders in evaluating permanent deformation; and an investigation into the possibility of using commercial rheometers for comprehensive testing of asphalt binders, asphalt mastics, and hot-mix asphalts.

2003; 54 pp.; TRB affiliates, \$27.75; nonaffiliates, \$37. Subscriber category: materials and construction (IIIB).

Highway Safety, Traffic Law Enforcement, and Truck Safety

Transportation Research Record 1830

Highlighted are efforts to improve highway safety, including boosting seat belt use in Hawaii, speed limit enforcement cameras in the District of Columbia, and automated enforcement of red-light running. Research reports also examine the restraint use and the age and sex characteristics of persons involved in fatal motor vehicle crashes, safety effects of differential speed limits on rural interstate highways, and the methodology for estimating vehicle miles traveled for commercial motor vehicles.

2003; 76 pp.; TRB affiliates, \$30; nonaffiliates, \$40. Subscriber category: safety and human performance (IV).

Travel Demand and Land Use 2003

Transportation Research Record 1831

Papers present models for examining joint travel by household members, nonworker activity-travel patterns, household behavior in evacuation conditions, day-to-day evolution of urban traffic congestion induced by commuter departure time decisions, household automobile transactions, and the number of non-work activity stops made by individual adults to, during, or from work.

2003; 239 pp.; TRB affiliates, \$40.50; nonaffiliates, \$54; Subscriber category: planning and administration (IA).

Bituminous Paving Mixtures 2003

Transportation Research Record 1832

Hot-mix asphalt moisture sensitivity and lime performance, screenings use, the gamma-ray method for measuring bulk specific gravity, the fatigue endurance limit for highway and airport pavements, and rapid triaxial tests in quality control are among the topics in this volume.

2003; 223 pp.; TRB affiliates, \$40.50; nonaffiliates, \$54. Subscriber category: materials and construction (IIIB).



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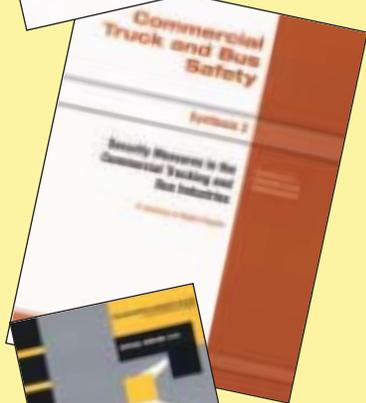
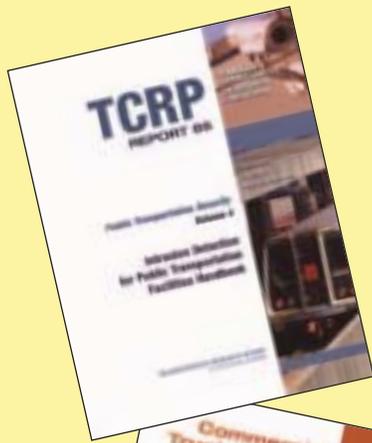
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