



# 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.

## 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.

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)

## 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.



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.



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.<sup>1</sup> Many are moving away from an orientation to mapping, to set up an enterprise organizational structure with staff performing technical support.

<sup>1</sup> 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](http://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.



PHOTO: DUFFSNE-HENRY 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.

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



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.

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.<sup>2</sup>

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.<sup>3</sup>

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-

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

<sup>3</sup> Moisture Sensitivity of Asphalt Pavements: A National Seminar, is available in print and CD-ROM from the TRB Bookstore, [www.TRB.org/bookstore/](http://www.TRB.org/bookstore/).



Photo: Chicago DOT

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

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: ENERGO 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 nonrecurring 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, carpools, 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.

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.

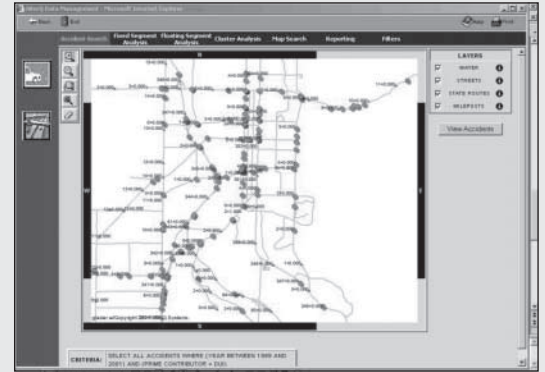
**Highway Safety**

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.



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.

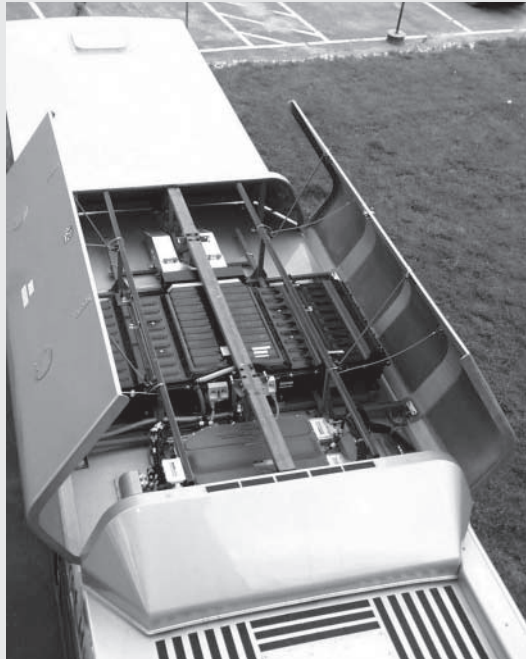
Transit agencies are implementing new services, system expansions, technologies, and equipment. Despite long lead-times, large capital programs are now in service or under consideration.

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



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.



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.

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