



Transforming Transportation Institutions, Finance, and Workforce

Meeting the Needs of the 21st Century

Specialists in the Transportation Research Board's Technical Activities Division identify current issues, collect and generate information about the issues, and then 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 about all modes of transportation.

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

This report presents a summary of what the TRB staff learned from these visits and activities in 2006.

“**T**ransportation Institutions, Finance, and Workforce: Meeting the Needs of the 21st Century” was the spotlight theme of the TRB 2007 Annual Meeting in January. The theme represented three of the Critical Issues in Transportation that were foremost for state departments of transportation (DOTs) and other agencies visited by TRB staff in 2006. Following are reports on ways that transportation agencies are working to transform their institutions, financing, and workforce. The reports also identify the areas most in need of innovation, with examples of some of the latest innovations that states are pursuing.

Institutional Issues

Policy and Organization

Even as the roles and responsibilities of state DOTs are being redefined, baby boomers are retiring and changing the composition and dynamics of the workforce. Many state agencies are preparing a new generation of transportation professionals to meet the evolving needs and are working to attract staff who are knowledgeable about finance, public-private partnerships, and concessionaire agreements.

Retaining the institutional memory to sustain a strong technical



PHOTO: UNIVERSITY OF HAWAII

Civil and Environmental Engineering students from the University of Hawaii visit a Hawaii DOT traffic control center.

workforce is a major objective. The Minnesota legislature passed an innovative bill that enables its DOT and other state agencies to rehire on a part-time basis retired employees who can contribute critical skills. The postretirement option—also known as the PRO—program enables retirees to work up to 1,044 hours annually for a maximum of five years. This allows for a gradual transition of seasoned department veterans from the workforce and enables the transfer of institutional knowledge and expertise to their successors.

Hawaii DOT has rehired retirees for some of its top positions. Because only a small number of engineers graduate from the University of Hawaii each year, filling positions vacated through retirement or attrition is difficult. Younger professionals are likely to seek better remuneration in the private sector or from the federal government, which provides a 25 percent cost-of-living adjustment. To hire qualified staff, Hawaii DOT has designated job categories with shortages and has made salary adjustments.

Planning

In 2006 state DOTs and metropolitan planning organizations (MPOs) focused on satisfying the changes specified in the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) for the surface transportation planning process. Consultation requirements were expanded significantly. Requirements also were added for plans to address environmental mitigation, performance improvements, multimodal capacity, and enhancement activities, with representation from tribal, bicycle, pedestrian, and disabled persons' interests.

In June 2006, the Federal Highway Administration (FHWA) and the Federal Transit Administration jointly issued a proposed revision of the regulations for the development of metropolitan and statewide trans-

portation plans and programs. Comments on the rules were due in September 2006, and the final rules are expected for release this summer. As of July 1, 2007, however, state and metropolitan plans submitted for federal approval must comply with SAFETEA-LU.

The provisions in SAFETEA-LU most critical for planning include the following:

- ◆ **Fiscal constraint.** Transportation planning and programming must identify the revenues that “are reasonably expected to be available” for implementing metropolitan long-range transportation plans, state transportation improvement plans, and transportation improvement plans, while still providing for the operation and maintenance of the highway and transit systems.

- ◆ **Consultation.** Depending on the details of the plan or project, consultations may be required, for example, with nonmetropolitan officials responsible for transportation, with resource agencies, or with federally recognized tribal agencies.

- ◆ **Visualization.** State DOTs and MPOs should use a range of visualization techniques in developing transportation plans.

- ◆ **Consistency of transportation plan with planned growth and development plans.** SAFETEA-LU promotes the connection between transportation and land use plans and economic development.

- ◆ **Environmental considerations in planning and project development.** The legislation calls for increased environmental mitigation, consultation with resource agencies, and the consideration of conservation plans and of maps and inventories of natural and historic resources, if these are available.

Energy and Environment

Public pressure and more rigorous requirements for environmental documentation are shaping the way that transportation agencies view and approach environmental stewardship. Stormwater management,



PHOTO: WASHINGTON STATE DOT

Proposed wildlife crossing over I-90 at Rock Knob, at the east end of Keechelus Lake, Washington.



PHOTO: ELMER KING

Nevada DOT wetland mitigation site prohibits public access during nesting season.

noise control, hazardous materials management, and wildlife crossings—along with emerging issues such as air toxics and global warming—are key environmental challenges.

The intermodal nature of state transportation systems adds to the complexity of environmental regulation. The increase in freight transportation by plane, train, automobile, and ship is leading agencies to rethink their approach to environmental analysis to meet regulatory demands for a thorough examination of project alternatives.

Public pressure to reduce local and global emissions is spurring research into applications of alternative fuels and into ways to reduce fuel consumption. Biodiesels, hydrogen fuel cells, ethanol, solar, and electric fuel options are being studied as ways to reduce emissions affecting local air quality and human health—such as particulate matter and other air toxics, carbon monoxide, and nitrogen oxides—and to reduce emissions affecting the global climate, such as carbon dioxide.

Agencies are taking a holistic approach through the development of comprehensive environmental management systems to ensure that environmental policies, programs, and research are addressing public concerns and regulatory requirements.

Data and Information Technologies

States are recognizing that information and data are important assets for decision making. With revenues constrained and construction costs on the rise, states are improving their data resources to serve as timely, flexible, and cost-effective guides to selecting solutions.

As the issues facing DOTs become more complex, the effective use of data across different application areas and systems—within the DOT and with outside partners—becomes more important. Transportation environmental applications, for example, require

extensive use of data from external sources. DOTs are developing partnerships to use the data generated by natural resource and environmental agencies. This seemingly straightforward sharing is complicated, however, because the data requirements for transportation applications often differ from those for the resource agency, which may have different goals, culture, and geographic scale.

Developing effective partnerships with resource agencies is the key to success. Pennsylvania DOT helped the state's historic preservation office make its resources available online with geographic referencing. Pennsylvania DOT's minor investment allows the transportation community to gain quicker access to historic preservation information, saving trips for staff and consultants and accelerating project reviews.

The data sharing is enhanced through written descriptions of data resources and their sources—that is, through improved metadata. Building better metadata foundations is a key to extending the use of expensive data resources.

Geographic information systems (GIS) continue to evolve as a tool for integrating data within DOTs and with other agencies. GIS applications are proving effective in asset management, performance measurements, and safety.

Consistent national datasets and information sources serve states for benchmarking, calibrating travel models, understanding the flows of people and freight into and through a region, and evaluating the effect of improvements. The availability of those datasets and the maintenance of their quality, however, has become a concern, as federal research funding sources face constraints. Funding for the National Personal Travel Survey—a basic source for personal travel behavior—is unclear, and the Census Bureau has not funded the Vehicle Inventory and Use Survey of freight and truck flows; but after a period of doubt, the Commodity Flow Survey has received funding for 2007.

Aviation

State aviation officials face continuing concerns about the airline industry, as well as about the funding of the national aviation system. In the meantime, state and federal aviation-related budgets are shrinking, and regulatory and paperwork requirements are becoming more complex, adding to the challenges.

Airlines must reckon with the cost of fuel, and uncertainty about the Essential Air Service program affects most airports nationwide. The advent of very light jets, which are expected to open a large market, will change the national airspace system and the airports that the new jets serve.

The federal government is reviewing the funding for the infrastructure needs of the national aviation



PHOTO: JOSEPH R. MORRIS

The Port of Long Beach continues to grow as a hub of freight and intermodal freight transportation.

system as the next cycle of congressional reauthorization approaches. A significant concern is that the current fuel taxes, user fees, and other charges will not be sufficient to cover future needs; moreover, the equitability of these charges for all users of the system is a subject of debate.

Many airports are struggling to accommodate the increased regulatory controls over all levels and types of operations. Sources of increased paperwork requirements include the State Block Grant Program and the Federal Aviation Administration's evaluation process for the implementation of new technologies—such as Global Positioning Systems (GPS) and other NAVAID or navigational aid approaches. These added administrative requirements, in turn, affect airports' ability to serve aircraft operator customers and the surrounding communities.

Freight Systems

Freight transportation volumes—fueled by international trade, as well as by domestic growth—continue to put pressure on the capacity of all modes, and projections show a similar picture for the future. States are recognizing that the connections for freight transportation between highway systems and other modes—particularly to ports and railroads—are critical, as is the problem of increased truck traffic in many corridors and urban hubs. With primarily Chinese imports crowding West Coast ports, the states of California, Washington, and Oregon have created freight-related offices within their DOTs and are addressing freight issues in the planning process.

Several states, including Colorado and Minnesota, have established freight advisory committees to coordinate with private-sector shippers and carriers. Freight movements are not confined by political boundaries, and many states have developed multi-jurisdictional—as well as multimodal—corridor approaches to identify, plan for, and invest in ways to

add freight system capacity.

As states make investments for freight transportation, they are looking for analytical tools to support decision making. Several states, including Ohio, Oregon, and Florida, are developing sophisticated freight modeling tools.

The public sector clearly has roles and responsibilities in freight transportation, and state DOTs are aware of the need to coordinate public- and private-sector timelines, priorities, and analytical approaches. State DOTs and other transportation agencies are seeking staff who can offer a range of knowledge and skills to deal effectively with freight matters.

Highways

Design

An aging infrastructure and a heightened public awareness of the importance of a reliable and safe transportation system is creating demand for the redesign of roadways, the rehabilitation of pavements and bridges, and the use of innovative materials and techniques to complete the task efficiently.

States depend on contractors for the design and inspection of infrastructure projects. States often require the contractor to perform the quality control and a contract inspection service to handle the quality assurance. Several states are looking into automated techniques for inspection, data collection, and reporting to compensate for a reduced in-house inspection workforce.

Many states are developing implementation plans for the recently piloted Pavement Design Guide from the American Association of State Highway and Transportation Officials (AASHTO). States are conducting calibration and training efforts and are looking for additional information from the National Cooperative Highway Research Program (NCHRP) to assist in training.

Use of the load and resistance factor design



PHOTO: CALTRANS

View of construction on the new skyway span of the San Francisco-Oakland Bay Bridge, scheduled for completion in 2013.

(LRFD) method for the subsurface part or foundation of bridges and other structures has increased; October 1, 2007, is the deadline for DOTs to meet the federal mandate for implementation. The level of adoption among the states, however, varies from full to none. Many states are calibrating the substructure aspects, with full implementation to follow. Some states are providing training to their staff on LRFD through National Highway Institute courses.

States are applying innovative materials—such as high-performance concrete and structural fiber-reinforced plastics—and are relying on innovative design and construction techniques—such as precast pavement and bridge members—to build structures more efficiently and with greater durability. The goal is to reduce work zone construction periods, as well as maintenance activities, in travel lanes.

Construction and Materials

State DOTs are focusing construction efforts on infrastructure renewal, congestion relief, and safety improvements. States are encountering shortages of materials and an escalation in bid prices. Several states report project delays caused by shortages of aggregates, portland cement, asphalt binder, and steel. Some have developed price-adjustment clauses for steel, asphalt, and fuel. Because of higher construction costs, a few states have scaled back the number of projects let.

At the same time, competition among contractors is decreasing in many states—often only one or two bidders respond. States with large construction programs over the next several years, such as Utah and California, are especially concerned about the lack of contractors. In some cases, contractors and suppliers have consolidated; in others, the work has increased, but the number of contractors has not.

In addition, highway contractors often are competing with homebuilders for labor, and transportation construction is only a fraction of the construction dollars in each state. Idaho reports that contractors are not willing to bid on transportation projects because of the many regulations and specifications with which they must comply; at the same time, much more work is available in the building industry, which has less stringent requirements.

Pavement noise remains a concern in many states; Arizona has used asphalt rubber extensively to reduce tire-pavement noise. Warm-mix asphalt continues to gain interest, as does self-consolidating concrete.

Geotechnical Engineering

Landslide and rockfall hazards remain a problem. The number of states that have a rockfall hazard rating system increases each year. Many use the rating



PHOTO: SASO MAX AMERICA

system to make hazard and risk assessments along highway corridors. Results of the analysis are generally used for prioritizing the mitigation work and for budgeting.

Interest in the acceleration of construction projects has prompted states to consider use of innovative materials such as geofoam. Approximately 50 percent of the states have applied geofoam in roadway projects; the construction of large sections of the embankments on I-15 in Utah is a notable example.

States also are interested in intelligent compaction—achieving the required level of compaction of subgrade, aggregate, and embankment materials is a key to a transportation facility's durability. An NCHRP project is determining the reliability of intelligent compaction systems and is developing construction specifications. Minnesota DOT is one of the first states to use intelligent compaction on a full-scale field project.



PHOTO: MINNESOTA DOT

Application of a warm-mix asphalt known as Sasobit, which hardens at ambient temperatures.

Intelligent compaction equipment, tested by Minnesota DOT, measures and records the quality of compaction with a global positioning system and increases and modulates the force as needed, preventing overcompaction.

Maintenance

The recruitment, training, and retention of the highway maintenance workforce are challenges for many agencies. Several agencies reported high numbers of vacancies and noted the difficulty of attracting and retaining qualified employees with pay rates below those for similar positions in other sectors.

DOTs continue to explore and evaluate maintenance outsourcing with mixed results. Limited in-house resources, the need for specialized expertise or equipment, statutory requirements, seasonal work, and contractor availability are some of the reasons for outsourcing.

Procurement practices include short-term "input models" with payments for labor, equipment, and materials; one- to five-year "output models" for an area or roadway corridor, with payments for accomplishments such as acres mowed or ditch-miles cleaned; and longer-term, lump-sum corridor or network "outcome models" that measure a level of service such as roadway smoothness, skid resistance, structural capacity, or time-to-bare-pavement after a snowfall. Several agencies noted the need for the maintenance community to share information on the effectiveness of the various types of contracts, including guidelines for warranties, penalties, and emergency contracting.

Maintenance management systems have incorporated such information as the condition of assets; customer feedback and surveys; workload planning and forecasting; measuring and evaluating input, output, and outcomes; and GPS to record work locations. Many agencies are using statistical sampling within a quality assurance program to measure levels of service for maintenance within and across jurisdictional boundaries.

The safety of the traveling public and of roadway workers is a priority for transportation agencies. States are implementing the FHWA Rule on Work Zone Safety and Mobility, a holistic approach to improve safety from project planning through design, implementation, and performance evaluation. Controlling traffic speeds in work zones remains a problem.

Operations

Congestion is ever-growing, particularly in metropolitan corridors. In the new joint NCHRP-Transit Cooperative Research Program (TCRP) report, *Commuting in America III*, author Alan Pisarski notes that the average work commute is now more than 25 minutes.¹ In

¹ NCHRP Report 550-TCRP Report 110: *Commuting in America III: The Third National Report on Commuting Patterns and Trends*. Transportation Research Board of the National Academies, Washington, D.C., 2006.

addition, almost 8 percent of daily work trips now take more than 1 hour. The percentage of work trips outside of the 6:00 a.m. to 9:00 a.m. peak hours increased dramatically between 1990 and 2000.

Other recent surveys have found that motorists and businesses are frustrated by the unreliability of journey time. Traffic operations professionals therefore are focusing on strategies to achieve travel time reliability through improvements in traffic signal control, incident management, freeway operations control strategies, the management of work zones, and managed lanes.

The private sector is providing traffic information to the public. Yahoo, Inc., and Microsoft's MSN offer e-mail alerts and interactive online maps that detail traffic congestion. Satellite radio providers XM and Sirius are providing traffic information in select markets. OnStar from General Motors offers weather and traffic bulletins. Handheld computer maker Palm, Inc., has introduced Traffic for Treo Smartphones in 10 metropolitan areas to help users avoid congestion.

Through a public-private partnership, Kansas DOT recently compared determinations of travel times and congestion based on the use of cell phones as traffic probes with measurements based on loop detector data. Preliminary findings indicate a high level of correlation between the two methods.

Safety

Traffic deaths were up slightly to 43,443 in 2005, compared with 42,636 in 2004. The fatality rate of 1.47 per hundred million vehicle miles increased from 1.46 in 2004. Motorcycle fatalities rose 13 percent in 2005, from 4,028 to 4,553. Pedestrian fatalities increased from 4,675 to 4,881 in 2005.

SAFETEA-LU mandated that each state develop a strategic highway safety plan. Many states submitted a plan in 2006, and all others expect to comply in 2007. In February 2007, states will conduct the third peer exchange to share successes, implementation strategies, and ways to overcome barriers.

Some states are using ignition interlocks for people who have had several convictions for driving while intoxicated. New Mexico has applied the law to first offenders; in conjunction with other tactics, this produced an 11.3 percent drop in alcohol-related fatalities during the second half of 2005.

Crash rates for teenage drivers continue to decline. Graduated licensing laws are a major reason. Strong laws, such as California's, show positive results. An independent evaluation of California's law by the Insurance Institute for Highway Safety showed a 23 percent reduction in the per capita crash rate of 16-year-old drivers. The restriction on driving by teenagers after 11 p.m. has reduced nighttime



PHOTO: NEW MEXICO DOT

Ignition interlock devices are connected to a car's ignition system and serve as alcohol breath screening mechanisms. A vehicle may be prevented from starting if the device detects that the operator's blood alcohol concentration is above a preset limit.

crashes by 27 percent. With the no-teen-passengers restriction, the teen-passenger-related crash rate dropped 38 percent.

Marine

Ports and Waterways

Ambitious port and waterway projects were in the works in 2006. Florida DOT issued a request for proposals for a public-private partnership project to design, build, finance, operate, and maintain a 1-mile tunnel between I-395 and the Port of Miami-Dade County, so that trucks could bypass surface streets, easing downtown traffic congestion.

In California, ports began competing for funds after the passage of the state's transportation bond. This included \$1.7 billion worth of projects at the Ports of Los Angeles and Long Beach and a \$600 million project to improve rail at the Port of Oakland. The Port of Oakland also is looking into a freight ferry service that would remove as many as 400 trucks from I-80, transporting the cargo via barges over the Sacramento River Delta to Sacramento. On the environmental front, Maersk, Inc., completed a pilot program under which the company's ships that call at California ports would no longer burn bunker fuel when approaching the coast.

On the inland waterways, Tennessee broke ground near the Mississippi River for a new slack-water port that should boost the economy of the northwestern part of the state with up to 3,000 new jobs. The approval and funding of infrastructure improvements are among the challenges for inland waterways.

Ferries

Ferry transportation received considerable attention in 2006. New York City has implemented a safety management system, with procedures affecting all aspects of ferry service, including pilot house operations and crew member training. Bridgeport, Connecticut, is reviewing plans to start a new ferry service along the coast and across Long Island Sound, as well as a container-on-barge service to haul freight between Bridgeport and New York. The Miami-Dade County MPO plans to present proposals for a water-transit system that could add water-taxi and water-ferry routes on Biscayne Bay.

Rail

Although much of the U.S. rail system is privately owned by freight railroads, most states have an active interest in passenger and freight services as key elements of the transportation system. Demand for commuter rail service for congestion relief is growing in many areas. An example is the New Mexico Rail



Photo: New Mexico DOT

Runner Express, which opened in the Albuquerque area in July. Most commuter and intercity passenger services operate on freight-owned rail lines that already are approaching capacity with increases in freight traffic, despite substantial capital investments by the freight railroads.

In late October, Amtrak started running new higher-speed express trains between Harrisburg and Philadelphia, substantially reducing trip times. The new service was made possible through \$145 million in improvements funded equally by Pennsylvania DOT and Amtrak; the commuter line runs on an Amtrak-owned extension of the Northeast Corridor. Pennsylvania DOT also issued grants totaling \$20 million to help Class I, regional, short-line railroads, shippers, and local transportation agencies fund improvements in freight rail infrastructure.

As freight volumes increase in all modes, states are seeking opportunities for freight railroads to absorb more intermodal traffic from congested Interstates. Virginia is looking for possible opportunities in the heavily traveled I-81 corridor. Funding continues to be a challenge for larger, regional, or corridor projects, such as CREATE in Chicago and the Mid-Atlantic Operations Study.

Public agencies and private industry share concerns about congested facilities, but frequently have different goals in developing joint solutions. Understanding which investment benefits accrue to the public and the private sectors is critical for improving the transportation system at all levels.

Public Transportation

According to *Commuting in America III*, congestion and gridlock will continue to develop in urban areas that require new or rehabilitated urban infrastructure,

New Mexico's Rail Runner commuter train leaves Lamy station, 70 miles north of Albuquerque.

Did You Know?

◆ Wyoming DOT has teamed with the University of Wyoming to create the Design Squad. The DOT offers the top 10 to 15 engineering students at the university part-time positions. The students gain real-world experience, and Wyoming DOT gains a head start in recruiting the next-generation workforce to full-time positions after graduation.

◆ After the passage of SAFETEA-LU, the Alaska Department of Transportation and Public Facilities published a brochure, *Federal Highway Earmarks: Frequently Asked Questions and Answers*, to help project sponsors understand how earmark projects are implemented through the agency.

◆ Idaho has a seaport. The Port of Lewiston, approximately 500 miles inland at the upper end of the Columbia–Snake River waterway system, handles barge and intermodal connections.

◆ Maine has the largest percentage of older persons of any state.

◆ Minnesota is the state with the most highway lane-miles dedicated to express buses.

◆ The Washington Metropolitan Area Transit Authority's Metrorail has 588 escalators, plus 230 eleva-

tors in stations, and another 30 serving shops and facilities. The system boasts the longest escalator in the Western Hemisphere, at the Wheaton, Maryland, station—508 feet (70 meters).

◆ In Iowa, any local agency—planning, municipal government, or law enforcement—can receive traffic crash data software and training to perform basic data analyses. The Center for Transportation Research and Education, funded by Iowa DOT and the office of the Governor's Representative for Highway Safety, provides the services and offers the agencies free assistance with additional data analysis.

◆ Rhode Island DOT's Traffic Management Center serves 39 cities and towns, which encompass rural, metropolitan, and tourist areas.

◆ The University of Delaware has a Center for Innovative Bridge Engineering that has 22 undergraduate students and 18 graduate students.

◆ The Mississippi River delta plain has the highest rate of relative sea-level rise of any region in the nation—3 feet per century—mostly because of rapid geologic subsidence.



The Metro Rapid BRT, operated by the Los Angeles County Metropolitan Transit Authority, speeds up commuter time by making fewer stops and running more frequently; special transponders cause traffic signals to favor the bus, and low-floor designs allow faster boarding and alighting.

including transit. State and local ballot measures have begun to address these transportation issues and needs; as of November 8, 2006, more than \$40 billion in transit-related initiatives has been authorized in 23 states.²

In addition to long-term needs, more immediate concerns arose from energy prices and hurricane preparations. By fall, however, fuel prices had peaked and dropped by nearly one-third, and the record number of hurricanes had not occurred as predicted. This removed substantial short-term financial stress from transit budgets; but long-term financial obligations are increasing as the workforce begins to retire. Many of the larger transit operators face unfunded pension liabilities, along with operating deficits and work agreements.

Nevertheless, services and systems expanded in 2006, and new technologies were applied. In California, commuter rail systems added service and amenities—including wireless personal computer connections aboard Caltrains. The New York Metropolitan Transportation Authority has a \$21 billion capital plan under way for 2005 through 2009. New Jersey Transit's \$7.2 billion plan includes a new, two-track tunnel under the Hudson River to Manhattan's Pennsylvania Station. Light rail systems are under construction in Phoenix, with expansions in Los Angeles and St. Louis. Bus propulsion technology is developing with electrification, fuel cells, and cleaner emissions. Eighteen cities are now providing bus rapid transit service.

² Preliminary November 7, 2006, Results. APTA Press Release, Nov. 8, 2006. www.apta.com.



Washington Metrorail's escalator at Wheaton, Maryland, is a commute in itself.