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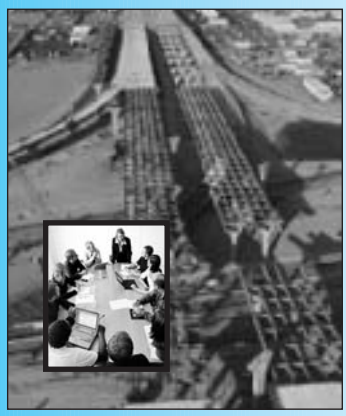

COVER: Good communication is necessary at all stages to marshal a limited but diverse workforce to complete major transportation projects efficiently.

TR NEWS

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

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ALSO IN THIS ISSUE:

COMING NEXT ISSUE

The latest developments in research to mitigate transportation noise from highways, transit, rail, and aircraft are featured in articles and supplemental summaries in the September–October *TR News*.

Accelerating the Implementation of Railway Technology

Transportation Technology Center Serves as Hub

ROY A. ALLEN

The author is President, Transportation Technology Center, Inc., Pueblo, Colorado.

For decades, major railway companies in the United States, Canada, and Mexico have pooled funds for research to advance railway technology. Members of the Association of American Railroads (AAR) work through a wholly owned subsidiary, Transportation Technology Center, Inc. (TTCI), in Pueblo, Colorado, to develop, test, and provide the safest and most cost-effective services to rail customers.

Under AAR's Strategic Research Initiatives Program, TTCI focuses on two major objectives:

- To conduct an efficient, effective research program for the railroad industry, and
- To operate and maintain a state-of-the-art railroad research and testing facility for suppliers and the government.

TTCI must achieve these objectives without an operating or capital subsidy from AAR or its member railroads.

Business Model

TTCI's management and board of directors have developed a business model that identifies the organization's core responsibilities: conducting the railroad industry's research program, conducting research projects for the Federal Railroad Administration (FRA), and providing technical support to AAR for standards development (Figure 1). TTCI provides these services at cost to FRA and AAR.

As a result, the revenues from the FRA and AAR activities do not cover the costs of maintaining and investing in the facilities, a requirement under the federal contract. TTCI therefore generates revenue through high-value commercial business and applies the earnings to the site, through capital investment, and to the business, through an internally funded research and development program that addresses industry needs.

No profits are returned to the parent company—all are reinvested. Figure 1 depicts the synergies among the research and technical support for FRA and AAR, the high-value commercial programs, and investments in facilities, equipment, and employees. Some of the TTCI investments are for leasehold equipment that becomes government property. In short, the business model is not conventional.

Serving Freight Railroads

Strategic Research Program

AAR and FRA cooperatively fund several safety improvement programs. Other research concentrates on extending the economic life of railroad assets—particularly of infrastructure, such as bridges, rail, special track, and track components. The North American freight railroad industry is capital-intensive, and earning the cost of capital is a struggle. Extending asset life while maintaining safe operations, therefore, is paramount.

The program's flagship project is a full-scale study of the physical, safety, and economic impacts of heavy axle loads. FRA and AAR, along with railway operating companies and suppliers, fund the cooperative research, which generates valuable information on track and component performance.

TTCI's Facility for Accelerated Service Testing (FAST) includes a high-tonnage loop for running a train of 4-axle cars with 35.5-metric-tonne axle loads. Field sites throughout the North American rail system

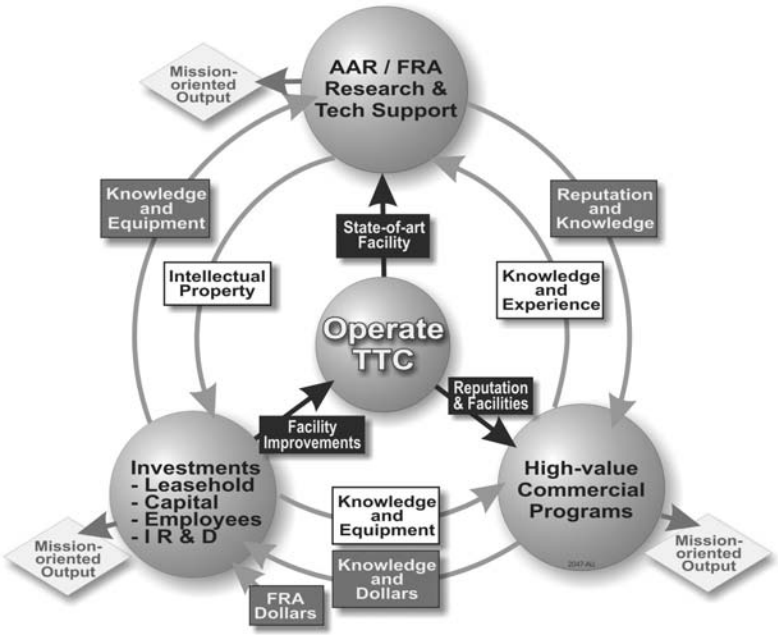


FIGURE 1
TTCI business model.

also are used for heavy axle load testing.

The FAST program has generated nearly 1.4 billion gross tonnes of traffic since heavy axle load testing began in 1988. Traffic often exceeds 100 million gross tonnes per year. As a result, the causes of increased rail wear and other problems with heavier loads can be identified before occurrence in revenue service. The program has ensured the safe and efficient introduction of heavier axle load cars in North America.

Research focuses on improving safety; on reducing the costs of track, track components, and bridges; and on reducing rail inspection costs and derailments. Laser-based inspection—a nondestructive testing technology in development—will provide a remote, noncontact method of detecting internal and external flaws in the rail.

Freight car and train research includes the development of advanced designs for bogies, the railcar's supporting swivel undercarriage that contains springs, dampers, wheels, axles, bearings, and brakes. Bulk-commodity cars, for example, must be track-friendly, even when carrying heavier loads. Improved ride quality is an objective for other freight cars, such as autoracks.

Research also aims at optimizing vehicle and track performance. This includes improving wheel and rail profiles, developing tools to determine track maintenance requirements from vehicle performance, and monitoring vehicle and train performance from the trackside. These projects relate directly to an industry initiative to reduce the stress state of the railroads—that is, the dynamic loads on the track structure from operating trains.

Exotic Start, Practical Focus

Air cushion vehicle under testing at the High-Speed Ground Test Center in the early 1970s.

The Transportation Technology Center started out in 1971 as the High-Speed Ground Test Center, to test ground transportation innovations such as tracked air cushion vehicles and linear induction propulsion. But interest in exotic ground transportation modes waned, and the focus shifted in the mid-1970s to the conventional technology of steel wheels on steel rail. The center is situated on land owned by the state of Colorado and is leased to the U.S. Department of Transportation (DOT).

Until 1982, the Federal Railroad Administration (FRA) operated the center through operations and maintenance contractors; much of the cost appeared as a line item in the federal budget. When FRA decided to discontinue operation of the Transportation Technology Center, the Research and Test Department of the Association of American Railroads (AAR) saw the value of

Stress State Initiative

In North America, the operating paradigm has required strengthening the track to transport the increasing axle loads safely—a costly approach that increases maintenance and track renewals. The operating officers of the major railroads therefore have adopted the approach of lowering the stress state of the railroads—reducing the loads and stresses on the track structure despite the increases in the axle loads.

Reducing the stresses of train wheels on the rails requires decreases in

1. The steady-state lateral loads;
2. The vertical loads;
3. The wheel–rail contact stresses; and
4. The adverse effects of vehicle dynamics.

The graph in Figure 2 shows the lateral force measured in curves for three segments of an intermodal fleet of identical railcars with different bogies. The right-hand distribution represents data on track strength. In this example, the bogie or truck design at the far left of the graph imposes the lowest lateral forces, presenting the least challenge to the track strength, and therefore should be the preferred design to reduce the stress state.

Other causes of track damage are the forces imparted to the track by freight cars known as "bad actors." In recent years, interest has increased in the trackside monitoring of railcar performance. The stress state initiative monitors the performance of individual freight cars in North America and provides data for preventive maintenance. Maintaining railcars before the performance declines to levels that are unacceptable reduces the stress state of the system.

Heavy axle load test on the high-tonnage loop at the Facility for Accelerated Service Testing.

Until recently, wayside detectors seldom included built-in communications capability; an exception was the wheel impact load detector (WILD). Detectors now come with data links to the Internet. North American railroads are deploying approximately 60 WILDs;

maintaining the site and assumed operation under a care, custody, and control agreement in October 1982. The terms permitted AAR to conduct research and to undertake commercial research for third parties at the center in addition to the work required by FRA and U.S. DOT.

Because of the center's commercial growth, the AAR Research and Test Department became a separate entity, the Transportation Technology Center, Inc. (TTCI), on January 1, 1998. TTCI continued operating the center under the contractual terms. In 2002, FRA contracted directly with TTCI for the operation of the center until September 2012.

Aerial view of Transportation Technology Center, Pueblo, Colorado.

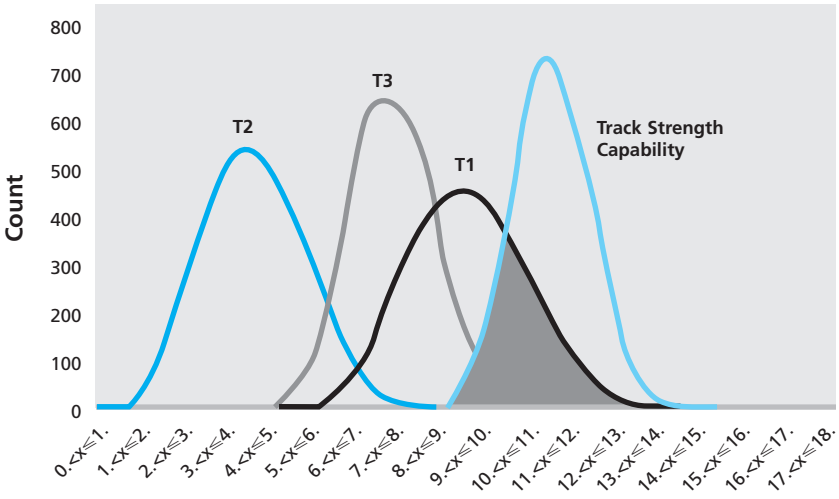


FIGURE 2 Lateral force performance measured in curves, shown as distributions for three segments of an intermodal fleet of identical cars with different bogies. The right-hand distribution represents data on track strength.

16 truck or bogie performance detectors; 3 wheel profile monitoring systems; and 7 newly introduced trackside acoustic detector systems (TADS).[1]

The possibility of acquiring detector data instantaneously via the Internet inspired TTCI engineers to develop a data-driven tool set. The result, the Integrated Railway Remote Information Service, or InteRRIS[2]—now integrated into a suite of programs developed by TTCI's sister company, Railinc[3]—provides the information to make predictive, condition-based maintenance decisions from performance data

[1] TADS is a trademark of TTCI. Inspection of more than 700 bearings has established the effectiveness of TADS in identifying defects, with a success rate of nearly 100 percent.

[2] InteRRIS is a registered trademark of TTCI.

[3] Located in Cary, North Carolina, Railinc is a subsidiary of AAR that maintains databases and communication networks for the North American railroad industry and develops rail-focused applications. TTCI and Railinc work together on projects that involve engineering and information technology applications and solutions.

A Tour of the Facility

The Transportation Technology Center is an isolated and secure 140-square-kilometer complex with an array of specialized facilities and tracks for testing freight and passenger rolling stock, vehicle and track components, and safety devices.

Test Tracks

The center's 80 kilometers of test tracks yield findings on track structure and vehicle performance, life-cycle prediction and component reliability, lading damage prevention, and freight ride quality and passenger comfort (Figure 3):

- The *railroad test track* (22.5 kilometers) studies vehicle stability and endurance at high speeds—up to 275 kilometers per hour. Electric-powered vehicles run on alternating current using an overhead catenary system that delivers 12.5 to 50 kilovolts at 60 hertz.
- The *transit test track* (15.2 kilometers) is available to transit equipment manufacturers and transit agencies for performance certification, endurance testing, and problem solving. The facility can use 600- to 1500-volt direct current from an electrified third rail and from 3 kilometers of a light overhead catenary.
- The *wheel–rail mechanism track* (5.8 kilometers) is used for safety tests of dynamic curving by rail vehicles.
- The *precision test track* (10.3 kilometers) yields vehicle dynamic responses to perturbed track geometry maintained to precise standards.
- The *high-tonnage loop* (4.5 kilometers) tests track systems and track components, the reliability and fatigue of track structures, and the performance of vehicles and components under heavy axle loads of up to 35.5 tonnes.
- The *impact facility track* tests controlled collisions of loaded and unloaded railcars.
- The *tight-turn loop* tests the interaction of vehicle and track on turns with small radii.

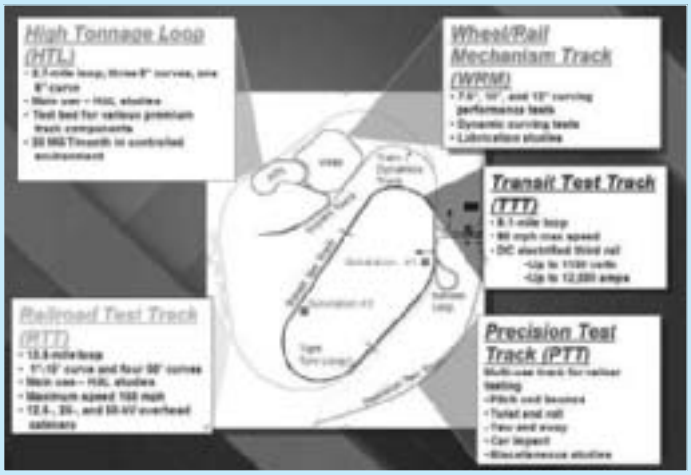


FIGURE 3 *Engineered facilities for dynamic testing.*

Test Laboratories

The center's laboratory facilities include

- An *inertial wheel dynamometer*, for testing rail-

instead of relying only on visual inspection. Railroads have adopted this concept under the Advanced Technology Safety Initiative.

Maintaining Standards

Under contract with AAR, TTCI maintains the railroad industry's technical standards, which ensure the safety, compatibility, reliability, and efficiency of equipment used in interchange service. AAR is the gatekeeper of the standards, but TTCI manages all standards-related technical activities and inspects services to ensure that the industry follows the interchange, design, and maintenance rules and standards.

TTCI also provides technical and administrative support to AAR committees of technical experts charged with developing and reviewing industry standards. The expert committees consider such topics as quality assurance, locomotives, intermodal equipment, open-top loading, freight car design, freight car truck systems, railway electronics, and freight and locomotive braking systems.

TTCI's Emergency Response Training Center was established in 1985 to train railroad personnel in handling accidents that involve tank cars carrying hazardous materials. The center has trained more than 20,000 students from all over the world, including emergency responders from the chemical industry, the emergency response community, and government agencies.

Commercial Activities

TTCI performs research and consulting for commercial customers worldwide. Following is a sampling of recent projects.

Locomotive Performance

U.S. Environmental Protection Agency (EPA) regula-

road wheels and brake shoes in studies of the thermal and mechanical environment of train braking and in certifying the performance of new brake shoe designs;

◆ A *vibration test unit*, which subjects a railcar up to 90 feet long and up to 130 tons to vertical and lateral force displacements that range from 0.2 to 30 hertz in simulated on-track conditions; and

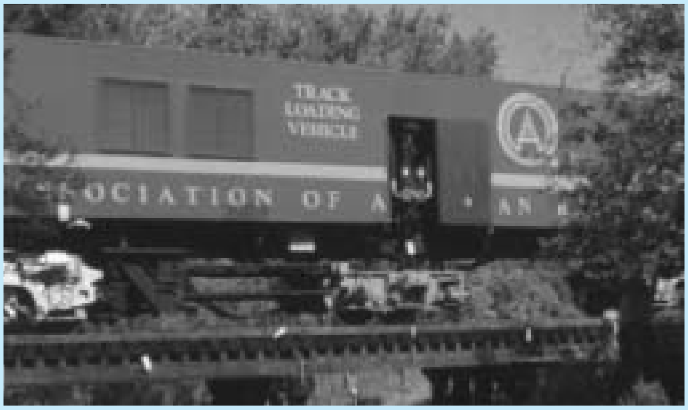
◆ A *simuloader*, which operates continuously to perform full-scale vibration and fatigue testing of rail vehicles directly through the bolster, the connection point of the bogie to the vehicle underframe, inducing complete life-cycle fatigue after a few weeks.

The center also operates metallurgical and nondestructive inspection laboratories, as well as other facilities and rigs to test center-bowl lubricants and liners, air brake systems, roller bearings, rail fatigue, and vehicle bogie suspension characteristics. Other test devices include

◆ The *track loading vehicle*, designed to study techniques for preventing derailment; moving at speeds of up to 30 miles per hour, the vehicle applies forces close to the strength limits of the rails and of the other track structure components such as ties, rail fasteners, and ballast; and

◆ *Instrumented wheelsets*, for measuring wheel–rail forces, certifying new car designs, and studying derailment prevention.

Vibration test unit.



Track loading vehicle on test track.

Crash test of a locomotive and trailing consist into a stationary consist.

tions have established strict emissions standards for new locomotives delivered for service in the United States on or after January 1, 2005. The regulations require manufacturers to demonstrate that the products meet the standards under a variety of conditions and for an extended period.

The General Motors Electro Motive Division (EMD) followed a rigorous, closed-loop design process that kept the tracks at the center busy around the clock with extensive testing to ensure that the new six-axle, heavy-duty SD70ACe locomotive met the 2005 EPA standards, as well as the needs of North American railroads.

One program tested the locomotives' bogies on the high-speed and perturbed track test facilities, which only are available at the center. Other tests attempted to make the locomotive systems fail under rigorous duty cycles, to identify and correct less-than-adequate design features before the assembly of the first production locomotive.

Bogie Design

In 2003, the North American railroad industry adopted a new bogie performance specification, M-976, developed by AAR's Equipment Engineering Committee. The specification aims to lower the stress state of the railroad by requiring freight car bogie manufacturers to develop and test advanced bogie designs to improve ride quality and to reduce the dynamic forces imparted to the track structure. Several commercial clients—including American Steel Foundry–Keystone and Standard Car Truck Company—spent more than 200 days at TTC in 2003 to ensure that their designs complied with the new specification.

Crashworthiness Testing

TTCI supports FRA in improving locomotive and passenger-car occupant safety and crashworthiness. TTCI conducted two locomotive crash tests in 2003. In one test, a locomotive and trailing consist—or following, linked railcars—collided into a covered hopper car for high-volume freight, which was coupled to a stationary consist, partly fouling—that is, obstructing—the right-of-way. In the other full-scale impact test, a locomotive collided inline into the rear of an empty flat car coupled to a stationary consist.

TTCI also assisted FRA in demonstrating the effectiveness of crash energy management (CEM) end structures on passenger vehicles. TTCI retrofitted two full-scale passenger vehicles with CEM end structures, designed to isolate and control the crush of the vehicles in a collision, and evaluated full-scale crashes into the facility's impact wall.

In all of the crashworthiness tests, the consists were instrumented, allowing comparison of the data with predictions from models.

Consulting and Problem Solving

Rail India Technical and Economic Services, Ltd., recently turned to TTCI to modify two crashworthy designs for passenger coaches. The designs were developed with computer simulation, and the modifications will be validated in full-scale impact tests in India.

Full-scale impact test: rear-end inline collision of a locomotive with an empty flat car coupled to a stationary consist.

Iron ore railroad operated by the Société Nationale Industrielle et Minière, Mauritania, travels through the Sahara. TTCI engineers performed an onsite study of wheel-rail problems.

A team of TTCI engineers traveled to Mauritania, Africa, in 2003, to test an iron ore railroad operated by the Société Nationale Industrielle et Minière. The single-track railroad runs through the Sahara for more than 800 kilometers, and the sand aggravates the rail and wheel wear. The engineers measured wheel–rail forces and angles of attack with a special 30-wagon test train. The data have provided information for making improvements.

In Sydney, New South Wales, Australia, TTCI engineers assisted in a government-sponsored inquiry into the derailment of a commuter train in 2003. The engineers performed vehicle characterization tests and built a mathematical model of the train, using the NUCARS program. The predictions from the models correlated with the testimony of signaling experts and with the physical evidence from the crash site.

TTCI has continued to work with Network Rail in the United Kingdom, managing an industrywide program initiated in 2003 to mitigate rolling contact fatigue, the damage that occurs to wheels and rails from repeated rolling and sliding contact. TTCI also participated in an effort to improve railway performance by enhancing wheel and rail adhesion during the autumn leaf fall.

TTCI's asset management team contributed to the Office of the Rail Regulator's review of Network Rail's long-term business plan by examining maintenance and renewal planning. As part of the review, TTCI conducted a benchmark study of North American maintenance and renewal policies.

In partnership with Booz Allen Hamilton, TTCI provided the Massachusetts Bay Transportation Authority with analytical and test support in resolving vehicle dynamic performance issues with the No. 8 car low-floor light rail vehicles.

Re-emergent Mode

High-speed and heavy haul operations have led to the re-emergence of rail transportation. New technologies are being introduced at a rapid pace, and many rail organizations are restructuring. In this environment of innovation, TTCI works with railways and suppliers to ensure the health of rail transportation and to usher in technologies that will benefit the rail industry in North America and around the world.

Massachusetts Bay Transportation Authority's No. 8 car low-floor light rail vehicle underwent testing and analysis at TTCI to resolve dynamic performance issues.

On Budget and On Time

Using the Power of People to Get Projects Done

BARBARA T. HARDER, NEIL J. PEDERSEN, TOM WARNE, AND BARBARA MARTIN

Harder is principal, B. T. Harder, Inc., Philadelphia, Pennsylvania. Pedersen is Administrator, Maryland State Highway Administration, Baltimore, and chairs the TRB Technical Activities Council. Warne is president, Tom Warne and Associates, LLC, South Jordan, Utah, and chairs the TRB Design–Build Task Force. Martin, a consultant in Helena, Montana, chairs the TRB Management and Leadership Section.

State departments of transportation (DOTs) have had to reconsider their ways of doing business. The DOTs had money and projects, but not enough qualified people to do the work.

The Transportation Research Board's Design–Build Task Force and the Management and Productivity Committee cosponsored a session at the 2004 TRB Annual Meeting to consider solutions. Specialists in personnel management and professionals in project management and construction examined the importance of people in completing projects on budget and on time, smoothly and successfully.

Business Beyond Usual

The Transportation Equity Act for the 21st Century (TEA-21), passed in 1998, infused significantly more funding into transportation projects. Many DOTs, however, did not have the staff capacity to handle the projects. Moreover, the tight employment market and attractive consultant salaries were luring experienced employees away—DOTs were competing with consulting firms for experienced project management staff.

Business as usual was not working. Expediting the work would require a shift in the distribution of responsibilities and a change in traditional relationships.

DOTs learned that partners committed to a common goal have an opportunity to produce stellar results. Alternative project management methods have provided the means to complete projects effectively with limited staff resources. The new work methods and partnerships have introduced a new set of challenges.

As a result of the significantly increased TEA-21 funding for transportation projects,

- DOTs either had to compete with consultants for experienced technical staff or had to change the way they did business.
- DOTs had to rely on innovative contracting methods, such as design–build, to complete the increased number of projects in less time.
- The relationships between DOTs, consultants, contractors, and the public changed.
- Partnerships to improve the quality and the production of projects increased.
- Public sensitivity to DOT operations increased.

What do partnerships entail, and how can partnerships affect the quality and efficiency of the product?

Leveraging People and Resources

Creating Mutual Advantage

Partnerships and alliances are hot topics in business today (*1*). Private, public, academic, and not-for-profit organizations have embraced the strategic mandate for collaboration, domestically and internationally and on a local or national scale. Partnerships have become a basic tool to achieve a host of organizational objectives (*2*).

A partnership involves agencies or organizations contributing to an effort by sharing resources—such as technical facilities, equipment, or financial, legal, and marketing expertise—cooperatively bearing the risks and jointly reaping the rewards. Partnerships are cooperative arrangements engaging companies, universities, or government agencies in varying combinations to pool resources for a shared objective.

Partnerships create mutual advantage—a win-win experience for the partners. Many partnerships create value for their stakeholders through enhanced knowledge and expertise, greater flexibility in performance, and more effective leveraging of resources (*3*). Partnerships in transportation substantially contribute to strong, productive, and vigorous efforts that produce mission-oriented results.

Building Trust

An author in a research journal has observed, "Profitable partnering relationships...are cemented by building trust, not by contract" (*4*). The most significant reasons for a partnership's success are the factors that deal with people. A partnership is a relationship, and trust is essential.

Most partnerships encounter differences in organizational cultures. In collaborative efforts within an organization, the shared culture and the established level of trust generally can overcome any differences that arise between units.

External alliances or partnerships that fail to deal with differences in organizational culture, however, have difficulty building trust and consequently reap fewer benefits. Partners must acknowledge, accommodate, and accept competing agendas. A successful partnership is able to address and deal with these issues. The goal is to achieve a relationship in which "the people involved…have the communication skills and cultural awareness to bridge their differences," preserving and fostering trust (*5*).

Compatibility and Commitment

In addition to trust, partnerships require compatibility and commitment. Compatibility implies that the partner organizations' strategic goals correspond with—that is, complement and reinforce—the shared goals. More than matching resources, resolving conflict, and dealing with differences, compatibility extends to the policies, values, and integrity of the partners and allows a partnership to thrive (*2*).

Partners can indicate commitment by assigning champions to promote the project results or by expressing the support of top management. One of the most successful strategies—more common in the private sector—is appointing a partnership or alliance manager. This "go to" person is not the project manager but is responsible for maintaining and advancing the partnership relationship, knows his or her organization thoroughly, has the authority to act on its behalf, and can relate effectively to the other partners' cultures, motivations, and needs.

Partnerships that have an important mutual project goal tend to be more successful than partnerships created for an unidentified future project. The focus on achieving the project goal enables partners to overcome problems that can undermine the relationship. If the desired outcome is important, the partners will work diligently to resolve extremely difficult problems and avoid jeopardizing the project goal.

Another element in a successful partnership is continuity among key players, such as the alliance manager and other leading staff. People make partner relationships work. Strength is built over time, and the longer the partnership continues, the more robust it can become. The people who are involved make the commitments, build the trust, and embody the partners' credibility.

Art of Communication

Effective communication builds and sustains partnerships and project delivery. Project development can be hindered by failures of communication, such as a lack of responsibility by team members, information withheld for fear of angering a manager, or commitments broken by key personnel.

Three Principles of Effective Partnerships

- Mutual trust
- Effective communication
- Cultural compatibility

Communication must be two-way, with an emphasis on listening. Messages sometimes are heard differently from what the speaker had intended and therefore should be validated and understood through follow-up. Communication failures cause most of the problems in project delivery. Although the same problems are not uncommon in contract projects, partnerships present greater potential for difficulties—which can be minimized or eliminated with the following strategies.

Team Dynamics

Involving the right people from the relevant disciplines and establishing positive team dynamics early will increase the likelihood of a project's success. A project manager who is a good communicator can ensure that all roles and responsibilities are clearly identified and understood by team members. Including personnel from the approval agency on the project team not only adds expertise but may avoid problems with second-guessing after the project's start.

Consultants and contractors must function on the team as equals of the agency staff. Training the consultants along with the agency staff ensures a shared understanding of the tasks and procedures. A diversified staff with different levels of experience may allow for more informed decision making.

Focused Meetings

Productive meetings require an agenda, a facilitator, and the participation of key players. Receiving the agenda beforehand gives participants the opportunity to prepare any necessary documentation for distribution at the meeting. This in turn cuts down on e-mails afterwards, which can be unproductive and can delay the project's momentum.

The agenda maps out the topics to be covered, and an adept facilitator can keep the participants focused on the agenda, noting items for action and follow-up and ensuring that all responsibilities are clear. An effective meeting requires participants with expertise in the topic, who have the knowledge and background to produce results and to provide insight into problems and best practices. Holding core meetings regularly can ensure the flow of valuable communication.

Keeping Perspective

Communication is the cornerstone of project management. Build a clear understanding of all tasks, inputs and outputs, schedules, accountability, and the budget. Open communication can deal constructively with the kinds of issues that always arise, such as personality conflicts or unforeseen obstacles, and can ensure that personnel receive timely information for decision making.

Management should convene regular project meetings for updates on the schedule, the budget, and unresolved issues. The accessibility of a manager enables staff to communicate openly and to use the manager as a resource. Communication is an art that flourishes with use.

Win-win solutions develop by involving representatives from all relevant parties, such as resource agencies, local government, and approval agencies such as the Federal Highway Administration, ensuring a sense of ownership in project-related decisions. Personnel in these offices who are familiar with the project will be more inclined to address concerns attentively and to communicate with the project manager promptly if problems arise.

Applying Technology

Technology has come a long way in the past 20 years; e-mail, conference calls, virtual meetings, and videoconferences offer flexibility, convenience, and spontaneity. Personnel can send maps and plans electronically and can meet via videoconference, eliminating travel time between job sites and management time between job sites and project management offices. This approach provides accessibility to all team members, trims travel expenses, and lowers communications costs.

New Communication Models

New communication models are needed for DOT construction projects. Traffic congestion and complex traffic controls transform the simplest project into a major effort in mobility management. Moreover, DOTs must meet the public's high expectations for performance

Public involvement and communication were at a rudimentary stage only 25 years ago and were accomplished mostly through public notices in newspapers, supplemented by roadside posters, fliers, and leaflets left on the doorsteps of the affected residents and businesses. Today the public demands more thorough and direct communication from DOTs, to be able to navigate through construction projects with as little delay or inconvenience as possible. Public communication must be more sophisticated and must include more media to improve results in terms of public response and action.

Utah Case Study

The Interstate 15 (I-15) reconstruction project in Salt Lake City, Utah, provides an example of the successful application of the new multifaceted model for communication. The 17-mile reconstruction project was designed and built in only 4.5 years. The original plan required 8 to 10 years of construction, but Utah DOT decided to complete construction before the 2002 Winter Olympic Games. A design–build procedure accelerated the $1.59 billion effort.

Before reconstruction, the I-15 corridor carried more than 200,000 cars per day. Utah DOT recognized the inadequacy of the traditional means of communicating with the public about an extensive project affecting so many people daily.

Targeting Messages

Messaging was key to public communication on the I-15 project. Utah DOT first defined target audiences

Scenes from the reconstruction of I-15, Salt Lake City, Utah, accomplished in half the time originally projected, to serve traffic for the 2002 Winter Olympics: communication allowed safe continuation of traffic during construction; night paving; pouring portland cement concrete near South Junction; column rebar awaiting placement; and bird's-eye view of segment. (All photos courtesy of Utah DOT.)

and crafted messages for each audience. This deliberate process identified a dozen stakeholder groups, including commuters, businesses, fire and medical crews, law enforcement, elected officials, rental car users, truckers, package delivery services, and school transportation agencies.

The targeted audiences received many specially tailored messages throughout the 4.5-year project. The messages were modified to account for different phases of the work. For example, early in the project, the messages communicated the reasons for the work and how to cope with the construction. Later the focus was on how to use the detours effectively. Finally, as the project approached completion, the messages aimed at assisting motorists in using the new facility to full potential.

The I-15 project leaders were particularly concerned about the appropriate media to communicate the messages. A 15- or 30-second spot during the 10 o'clock news was the most cost-effective means for sending a message to some audiences. For others, the Internet was best. At one stage of the project, sending faxes to trucking companies every Friday afternoon was an effective way to share information about closures and detours for the coming week.

Assessing the Approach

Many measures were taken to assess the effectiveness

of these strategies during the I-15 project. A final poll of the public revealed that

- 86 percent endorsed Utah DOT's use of design–build under an accelerated schedule;
- 75 percent had a favorable impression of Utah DOT;
- 88 percent had a favorable impression of the contractor; and
- 83 percent said that the construction was either better than they expected or about what they expected.

Today's public wants to be informed, to be able to use the information from state DOTs and other sources to improve personal mobility. This type of communication must be proactive, aggressive, deliberate, thoughtful, and effective. Audience-appropriate communication is the new model for DOTs in serving customers and advancing substantive projects.

Project Management Road Map

Communication is intrinsic to the success of a team, which coincides with the success of a project. Communication can deteriorate through a lack of project management and a loss of interconnections between team members, approval agencies, and the public.

The following lists are summaries of people-centered practices that keep projects on budget and on time regardless of the project's purpose and methods.

Practices that benefit all parties, internal and external:

- Involve the affected parties early—the public, partners, and regulating agencies—and build a sense of shared ownership.
- Have the affected parties meet regularly to discuss the project's progress.
- Communicate bad news early.

Practices that benefit internal partners:

- Establish clear, common goals for the project.
- Choose the right people and assemble the mix of skills and authority to get a project done.
- Set expectations for communications—this should be done by the executive management.
- Provide training in communication skills, effective meeting techniques, and project management, and ensure that staff understands the importance of all facets of communication skills.
- Never withhold information.

Practices that benefit project partners:

- Treat partners as peers—integrity and respect contribute to success.

Utah DOT kept truckers up-to-date on construction detours and roadway closures with weekly faxes to main offices.

- Spend time in teambuilding to work with differences in organizational cultures.
- Regularly review the project's status and recognize the signs of a failing project.
- Involve partners in all key decisions.
- Train consultants along with agency staff.
- Make regulators a part of the team.
- Differentiate the core team from the larger team.

Practices that benefit stakeholders:

- Identify the public groups affected by the project.
- Include all interested parties early and meet regularly to encourage a sense of ownership in the project.
- Target messages and methods to each group's interests.
- Change the messages to reflect changes in the progress of the project.
- Use the most effective medium for each target audience.

In sum, get to know and engage partners and stakeholders; communicate early and often; and maintain an approach of trust and mutual respect.

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EARMARKING IN U.S. DEPARTMENT OF TRANSPORTATION RESEARCH PROGRAMS

What Is the Rationale? What Are the Risks?

MARTIN WACHS AND ANN BRACH

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The federal government has long supported transportation research and innovation. The introduction of materials, improvements in design, protection of the environment, and innovations in travel safety depend on the continuous development of new knowledge and on the objective evaluation of projects and programs.

The U.S. Department of Transportation (DOT) has funded research into highway, transit, aviation, rail, and marine applications. U.S. DOT research programs are carried out by the department's staff and by private and academic institutions that typically compete for awards based on merit and experience.

In the past 10 to 15 years, however, transportation research programs have experienced a dramatic growth in earmarking—that is, in Congressional legislation specifying that research centers, projects, or studies should be located at particular institutions. Between 1995 and 2003, earmarking increased from about 1 percent of the department's research budget to about 14 percent (Figure 1). This level of earmarking, however, is modest compared with the situation faced by some agencies within U.S. DOT and by programs within the agencies.

In response to concerns about the increased earmarking of funds for transportation research programs, the TRB Executive Committee requested a white paper presenting data and perspectives on research earmarking. This article is an abbreviated version of the white paper, which has been published in full in a research journal (1).

NOTE: *This article was in production when Congress passed the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). Preliminary analysis indicates that earmarking levels in SAFETEA-LU are higher than in previous authorizations. An article in an upcoming* TR News *will examine in detail the research provisions in SAFETEA-LU.*

Elements of Earmarking

A Congressional earmark designates three elements: a research area or project, a funding amount, and a recipient—that is, an institution that will perform the research. The last element, the recipient of the funds, is the most critical and yet the most ambiguous.

Congress may designate a recipient in several ways. The clearest is to name the recipient in the legislation or in an accompanying report. Although a report does not have the force of law, agencies generally treat report designations as binding.

In other cases, the recipient is not named, but the law or report language is so restrictive that only one recipient can meet the criteria. In yet other cases, Congress uses informal channels to make known to an agency the intended recipient of the funds. The effect is the same—the agency knows it must provide a certain amount of funding to a particular recipient to avoid repercussions, perhaps in future appropriations.

Research earmarks differ from earmarks for highway and other public works projects. Construction earmarks account for less than 10 percent of highway program funds; by contrast, earmarks of research programs in some cases account for 40 percent to 90 percent of a research budget. Construction earmarks do not designate engineering and construction firms, but research earmarks designate research institutions. Construction projects must meet planning, engineering, and environmental requirements and standards, but earmarked research is not subject to

the competition and merit review standards that ordinarily would be applied.

Competition and Peer Review

Discussion about earmarking must consider the principle that the competitive award of funding through the judgment of scientific peers is the best way to ensure high-quality research. Expert judgment is needed to assess the character of the research, which is a quest for new knowledge and for solutions to unsolved problems. In many cases this high degree of expertise is shared by a small number of colleagues who have a similar education and similar research or technical experience.

Quality assurance is part of the culture of science. Research should be as free as possible from political or other extraneous influences, to preserve the reliability, accuracy, and objectivity of the results. Although science may be subject to the same types of influences as other enterprises, the ideal of minimizing nonscientific impacts on scientific results remains a central tenet of research culture.

Legislative bodies always have designated research funds for particular purposes, such as traffic safety, pavement improvement, or transportation demand management, but historically the selection of the researchers has been left to peer review. Review processes, like those of the National Science Foundation and the National Institutes of Health, incorporate measures to avoid awarding funds on the basis of friendships, influence, political connections, or lobbying.

Widely circulated announcements encourage researchers to study and solve particular problems. Experts in the field anonymously review the proposals and budgets prepared by other researchers and recommend selection of the most promising. Although most federally funded research is conducted through open competition, the increasing share of earmarked research funding bypasses these processes (3). This trend warrants careful analysis and interpretation.

Earmarking in U.S. DOT Research Programs

To assess the extent of earmarking in U.S. DOT programs, data were gathered from five U.S. DOT agencies, representing 85 percent of the department's research budget from fiscal year (FY) 2000 through FY 2004.

Federal Highway Administration

In FY 1997, the last year before the Transportation Equity Act for the 21st Century (TEA-21), approximately 12 percent of the Federal Highway Administration's (FHWA) research and technology (R&T) deployment programs were earmarked by authorization and appropriations legislation. With the passage

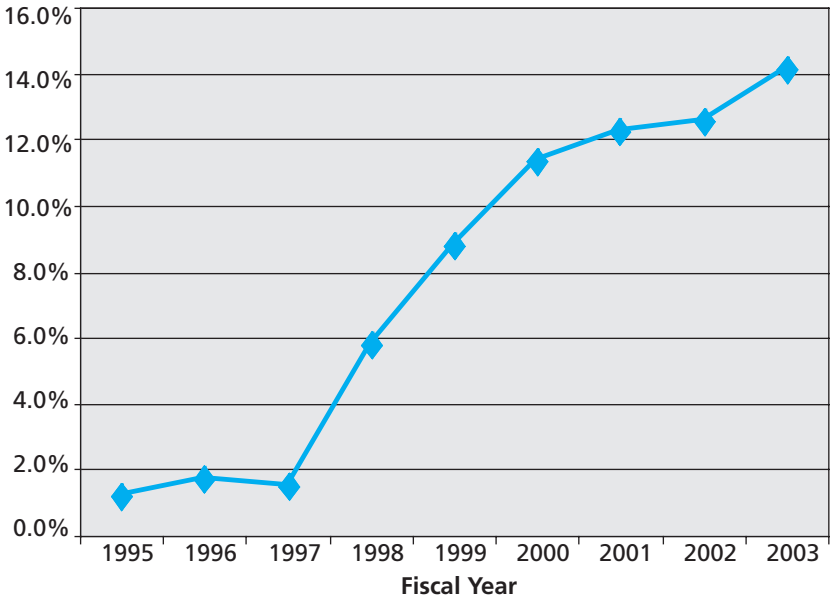

FIGURE 1 Earmarks as a percent of U.S. DOT R&T program (2). *Source: U.S. DOT budget tables.*

FHWA's Turner-Fairbank Highway Research Center, McLean, Virginia, and demonstration of testing procedure in one of the facility's laboratories. (Photos courtesy of FHWA.)

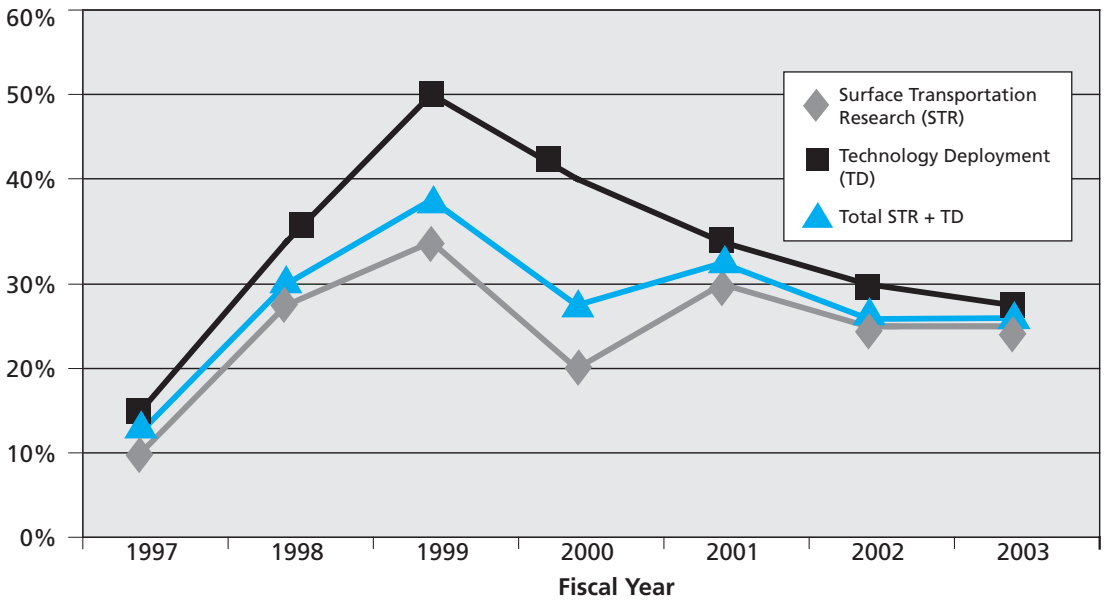

FIGURE 2 Earmarks as a percent of FHWA's R&T program (with limitations applied). *Source: FHWA budget tables.*

of TEA-21, authorization earmarks alone increased to almost 19 percent of R&T funding. Adding earmarks from the annual appropriations process, the average level of earmarking during the TEA-21 years reached 33 percent of the R&T program.

The impact was reduced in FY 1999, 2000, and 2001 (Figure 2), as appropriators agreed to specify the earmarks up to a certain amount. This allowed FHWA to maintain minimum research operations in critical areas and to keep core laboratories open at the Turner-Fairbank Highway Research Center. Without this agreement, 45 percent of FHWA's research program would have been earmarked in 1999 and 2001.

Under TEA-21, 29 percent of FHWA's R&T program was earmarked: 26 percent of the research portion of the program and 35 percent of the portion for technology deployment. Average earmarking during the 6-year period, however, masks the dramatic impact on some parts of the R&T program. Structures, pavement, and safety programs received more earmarks than research in policy, environment, and planning.

In FY 1999, for example, 65 percent of FHWA's structures research program was earmarked. In the same year, the pavement research program received an

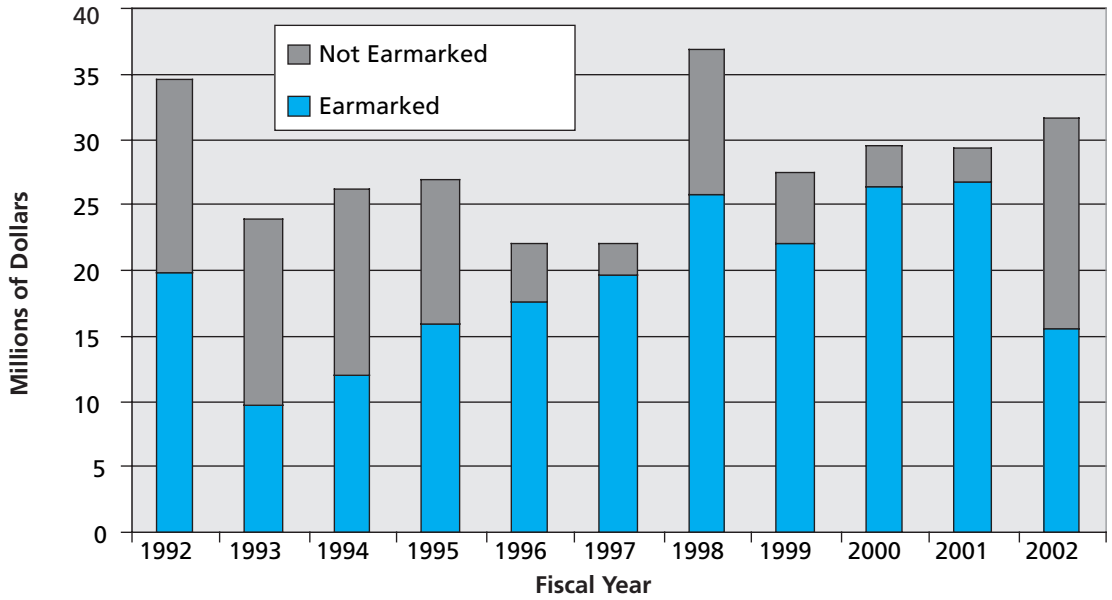

FIGURE 3 Earmarks as a percent of FTA's R&T program, FY 1992–FY 2002. *Source: FTA.*

appropriation of $11.6 million but was expected to accommodate $14 million worth of authorization and appropriations earmarks. Over the course of TEA-21, the technology deployment program dealt with annual earmarks ranging from 26 percent to 54 percent.

Federal Transit Administration

Earmarking levels in the Federal Transit Administration's (FTA) R&T program have been high for more than a decade. From FY 1992 though FY 2002, the degree of earmarking ranged from about 40 percent of the total research program to 90 percent (Figure 3), leaving the agency with little discretion in managing its R&T program.

FTA's earmarks contrast sharply with FHWA's. Earmarks in highway research are almost entirely for research and almost all are directed to universities; FTA earmarks, however, display more diversity in the activities funded and in the recipients. Between FY 1992 and FY 2004, 14 percent of earmarked R&T funding went to research activities, and half of the funding was directed to activities associated with testing or implementing new technologies.

The remainder of the earmarks appear to fund planning or program implementation. A substantial number of projects (33 of 109) were planning studies for bus, rail, and other transit initiatives in particular locales, although these projects only consumed 6 percent of the earmarked funding. Similarly, community-oriented projects—such as programs to provide access to jobs or transportation for senior citizens—accounted for 7 percent of the earmarked funding. In the "other or uncertain" category are R&T program earmarks to fund the purchase of equipment, the construction of facilities, or operations.

As might be expected from the relatively small amount of funds earmarked for research, universities represent a small percentage of earmark recipients (9 percent). In contrast, local jurisdictions, transit authorities, and a few states comprise nearly half of the earmark recipients for planning studies, technology implementation projects, and projects to fund operations, equipment, or facilities.

Private organizations—often industry associations or private research institutions—receive about 30 percent of earmarked R&T funding. Some of these earmarks were for research, a few for training or standards development, and several for development and testing of new technology.

Federal Aviation Administration

Before 1998, few earmarks affected the Federal Aviation Administration's (FAA) research program. Earmarking then rose significantly, from less than $10 million per year to $30 million or more (Figure 4). Beginning in the mid-1990s, FAA's total research appropriation began to fall, so that the increased earmarking has had a greater impact on the program, rising from less than 5 percent to between 13 percent and 27 percent.

All FAA earmarks appear to be for R&T development; however, the recipients are not necessarily universities. Between FY 1990 and FY 2004, of the 89 earmarks from FAA's program, 25 went to universities, 6 to airports, and 1 to a state DOT. The largest number of earmarks, 42, went to private laboratories, research centers, and consortia of industry and other

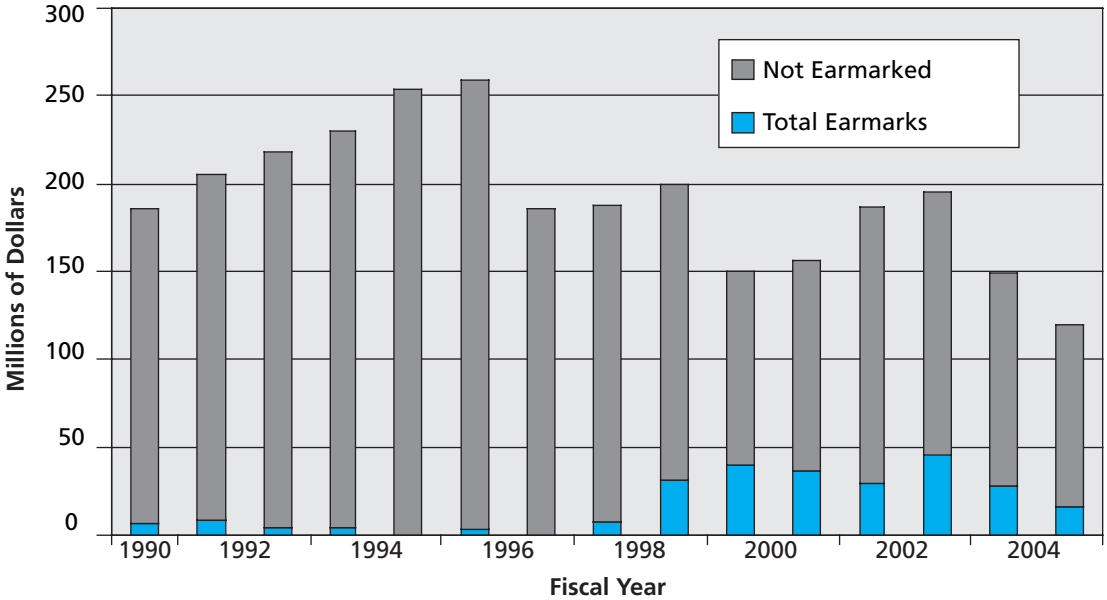

FIGURE 4 Earmarking in FAA's research program. *Source: FAA; 1991 data only include earmarks from House Appropriations Committee.*

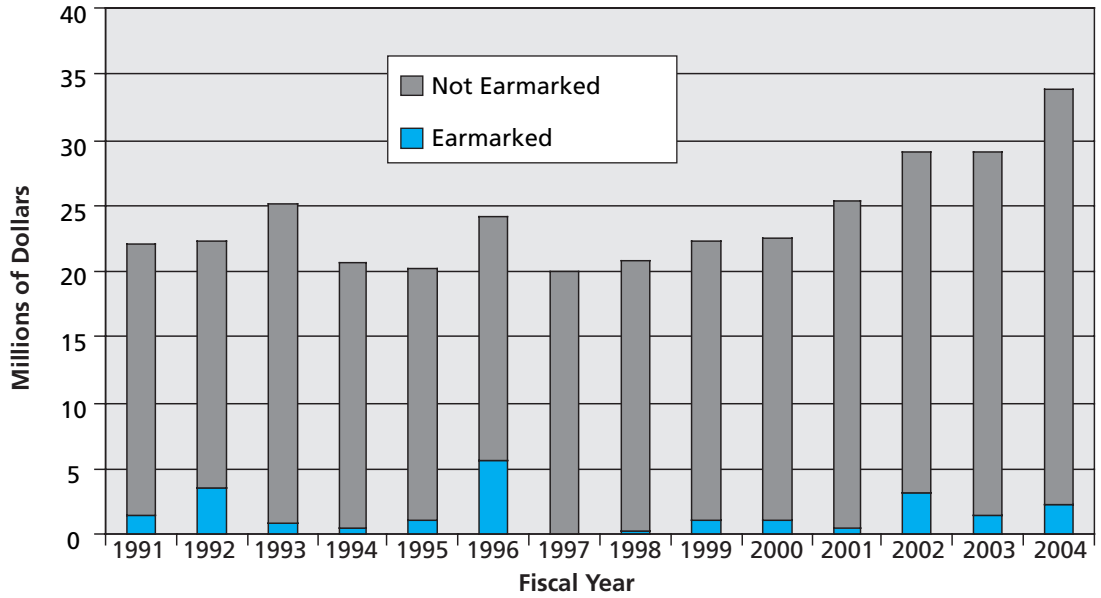

FIGURE 5 Earmarking in FRA's research program. *Source: FRA funding table.*

institutions. A significant class of recipients, however, consisted of federal agencies or laboratories, which received 15 earmarks.

Federal Railroad Administration

The Federal Railroad Administration's (FRA) research appropriations have been subject to a lower level of earmarking than those of FHWA and FTA. From FY 1991 through FY 2004, earmarking usually affected less than 10 percent of the program, rising to 16 percent in FY 1992 and to 23 percent in FY 1996 (Figure 5). Of the 24 earmarked activities, only three lasted more than 1 year, with never more than four earmarks in any year.

Most of the FRA earmarks were for research, often by universities; some were for planning or design studies. The data do not include the Next Generation High-Speed Rail Program, with annual funding of about $20 million to $30 million, nearly all of which has been earmarked in recent fiscal years.

University Transportation Centers

The University Transportation Centers (UTC) program, administered by the U.S. DOT's Research and Innovative Technology Administration (RITA), fosters the development of transportation professionals and researchers by funding research at universities.

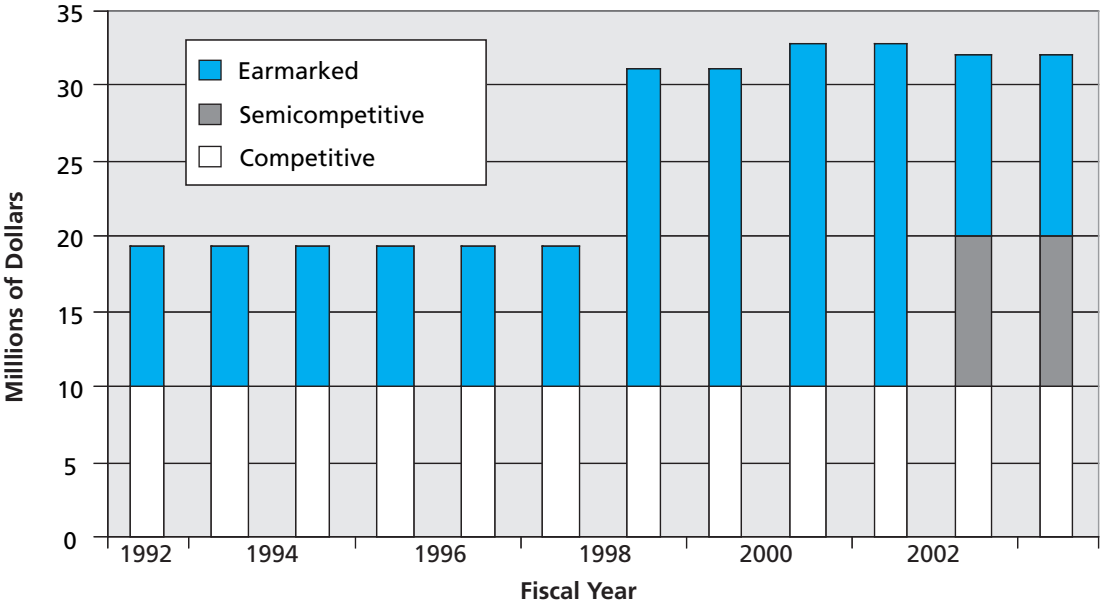

FIGURE 6 Earmarking in the UTC Program. *Source: RITA.*

Open Discussion on Earmarking

In October 2004, the Transportation Research Board (TRB) convened a meeting to discuss transportation research earmarking. Participants included university researchers, congressional staff, and representatives of U.S. Department of Transportation (DOT) programs, transportation agencies, and industry associations.

The participants reviewed the data presented in a white paper (*1*), heard presentations from experts on research earmarking, and discussed the reasons for and concerns about the practice. The session was not convened to produce consensus positions; discussion points included the following:

- Some participants maintained that earmarks help to achieve policy goals, such as education, longer-term research, entry into new areas, support for minorities, and the redirection of unresponsive programs. Others countered that earmarks are not the best ways to achieve some of these goals.
- Some expressed concern that reducing competition and peer review leads to mediocre research. In addition, high levels of earmarking impede an agency's ability to manage its program, attract talented staff, and respond to emerging opportunities.
- Several participants stated that transportation research funding is inadequate, particularly for investigator-driven, longer-term, and more fundamental research, for which universities are well suited. With earmarking, universities may bypass competitive processes to gain more reliable funding flows with fewer stipulations. As a result, however, fewer resources are available for competition, which in turn sparks more lobbying for earmarks.
- Many participants noted that U.S. DOT research programs should engage in more stakeholder involvement, strategic planning, performance measurement, and marketing of research benefits. These practices may lead to constituent support for more competitive programs and perhaps for larger research budgets.

Participants in the discussion about legislative earmarking included (left to right) William W. Millar, American Public Transportation Association; Richard F. Marchi, Airports Council International–North America; Peter Ruane, American Road and Transportation Builders Association; Anthony Kane, American Association of State Highway and Transportation Officials; Dennis Judycki, Federal Highway Administration; and Michael D. Meyer, Georgia Institute of Technology.

Eric Webster, U.S. House of Representatives Committee on Science, addresses a point to Barbara Sisson, Federal Transit Administration, and Michael S. Townes, Hampton Roads Transit and then-Chair of TRB Executive Committee.

Earmarking discussion attracted a range of distinguished participants.

PHOTO: SOUTHWEST REGION UTC CONSORTIUM

Students collaborate on project funded by University Transportation Centers program.

From FY 1992 through FY 2003, 10 centers—one for each federal region of the country—have received competitive awards every few years (competed and earmarked awards are shown in Figure 6). These regional centers are consortia of several universities with one serving as the lead. The remainder of the UTC program funding is earmarked to individual universities or consortia.

In the fourth year of TEA-21, 17 earmarked centers competed and 10 were awarded funding for the last 2 years of the authorization cycle. These account for the semicompetitive portion of the program for FY 2002 and FY 2003 (Figure 6).

The rationale of regional distribution for the 10 centers is to ensure professional capacity building in transportation throughout the country, responding to concerns about the availability of a qualified workforce. This rationale, however, also can justify earmarks to universities in areas with particular needs for transportation professionals or with student populations underrepresented in transportation.

Before TEA-21, the UTC program was small, and few questioned that nearly 50 percent of the program was earmarked. Under TEA-21, the program grew by approximately 60 percent, and earmarking rose to 70 percent of the program; at the same time, university earmarks significantly increased under FHWA. As a result, UTCs received more attention, and expectations rose for useful research and the training of professionals.

Driving Forces

Institutions have sought direct congressional designations of research funds for several reasons:

◆ ***The traditional peer review process is perceived as biased toward established, prestigious universities.*** Advocates claim that earmarking creates a level playing field and improves the competitive performance of less prestigious institutions (*4*). Nevertheless, well-established programs also receive earmarks (*3*).

◆ ***Facilities are necessary for an institution to compete in certain research areas but federal funding of research facilities is considered inadequate.*** Some U.S. DOT earmarks have paid for the development of research facilities, but most have not.

◆ ***U.S. DOT funding of investigator-driven research is inadequate.*** Because U.S. DOT's mission-driven programs provide little opportunity for researcher-initiated work, universities may seek earmarks related to the interests of faculty. Some evidence supports this concern—in FY 1995, approximately 10 percent of U.S. DOT research funding went to universities (*5*), compared with 22 percent of all federal research funds (*6*).

◆ ***Competition may be inappropriate in special cases that involve classified research or that require unique institutional qualifications.*** Data were not available, but anecdotal evidence suggests that these cases account for a small portion of U.S. DOT research funding.

◆ ***Agency programs are perceived as nonresponsive or insular.*** Some nonacademic stakeholders have used earmarks to direct agency research to their interests or to influence agency programs that have relatively little external input or review. At least one major transportation stakeholder group has used this strategy in working with a U.S. DOT agency.

Noteworthy Risks

Earmarking raises some risks in the quality and the management of research:

◆ ***Earmarking may push universities' energies in the wrong direction.*** Competition encourages researchers to prepare innovative, well-documented, and persuasive proposals for judging by scientific and technical experts. The focus is on the transportation problem and on the research or technological approaches that promise the best solutions.

Writing research proposals, reviewing proposals, evaluating alternative research designs, and examining the credentials of faculty members are practices that broaden knowledge about the topics and advance the state of the art. Earmarking, in contrast, relies on lobbying, which focuses on the relative power of members of Congress (*7*) and on the benefits—such as jobs and other impacts on the local economy—that will accrue to a legislator's jurisdiction.

◆ ***Earmarking can adversely affect mission-oriented research.*** Each U.S. DOT agency directs R&T toward the fulfillment of its mission. When a substantial portion of the research budget is earmarked, an agency has difficulty supporting its mission with research. Earmarks typically are designated without regard for research plans and sometimes without consideration of an agency's mission. Even when the earmarks are for relevant research and the researchers are responsive, agencies lose the ability to prioritize, to manage, and to respond to emerging needs and opportunities.

As noted earlier, earmarking threatened the continuation of basic laboratory functions at FHWA. After

the terrorist attacks of September 11, 2001, FTA was unable to redirect funding to security research, because 90 percent of its research budget was earmarked. High levels of earmarking also leave an agency with few resources for the ancillary activities needed to achieve technological objectives, such as prototype development, testing and evaluation, technology transfer, coordination, and information sharing.

◆ ***Earmarking reduces accountability for the expenditure of public funds.*** When an agency chooses a researcher competitively, a contract often specifies the deliverable—that is, the required product. Nonperformance can result in termination of the contract and redirection of funds to more responsive researchers.

Agencies also can negotiate with contract researchers as needs change. Even when delivered to a research institution via contract, earmarked funds are provided regardless of performance, because the award originated from a powerful politician, not from a scientific or technical decision.

◆ ***Earmarking causes disadvantages for other transportation research stakeholders.*** Universities and other research institutions that do not receive earmarks are cut out of the research program as the competitive funds dwindle. This increases the pressure for these institutions to seek earmarks.

Other stakeholders, such as users and providers of transportation facilities and services, as well as those in associated trades and industries, also are affected by earmarking. For example, during TEA-21, earmarks and other designations left FHWA without resources to continue implementation support for the Strategic Highway Research Program (SHRP). Yet many states were implementing the SHRP results, and coordination and support of these efforts was critical.

State DOTs therefore agreed to dedicate funds from the National Cooperative Highway Research Program (NCHRP) to make up for the federal shortfall. Over 4 years, NCHRP spent $26 million on SHRP activities—funds that would have been used to solve collective state technical problems not addressed in FHWA research.

As the impacts of earmarking in FHWA's program became more apparent, a range of stakeholders discovered that the agency was no longer able to fund research in areas as diverse as pavements and travel demand modeling, which are critical for the national transportation system.

◆ ***Earmarking may undermine respect for science and jeopardize academic freedom.*** In allowing the bypass of peer review through earmarking, universities jeopardize the privileged place that science in general and that universities in particular have earned in American society through the delivery of outstanding scientific and technical research products. For example, the government's support for the system of peer review allows the scientific community to influence the content of federal research programs and the allocation of research funds—a privilege unheard of in other federally funded activities and rare in other countries.

The collective benefits earned through research are taken for granted when individuals succumb to the temptation for a "free ride" on the system via earmarking (3). Earmarking may undermine respect for science and jeopardize academic freedom by reducing researchers to a special interest group expected to deliver votes and politically useful research results.

Critical Needs

For decades U.S. research has delivered outstanding scientific and technical results that have improved the quality of life. A hallmark of this enterprise has been competition under the review of scientific and technical experts. The erosion of this time-tested process, as individual research institutions seek their own benefits through earmarking, threatens to undermine the promise of collective benefits of research to society.

Support for federal funding of transportation research depends on its effectiveness, which requires strategically focused programs carried out by highly qualified, independent researchers. With critical needs in safety, security, congestion relief, and infrastructure renewal, transportation cannot afford to be served by anything but the highest-quality research.

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Improving U.S. Highway Safety

Have We Taken the Right Road?

BRIAN O'NEILL

The author is President of the Insurance Institute for Highway Safety and the Highway Loss Data Institute, Arlington, Virginia. He was the featured speaker at the TRB Annual Meeting Chairman's Luncheon, January 2005.

The most reliable statistics for assessing progress in U.S. highway safety are the annual counts of motor vehicle crash deaths. In 1970 the United States experienced 54,633 deaths from crashes (Figure 1). The 2003 total was almost 11,000 fewer—42,643. The mileage death rate dropped from 4.88 deaths per million miles traveled to 1.56, and deaths per 100,000 population dropped from 26.8 to 15.4.

These figures indicate progress in highway safety. Nevertheless, 42,000 deaths each year is too big a price to pay for personal mobility.

Science-Based Approach

In the first 60 or so years of motorization, highway safety countermeasures were not effective, consisting mainly of efforts to educate drivers. By the late 1960s a science-based approach began to replace education-based efforts with countermeasures aimed at road users, vehicles, and the environment.

The National Highway Safety Bureau (NHSB) began to set performance standards for vehicle designs and to issue standards to address road user behavior at the state level. The Federal Highway Administration (FHWA) started to establish new standards for safe road designs. For the first time, significant federal funds were available for research into additional countermeasures.

The first federal motor vehicle safety standards required features such as energy-absorbing steering columns and penetration-resistant windshields. These national vehicle safety standards were the first of this type in the world.

At the same time, the federal government issued standards to address road user issues at the state level. These included requirements for driver licensing and for motorcycle helmet use, as well as countermeasures for alcohol-impaired driving.

FHWA established standards for new road construction with roadside clear zones, breakaway lights

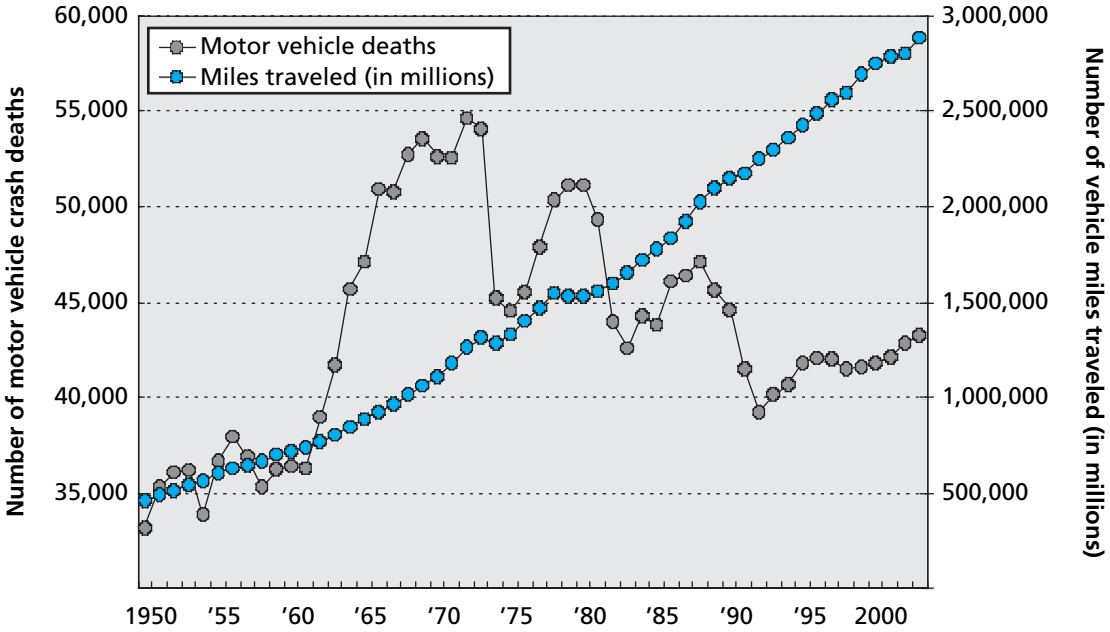

FIGURE 1 Motor vehicle crash deaths and total miles traveled, 1950–2003.

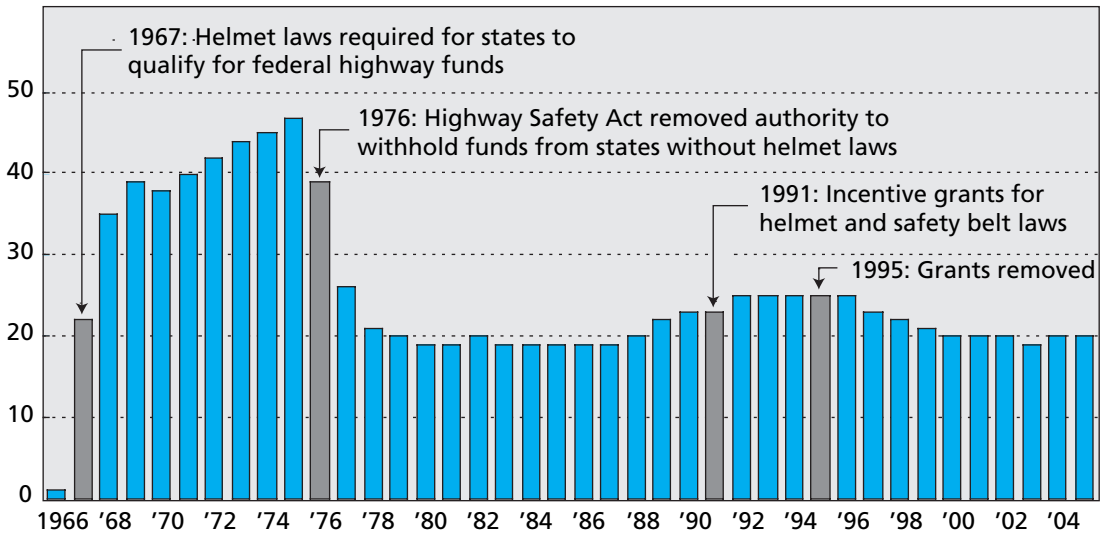

FIGURE 2 States with universal helmet laws, 1966–2005.

and poles, and guardrails, as well as requirements for removing roadside hazards and upgrading safety on roads under renovation. In the 1970s federally mandated countermeasures addressed problems related to road users, vehicles, and the road environment, and more countermeasures were expected.

Instead, the mandates stopped. What went wrong?

Legislation Overturned

The federal role in regulating road user behavior unraveled in the mid-1970s. All but three states—California, Illinois, and Utah—had enacted laws for motorcycle helmet use, as required by one of the federal safety standards for road user behavior. States that did not meet the requirements could be penalized by the loss of federal highway construction funds.

In 1975, the U.S. Department of Transportation notified the three states that the funds would be withheld. Congress quickly overturned the legislation authorizing the federal mandates for road user behavior, eliminating the federal government's ability to coerce states to establish effective programs and laws for road user behavior.

The consequences are apparent—in 1975, 47 states had laws requiring all motorcyclists to wear helmets; today only 20 states have these laws (Figure 2). More than 700 motorcyclists died in 2003 because not all states have helmet use laws.

California wielded the most political influence in eliminating the federal standards for road users, but today California has a helmet use law and a seat belt use law with higher use rates than most other states. Good state-level programs therefore can change road user behavior, but the United States is more like 50 different countries—some states have good programs and some have bad ones.

Federal Safety Legacy

Two legs of the federal highway safety program have remained in place—the National Highway Traffic Safety Administration (NHTSA), which succeeded NHSB, and FHWA. On balance, these programs have been successful.

Although quibbles may arise over specific vehicle safety standards, NHTSA has done reasonably well at setting standards that have improved vehicle safety. Since the late 1970s NHTSA's New Car Assessment Program (NCAP), which crash-tests new vehicles to provide information for consumers, has opened a worldwide marketplace for new car safety—including EuroNCAP, Australian NCAP, Japanese NCAP, and the crashworthiness evaluations by the Insurance Institute for Highway Safety. These programs provoke automobile makers to improve crashworthiness designs quickly, to gain better ratings.

FHWA requirements for new road construction and road restoration have reduced the numbers of hazardous road design features. More can be done with traffic calming countermeasures in urban areas, and local traffic engineering efforts to improve safety

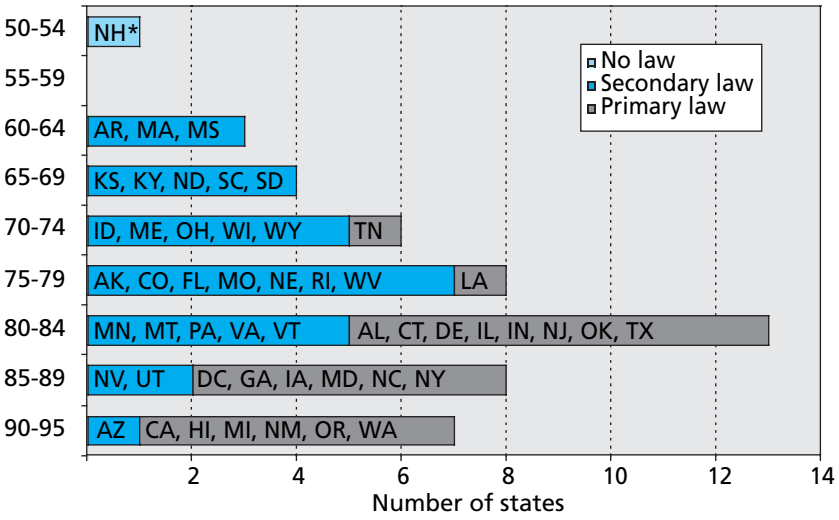

FIGURE 3 Percent belt use reported by states, 2004. (* Estimated rate from 2003.)

often have been insufficient. Nevertheless, the U.S. record on safety designs for roads and new vehicles compares favorably with that of most other motorized countries.

Road User Issues

Belt Use

Despite failing to maintain federal requirements to address road user issues, the United States has realized some successes. In the early 1970s, safety belt use was estimated to be less than 20 percent. The use of shoulder belts—which then were separate from lap belts—was less than 10 percent. Today the estimate of national belt use is about 80 percent, lower than in Canada and Australia but higher than in Europe.

Just as belt use varies from country to country in Europe, state-by-state use also varies. The lowest use is in New Hampshire, the only state without a belt use law, where slightly more than 50 percent of motorists buckle up. Seven states—Arizona, California, Hawaii, Michigan, New Mexico, Oregon, and Washington—reported belt use by more than 90 percent in 2004 (Figure 3). These seven states clearly demonstrate that high rates of belt use are achievable if state leaders are willing to address the issue.

(*Above*) Lumidigm technology, developed to measure diabetics' blood sugar with an infrared scan of the skin, may be adaptable to prevent engine start-up if the driver's blood alcohol content is high. (*Right*) Sobriety checkpoints are effective deterrents to impaired driving but are not widely used.

Alcohol-Impaired Driving

Another big problem is alcohol-impaired driving; as with belt use, the United States has made some progress but still has a long way to go. In 1982 the blood alcohol content (BAC) for 51 percent of fatally injured drivers of passenger vehicles was greater than or equal to 0.08 percent; in 2003 32 percent of fatally injured drivers had BACs of 0.08 percent or higher. Although the reduction is significant, the numbers still are much higher proportionately than those for many other countries that have addressed the problem.

When used widely, sobriety checkpoints can change motorist perceptions about the risk of being apprehended for impaired driving, which in turn deters the behavior. But checkpoints are not widely used—many states do not use checkpoints at all. Without changing the perceptions of potential offenders about the risk of apprehension and without finding other approaches, significant inroads to solving the problem are unlikely.

Technology, however, may provide an answer. For example, BAC can be measured by scanning the skin with infrared light—a measurement more precise than that obtained from a breath sample. The relatively inexpensive technology could be installed on vehicles to lock the ignition if the driver is impaired. In the long term, this may become a necessary measure to reduce the incidence of impaired driving.

Speed

The other big road user issue is speed—and the United States is failing miserably. The brief experiment with a national maximum speed limit of 55 miles per hour (mph) in the 1970s and 1980s demonstrated the savings in lives when travel speeds are reduced.

The experiment with a national 55-mph limit, with a national 65-mph limit, and finally with limits set by the states has provided convincing evidence of the relationships between speed limits, travel speeds, and fatalities on limited-access highways. The consequence of higher speed limits and higher travel speeds has been an increase in deaths, as documented in many studies. Nonetheless, speeds and speed limits continue to creep higher.

Countermeasure Science

Using science to determine which countermeasures work and which do not is straightforward for vehicle designs and for road designs—the physics, engineering, and biomechanics are well understood. Yet this also should apply to countermeasures related to road user behavior. Although different scientific disciplines are involved, definitive conclusions can be reached about what works and what does not.

The problem is that policy makers too often have

chosen to ignore the scientific evidence. For example, many studies have shown that education by itself rarely changes road user behavior, but that well-publicized enforcement of traffic laws does. Nonetheless, many decision makers ignore this science and insist that more education is all that is needed.

Why ignore the evidence that driver education fails to reduce crashes? The overwhelming bulk of serious crashes in the United States involve a driver breaking a traffic law or not paying attention. Beyond telling motorists to obey the laws and pay attention, what other education is necessary?

Contributing factors in fatal crashes typically include some of the following: high speed, alcohol use, nonuse of belts, and red light running. Are more education programs necessary to remind drivers that these behaviors are dangerous? Yet the belief prevails that education is a—or in some cases *the*—countermeasure that will change road user behavior.

Policy Failure?

In his new book, *Traffic Safety*, Leonard Evans says that this history amounts to a "dramatic failure of U.S. safety policy." Evans claims that by 2002 the U.S. safety record—as measured in terms of deaths per mile traveled or per registered vehicle—fell behind the record of many other countries. He claims that this occurred because the United States focused on vehicle safety issues and not on road user behavior.

Evans reports that "prior to the mid-1960s the United States had the safest traffic in the world," but that by 2002, fatality rates per thousand registered vehicles and per billion kilometers of travel in Great Britain, Canada, and Australia were lower than in the United States. But if the United States is considered as 50 separate jurisdictions—which is appropriate, because countermeasures aimed at road user behavior vary from state to state—a different picture emerges.

Death rates per thousand registered vehicles were 0.11 in Great Britain, 0.16 in Canada, and 0.13 in Australia in 2002. In that same year, several New England states had death rates per registered vehicle of 0.11 or lower, and 21 states had rates of 0.16 or lower. For mileage rates, Evans only compares the United States with Great Britain, which had a death rate of 7.0 per billion kilometers traveled in 2002; but again, eight states had mileage rates as low as Great Britain's or lower.

All comparisons of fatal crash rates must be interpreted with caution and with caveats, because of differences in the proportions of urban versus rural mileage, traffic congestion, amount of travel by young drivers, and other characteristics. For example, approximately 90 percent of the population of the United Kingdom lives in urban areas, compared with 77 percent of the U.S. population; proportionately more high-risk rural mileage is traveled in the United States.

Red light running crash recorded by camera connected to traffic signal and sensors. Data include time elapsed since red signal as well as vehicle's speed.

The New England states typically have lower death rates for motor vehicle crashes, but many southern and southwestern states have high rates. Attributing all or even most of these differences to traffic safety policies is a mistake, but clearly some differences result from differences among state laws.

States of Safety

Contrary to Evans's claim, the "dramatic failure" is not in "U.S. safety policy" but the safety policy of some states. Alternatively, a single dramatic failure occurred in 1976 when the U.S. Congress repealed the federal authority to coerce states into adopting highway safety standards. Regardless, many aspects of U.S. safety performance must be assessed at the state level, where road user behavior is regulated.

Some recent work in Europe has examined the road safety programs of Sweden, the United Kingdom, and the Netherlands—the so-called SUN countries—which have the lowest fatality rates in the European Union. The goal was to identify the road safety strategies and programs that contribute to better records. The same should be done in the United States, because several states have fatality rates comparable to those in the SUN countries.

Why do some states have better highway safety programs than others? Why does California retain a motorcycle helmet use law and enact a primary seat belt law with high use rates when so many other states do not? Why does New York State have a good enforcement program aimed at alcohol-impaired driving when so many other states do not? These are important questions.

The United States will continue to make progress on vehicle safety and road safety issues. Progress on road user issues, however—such as belt use, motorcycle helmet use, alcohol-impaired driving, and speed—will depend on political action at the state level. Good programs must aim at these problems in all 50 states, not just in some.

Signals *is a guest editorial column, published on an occasional basis, that offers thought-provoking commentary by organizational leaders, to stimulate discussion on topics related to transportation research, practice, and policy. Reader response is encouraged in the form of letters to the editor.*

Designing Superpave Mixes with Locally Reclaimed Asphalt Pavement

North Central States Jointly Fund Study

REBECCA McDANIEL AND TOMMY NANTUNG

Rebecca McDaniel is Technical Director, North Central Superpave Center, Purdue University, West Lafayette, Indiana, and Tommy Nantung is Section Manager, Research Division, Indiana Department of Transportation, West Lafayette.

States in the North Central region of the United States quickly adopted Superpave® starting in 1993. At that time, however, the Superpave specifications did not provide guidance on the use of reclaimed asphalt pavement (RAP) in hot-mix asphalt (HMA). States therefore were reluctant to specify RAP in HMA pavements, although most previously had recycled RAP into new HMA pavements. As a result, RAP use decreased, despite the environmental and economic benefits.

Problem

The Superpave specifications initially did not address how to incorporate RAP into the mix design, despite reports of good performance with RAP. As Superpave became the predominant means for designing and analyzing asphalt mixtures, guidelines for RAP use were developed under National Cooperative Highway Research Program (NCHRP) Project 9-12, Incorporation of Reclaimed Asphalt Pavement in the Superpave System, completed in March 2000 by the North Central Superpave Center (NCSC) and the Asphalt Institute (*1*–*3*).

The study led to changes in three specifications adopted by the American Association of State Highway and Transportation Officials, allowing the incorporation of RAP into Superpave mixtures. But NCHRP Project 9-12 did not include materials common to the North Central United States. Therefore seven states in the region—Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, and Wisconsin—jointly funded a concurrent regional project at the

NCSC to study typical regional materials and higher RAP contents (*4*).

Solution

The study expanded the NCHRP project research by investigating materials common to the North Central region, as well as the use of a higher RAP content. Researchers compared the mixture properties of different proportions of RAP and virgin materials. Indiana, Michigan, and Missouri each provided one plant-produced mixture with RAP for study, along with the component raw materials—RAP, virgin binder, and virgin aggregate.

Laboratory Tests

The plant-produced mix from each source was recreated in the laboratory with the same RAP content. A comparison of the plant and lab-produced mixes verified that the lab procedures had produced realistic mixtures.

In addition, the raw materials were combined in the lab to produce mixtures with no RAP and with a content of up to 50 percent RAP. Binder and mixture tests were performed following the protocols established in the NCHRP project. The mixtures with different RAP contents were compared for recovered binder stiffness and creep, as well as for mixture stiffness and permanent strain.

In the laboratory, binder properties were determined for

- Unaged, original binders;
- Binders aged in a rolling thin-film oven (RTFO), to simulate the binder aging or hardening that occurs when a mixture is produced in a hot-mix plant; and
- Binders aged by the RTFO and a pressure-aging vessel (PAV), to simulate in-service binder aging.

The properties were measured in terms of critical temperatures—that is, the temperatures at which the binders just met the specification limits. The temperatures also were determined for virgin binders with no RAP; for binders extracted and recovered from RAP, or 100 percent RAP; and for binders recovered from mixes with specific percentages of RAP.

Results

The study results showed that acceptable Superpave mixtures could be designed with as much as 40 percent to 50 percent RAP, although the gradation and aggregate quality may limit the amount of RAP that can be used. The addition of 20 percent to 25 percent RAP significantly stiffened the binder and mixture; with higher RAP contents, the mixture stiffness increased and the permanent strain decreased.

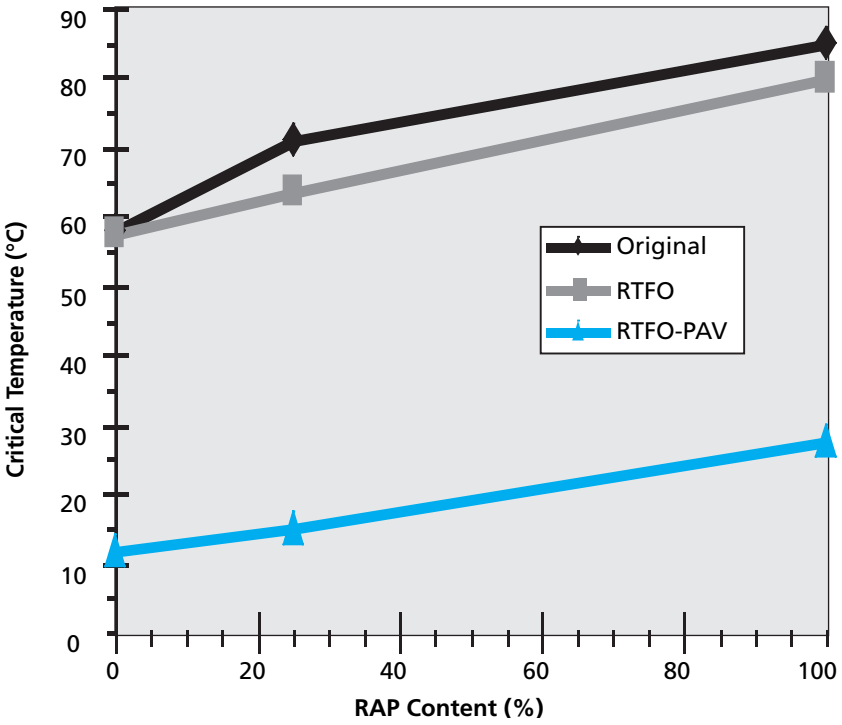

FIGURE 1 Measured binder properties can be predicted with linear blending charts.

The study also confirmed the finding from NCHRP Project 9-12 that blending the hardened RAP binder and the virgin binder could be charted as an approximately linear relation. Figure 1 charts binder properties versus RAP content for the study. The properties of the virgin and recovered RAP binders are those shown for 0 percent and 100 percent RAP, respectively.

Linear blending charts were constructed to predict the properties of binders incorporating various percentages of RAP by connecting the virgin and RAP binder properties with a straight line. The properties of a binder blended with RAP can be estimated by where the connecting line crosses the RAP content.

The data for the actual recovered, blended binder properties for 25 percent RAP in the RTFO and RTFO-PAV conditions fall on the straight lines connecting the RAP and virgin binder properties. This confirms that the linear blending charts are appropriate for predicting blended binder properties.

As expected, however, linear blending did not occur in the unaged condition. In this instance, the RAP binder was tested as if it were unaged—that is, as if it had not gone through the hot-mix plant—although it was aged material. The blend of RAP and

virgin binder also included some aged material. When the RAP binder and the blended binder were tested as if they were unaged, the critical temperatures were somewhat overestimated, as indicated by the deviation from the straight-line relationship.

These results support a tiered approach to RAP use. Low amounts of RAP can be used without adjusting the virgin binder grade, but larger amounts of RAP call for a softer binder to counteract the stiffening effects of the oxidized RAP binder.

The results agreed with the NCHRP 9-12 findings, suggesting that states in the North Central region could implement the results and recommendations of the national study with confidence.

Application

States in the North Central region report that, in general, RAP use is returning to the levels common before Superpave. Indiana and Kansas use as much RAP as before, with typical contents around 15 percent to 25 percent.

Use is increasing in Iowa as contractors adjust to gyratory mix designs for roads with lower traffic volume. RAP content is typically 10 percent to 15 percent, but some mixes have included 26 percent.

Illinois RAP use ranges from 0 to 50 percent, depending on the application. The Nebraska Department of Roads reports that about 90 percent of the mixes used in the state contain between 5 percent and 50 percent RAP.

Wisconsin reuses 100 percent of the material milled up in the state, with RAP contents of up to 35 percent in the lower pavement layers and up to 20 percent in the upper layers. Missouri was not a major recycling state before the implementation of Superpave, but now allows the use of up to 15 percent RAP in mixes for low-volume roadways.

The Indiana material tested in this study has been placed on a Specific Pavement Studies test site of the Long-Term Pavement Performance Program for 12-year monitoring and evaluation.

Benefits

As a sponsoring state, Indiana conducted a cost–benefit analysis of the research project as part of an independent review of the cost-effectiveness of the DOT's research program. The findings are documented in a report posted on the web, which also details the assumptions.[1]

Because the costs of this project were shared with six other states, Indiana DOT contributed only $15,000—one-seventh of the study cost of $105,000. According to the conservative estimate of the cost-effectiveness review, Indiana DOT's savings in materials were nearly $330,000 per year when adding only 5 percent RAP to more than 5 million tons of base and intermediate mixes—although RAP contents of 15 percent to 20 percent are more typical. The review did not assess the environmental benefits of reusing RAP.

The study yielded a conservative benefit-to-cost ratio of 220:1 for Indiana in material cost savings alone; the six other states that shared in funding the study may accrue similar or even higher benefit-to-cost ratios. This regional study allowed states to pool resources and to leverage funding to investigate a common concern effectively and economically.

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4. *Use of Reclaimed Asphalt Pavement (RAP) Under Superpave Specifications*. Joint Transportation Research Program, Purdue University, West Lafayette, Indiana, May 2002. http://rebar.ecn.purdue.edu/JTRP_Completed_Project_Documents/ SPR%5F2143/FinalReport/spr_2143_final.pdf

EDITOR'S NOTE: Appreciation is expressed to Amir Hanna, 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, Keck 488, 500 Fifth Street, NW, Washington, DC 20001 (telephone 202-334-2952, e-mail gjayaprakash@nas.edu).

[1]http://rebar.ecn.purdue.edu/jtrp/Benefit03/2003%20Programs/SPR2143_RAP.pdf

CALENDAR

TRB Meetings

2005

September

11–14 Northeast Community Impact Assessment Workshop*
Trenton, New Jersey
Martine Micozzi

11–14 Environmental Stewardship and Streamlining: Fact or Fiction*
Santa Fe, New Mexico

15–16 Investing in Human Capital: Selection, Training and Work Socialization in the Railroad Industry
Irvine, California

22–23 Workshop on Role of the Driver in Vehicle–Infrastructure Integration and Cooperation: Research Needs
Dulles, Virginia
Richard Cunard

22–24 Third International SIIV Congress: People, Land, Environment, and Transport Infrastructures—Reliability and Development*
Bari, Italy

28 Vehicle Inventory and Use Survey Data User Workshop* (by invitation)
Washington, D.C.
Thomas Palmerlee

October

2–5 SmartRiver21: International Symposium on Global Commerce and Strategies for Inland Navigation and Economic Development*
Pittsburgh, Pennsylvania
Joedy Cambridge

5–7 Road Safety on Four Continents*
Warsaw, Poland

18–19 Aviation Forecast Assumption Workshops (by invitation)
Washington, D.C.

31–Nov 1 First National Conference on Roadway Pavement Preservation
Kansas City, Missouri

November

1–3 Sixth National Conference on Transportation Asset Management: Making Asset Management Work in Your Organization
Kansas City, Missouri

14–16 2005 International Truck and Bus Safety and Security Symposium*
Alexandria, Virginia
Richard Pain

December

8–9 Data Requirements in Transportation Reauthorization Legislation Conference
Washington, D.C.
Thomas Palmerlee

2006

January

22–26 TRB 85th Annual Meeting
Washington, D.C.
Linda Karson

March

28–30 Transportation and Economic Development 2006*
Little Rock, Arkansas

April

9–11 10th National Light Rail Transit Conference: Light Rail, A World of Applications and Opportunities*
St. Louis, Missouri
Peter Shaw

19–21 Visualization in the Changing Transportation World
Denver, Colorado
Richard Pain

June

4–7 North American Travel Monitoring Exposition and Conference
Minneapolis, Minnesota
Thomas Palmerlee

July

TBD Freight Demand Modeling: A Conference on Improving Analysis and Forecasting Tools for Public-Sector Decision Making
Elaine King

TBD Joint Summer Meeting
San Diego, California
Mark Norman

16–19 Third International Conference on Bridge Maintenance, Safety, and Management*
Porto, Portugal

16–20 11th AASHTO/TRB Maintenance Management Conference*
Charleston, South Carolina

25–29 Fifth International Symposium on Highway Capacity*
Yokohama, Japan
Richard Cunard

Additional information on TRB meetings, including calls for abstracts, meeting registration, and hotel reservations, is available at www.TRB.org/calendar. To reach the TRB staff contacts, telephone 202-334-2934, fax 202-334-2003, or e-mail lkarson@nas.edu. Meetings listed without a TRB staff contact have direct links from the TRB calendar web page.

*TRB is cosponsor of the meeting.

Stephen W. Forster

Concrete and Concrete Pavements Consultant

Through diverse professional positions—including petrographer, research geologist, research highway engineer, concrete pavement research team leader, and technical director for pavement research at the Federal Highway Administration (FHWA), Stephen W. Forster has influenced pavement design, construction, evaluation, and performance. He has worked to streamline the highway construction process and to increase pavement life through better materials and construction techniques.

After completing his undergraduate education in geology at Union College in Schenectady, New York, and earning a Ph.D. in geology from Syracuse University, Forster served for the military in Vietnam as a soils analyst, conducting tests on construction materials. The experience inspired his interest in the use of rock aggregates in construction and commenced a 30-year career in the highway industry.

"Always keep your mind open to new ideas. What has been standard practice for years can become obsolete overnight."

After returning from Vietnam in 1972, Forster accepted an assignment with the New York State Geologic Survey, working on a project to evaluate and interpret geological features recorded in satellite images. In 1975, FHWA hired him as a petrographer at what was then called the Fairbank Highway Research Station, in McLean, Virginia. One of his first projects was to develop an image analysis system for automating the microscopic analysis of entrained air void systems in hardened portland cement concrete (PCC).

As Forster settled into his position at FHWA and spent time interacting with engineer coworkers, he quickly found a niche in the area of construction materials. His education and background contributed to understanding the behavior and performance of these materials.

At the time, most research concentrated on the binders used in pavements, but little attention was paid to the aggregate, which was treated as inert filler in the paving material. Engineers tended to categorize aggregates under a few basic rock types, assuming, for example, that all limestone, granite, or sandstone would behave similarly when used as aggregates. Knowing that each rock type contains many physical and chemical differences, Forster provided insight into the reasons that aggregates perform in particular ways when unbound, in asphalt, or in a PCC mix.

"I realized that I had a definite role to fill as a bridge between the engineer's knowledge of mechanical behavior of the materials and my insight into the chemical and physical basis for the behavior of the materials, particularly the aggregate," Forster recalls. "Incorporating this knowledge enhanced our ability to predict the behavior and performance of the materials."

This information was useful for forensic analysis of samples from pavements or bridges to find the cause or causes of an observed performance. Consequently, Forster authored an updated and revised rock and mineral identification manual by D. O. Woolf of the Bureau of Public Roads, the predecessor to FHWA.

The new version, *Rock and Mineral Identification for Engineers*, included a step-by-step process for easy and positive identification of the more common rocks and minerals. Forster also included a section on how various rocks behave as construction aggregate. The manual continues to be a popular reference and course text for FHWA's National Highway Institute.

When Forster became team leader of the Concrete Pavement Research and Development team at FHWA, his responsibilities expanded to include behavior and performance of concrete materials and pavements. His approach to high-performance concrete pavements considered and integrated all aspects of the paving process to ensure the success of the final product.

This led to a series of research studies on materials, mixture and pavement design, and environmental conditions, as well as studies intended to integrate the various aspects of paving projects into guidelines for the user community. The study resulted in a high-performance concrete pavement software package known as HIPERPAV, which covers many aspects of early-age and long-term behavior of concrete pavement.

Forster has received the FHWA Administrator's Award for Superior Achievement. His association with TRB began in 1976 and includes presentations and publications on construction materials and pavement, as well as several citations and awards, culminating in emeritus membership in TRB's Mineral Aggregates Committee. Forster was elected a fellow of the American Concrete Institute, received the American Society of Testing and Materials' Prevost Hubbard Award, and has been named to several honorary association memberships. He also received the Bronze Star for his service in Vietnam.

Forster recalls the excitement of working in a laboratory to advance state-of-the-art knowledge and practice; however, he notes that he equally enjoyed later career assignments, such as helping to set the direction and emphasis of FHWA's research program, and observing his staff advance in knowledge, ability, and results.

"Always keep your mind open to new ideas," he advises those starting a career in the highway industry. "What has been standard practice for years can become obsolete overnight."

Nonseparated HOV Lanes Linked to Car Crashes

Vehicle crash rates may rise when high-occupancy vehicle (HOV) lanes are positioned next to general traffic lanes without a physical barrier between the two, according to a study recently released by the Texas Transportation Institute (TTI), Texas A&M University, College Station. The crash rate on highways with nonseparated HOV lanes has risen by 56 percent, the TTI study found.

The crashes that most often occur without a barrier tend to be sideswipes and fender-benders. Drivers weaving between general traffic lanes and HOV lanes often cause the collisions.

TTI's study compared crash rates on a Dallas, Texas, highway before and after the addition of an HOV lane without a barrier from the general traffic. Dallas traffic planners are considering the placement of barriers between a new HOV lane and general traffic, which would cost up to $8 million.

California, New York, and seven other states are underwriting a $200,000 national study this year on the safety of HOV lanes. The study will produce a guide for transportation planners on the safest designs for HOV lanes.

Rollover Resistance Improves in Ratings

Automobile manufacturers have improved the resistance to rolling over for many brands of sport utility vehicles (SUVs), according to 2005 ratings by the National Highway Traffic Safety Administration (NHTSA). This year, twenty SUV models earned positive ratings of at least four stars out of five, up from just one SUV in 2004.

The highest rated 2005 model was Ford Motor Company's Freestyle 4X4, which has a 13 percent chance of rolling over if involved in a single-vehicle crash. The vehicle is characterized as a "crossover"—a combination of an SUV and a station wagon—with a low center of gravity.

"It is encouraging to see the positive impact our rollover rating program has had on making vehicles more stable, particularly on SUVs," said NHTSA Administrator, Jeffrey W. Runge.

The full results for NHTSA's 2005 SUV Crash Test Summary are available at www.safercar.gov.

Study Points to Flaws in Speeding Policies

The National Forum on Speeding, conducted by the Governors Highway Safety Association (GHSA), in Washington, D.C., has recommended enhancing the coordination of federal, state, local, and private policies and programs to curb speeding. A GHSA survey of safety efforts to control speeding revealed the following:

- Aggressive driving is not commonly defined in state statutes. Ten states have enacted legislation defining aggressive driving, but other states rely on informal definitions, federal definitions, or reckless driving statutes.
- Geographic and demographic data only for crashes that involve speeding are not readily available in statewide formats.
- Most jurisdictions do not use speeding statistics to target highway safety funding, but instead include speeding in other funded activities.
- The public believes that law officers will not cite offenders who are driving 5 to 10 miles per hour above posted speed limits.

According to GHSA, increased enforcement of speeding related laws is difficult because of uncertainty in highway safety funding, the large numbers of officers retiring, and increased attention to homeland security issues. The group recommends the use of automated enforcement systems that combine radar or other technology to detect and record speed limit violations automatically.

The report "Survey of the States: Speeding" is available at www.ghsa.org.

Photo: Mark Finkenstadt

Ralph J. Cicerone, 21st NAS President

Cicerone Takes Helm at National Academy of Sciences

On July 1, Ralph J. Cicerone began a 6-year term as president of the National Academy of Sciences (NAS), succeeding Bruce Alberts, who had completed his second term as president, the maximum allowed by NAS bylaws. From 1998 until 2005, Cicerone was chancellor of the University of California, Irvine, where he held the Daniel G. Aldrich Chair in Earth System Science. He has studied atmospheric chemistry and climate change, helping to identify the role of nitrous oxide and methane in climate change and global warming.

Cicerone has been a member of 20 NAS committees since 1984 and served on the NAS Council from 1996 to 1999. He currently serves on the Committee of the Guide for Recruiting and Advancing Women in Science and Engineering Careers in Academia, and on the advisory board of the Marian Koshland Science Museum.

An electrical engineer by training, Cicerone completed his undergraduate work at the Massachusetts Institute of Technology, and then received a master's and a doctoral degree in electrical engineering from the University of Illinois, Urbana–Champaign.

Former NAS President Bruce Alberts (*left*) and TRB Executive Director Robert E. Skinner, Jr., at a staff reception for Alberts on the 10th floor of the Keck Center of the National Academies, where guests wore replicas of his signature necktie. The building of the center was a major initiative under Alberts' leadership.

"Ralph Cicerone is an energetic, thoughtful, and respected leader," says Alberts. "He will be a strong advocate for the advancement of science and for promoting the many applications of science for improving human welfare around the world."

Alberts, a cell biologist on the faculty of University of California, San Francisco, plans to return to California to continue teaching science. He will represent NAS as cochair of the InterAcademy Council in Amsterdam until 2009.

On July 21, Cicerone testified before a Senate subcommittee on global climate change to summarize the current state of climate science, based on the findings in recent National Academies' reports.

"Carbon dioxide in the atmosphere is now at its highest level in 400,000 years and continues to rise," he stated. "Nearly all climate scientists today believe that much of Earth's current warming has been caused by increases in the amount of greenhouse gases in the atmosphere, mostly from the burning of fossil fuels."

Coast Guard Applies TRB Special Report

Adopting methods proposed in a 2001 report by a National Research Council study committee convened under the auspices of TRB's Marine Board, the U.S. Coast Guard (USCG) is using a new environmental equivalency index to evaluate alternative tanker designs.

TRB Special Report 259, *Environmental Performance of Tanker Designs in Collision and Grounding,* contained a new method for evaluating oil tanker designs according to the potential damage from an accident. The new procedure was intended to ensure protection of the environment and less costly designs. Innovative designs could be compared to the safety performance of the double hull—a type of tanker with second internal sides and bottoms in the hull, acting as reinforcement.

The TRB-proposed methodology adopted by USCG analyzes three features: the amount of structural damage to the ship and the resulting spillage during a potential collision; the environmental consequences of a spill, including physical measures such as the area of oil in the water and extent of shoreline damage; and how ships of similar size but different design would react during the same incident.

USCG has published a notice in the *Federal Register* announcing the availability of the new environmental equivalency evaluation index. The index can be found online at http://www.uscg.mil/hq/g-m/mse/mse2-dh-alt-eval-index.pdf

For further information contact James Person, USCG (telephone 202-267-2988, e-mail jperson@comdt.uscg.mil).

Technical Committees Harbor in Boston

TRB's 30th Annual Summer Conference on Ports, Waterways, Freight, and International Trade convened in July in Boston, Massachusetts. The conference was held in conjunction with the TRB Joint Midyear Meeting, following the TRB Commodity Flow Survey Conference.

Participants shared information on a range of topics, including challenges and opportunities facing the nation's marine transportation system and its users, transportation financing, sustainability, and transportation and global supply chain security. The conference included two technical tours—one of Boston Harbor, focusing on ferry operations and liquefied natural gas transport; and the second of the MassPort Conley Terminal, focusing on container and intermodal operations.

TRB's committees on ports and channels, inland water transportation, ferry transportation, intermodal freight terminal design and operations, international trade and transportation, military transportation, agricultural transportation, critical transportation infrastructure protection, and the marine environmental task force were among those holding midyear meetings in conjunction with the conference.

Select conference presentations are available as e-sessions online at http://gulliver.trb.org/conferences/e-session/2005midyear.htm.

Conference participants enjoyed a 2-hour technical tour of Boston Harbor. (*Left to right:*) Libby Ogard, Freight Transportation Planning and Logistics Committee; Jeannie Beckett, Ports and Channels Committee; Steve Kale, Intermodal Freight Transport Committee; Mary Brooks, International Trade and Transportation Committee

LEADERS AT WORK—The TRB Executive Committee convened for its midyear business meeting in Woods Hole, Massachusetts, in June. The agenda included the review and approval of proposed new conferences and studies; discussion of an updated version of Critical Issues in Transportation; and a policy session featuring four guest speakers on the topic, How Should America Pay for Transportation? (*Left, left to right:*) Executive Director Robert E. Skinner, Jr., and Executive Committee Chair John Njord—presiding at his first meeting since assuming office in May—consider points raised in a discussion. The Technical Activities Council also met in conjunction with the Executive Committee; (*below, left to right:*) members L. David Suits, Marcy S. Schwartz, Leland D. Smithson, Robert C. Johns, and Barry M. Sweedler review program plans for the 85th Annual Meeting, January 22–26, 2006, in Washington, D.C.

COOPERATIVE RESEARCH PROGRAMS NEWS

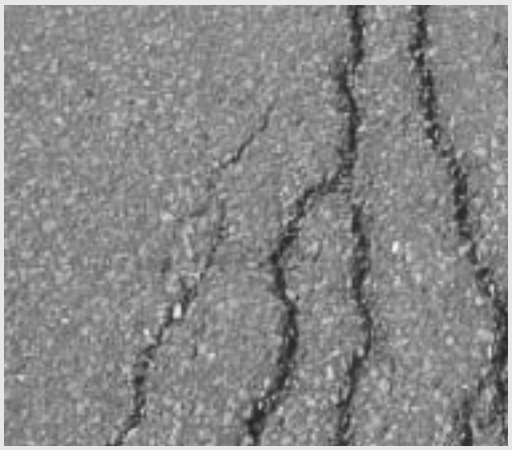
Predicting Reflection Cracking in Hot-Mix Asphalt Overlays

Reflection cracking remains a primary form of distress in hot-mix asphalt (HMA) overlays on flexible and rigid pavements. The penetration of water and debris into cracks accelerates the deterioration of the overlay and the underlying pavement, reducing service life.

Activity influenced by traffic volume, daily and seasonal temperature variations, pavement structure and condition, HMA mixture properties, and the degree of load transfer at joints and cracks induces movement in pavement. This movement near joints or cracks causes strain in the overlay, resulting ultimately in reflection cracking.

Preliminary models have been developed for predicting the extent and severity of reflection cracking in HMA overlays; however, research to evaluate these models is limited. Additional research is necessary to address the issues associated with reflection cracking and to develop newer models for use in mechanistic-empirical procedures for the analysis and design of HMA overlays.

Texas A&M Research Foundation, College Station, received a $500,000, 27-month contract



[National Cooperative Highway Research Program (NCHRP) Project 1-41, FY 2005] to identify or develop mechanistic-based models to predict reflection cracking in HMA overlays of flexible and rigid pavements, and to produce associated computational software for overlay design and analysis. The models will help account for the effects of reflection cracking, improving the analysis and design of HMA overlays of flexible and rigid pavements.

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

Assessing Performance in Snow and Ice Control

Monitoring performance in snow and ice control operations is critical because of the limited availability of resources and the increased practice of outsourcing to service providers. Diverse performance measures have been used in the United States and abroad with varying degrees of success.

Widely accepted measures applicable to many roadway classifications and storm characteristics have yet to be developed. Research is necessary therefore to evaluate and identify appropriate measures of performance that will apply to all areas and circumstances.

The Center for Transportation Research and Education, Iowa State University, has been awarded a $150,000, 18-month contract (NCHRP Project 6-17, FY 2005) to recommend methods and measures for assessing performance in snow and ice control operations.

The research will encompass all roadway classifications and storm characteristics to ensure that measures apply to a variety of areas. The goal is to help highway agencies make appropriate adjustments to improve performance and reduce the costs of resources for snow and ice control operations.

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

Globalisation, Policy and Shipping: Fordism, Post-Fordism and the European Union Maritime Sector

Evangelia Selkou and Michael Roe. Edward Elgar, Massachusetts, 2004; 256 pp.; $100 hardcover; 1-84376-934-4.

The central theme of this book concerns the international shipping industry and its development in the context of increasing globalization and supranationalism. In the current maritime sector a vessel's owners, cargo, registration, and crew might each originate from many different countries. The authors question the role, authority, and relevance of national shipping policies in the context of growing supranational bodies such as the European Union (EU). A detailed case study of EU shipping policy and an analysis of the roles of different member states illustrate this point. Models of shipping development and activity are also included, providing a basic understanding of the industry at the turn of the millennium in relation to Fordism—an economic process based on Henry Ford's production line.

Terrorism: Reducing Vulnerabilities and Improving Responses—U.S.–Russian Workshop Proceedings

National Research Council, Washington, D.C., 2004; 254 pp.; $44 paperback; 0-309-08971-9.

In February 2002, the National Academies and the Russian Academy of Sciences established parallel committees of members to develop a program of cooperation to counter terrorism. American and Russian specialists gave presentations on cyber-, urban, biological, and radiological terrorism and discussed the hostage situation at Dubrovko in Moscow and the damage inflicted in New York during the September 11, 2001, terrorist attacks.

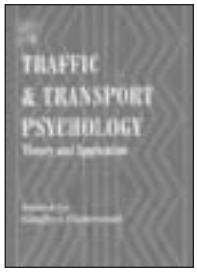
This volume contains the presentations and discussions in their entirety, providing a basis for developing an agenda for sustained cooperation that should serve counterterrorism experts and government officials. Terrorism's impact on transportation is addressed, most notably in a chapter on the cyberterrorism threat to computer systems that control the intermodal shipment of cargo.

Improving Access to Public Transport

European Conference of Ministers of Transport, France, 2004; 82 pp.; $29; 92-821-1323-X.

Drawing on the work of a joint task force of the European Conference of Ministers of Transport and the International Association of Public Transport, this report examines how cooperation between public transport service providers and local authorities can improve accessibility to public transport for the disabled. Included are case studies from Gothenburg, Sweden; Grenoble, France; Prague, Czech Republic; and Liverpool, United Kingdom.

Traffic and Transport Psychology: Theory and Application



Edited by Talib Rothengatter and Raphael Denis Huguenin. Elsevier Science, Ltd., Netherlands, 2004; 492 pp.; $110; 0-08-043925-X.

This volume presents an overview of the trends in traffic and transportation psychology, including basic approaches and integrated models; driver cognition, performance, and impairment; driver safety, enforcement, and training and rehabilitation programs for traffic offenders; and mobility and environment protection concerns.

The books in this section are not TRB publications. To order, contact the publisher listed.

TRB PUBLICATIONS

Transportation Finance: Meeting the Funding Challenge Today, Shaping Policies for Tomorrow
Conference Proceedings 33

These proceedings summarize the Third National Conference on Transportation Finance, held October 2002 in Chicago, Illinois. The conference examined the challenges of financing the nation's transportation systems and provided a forum to exchange perspectives on what has and has not worked, with special focus on possible new approaches to funding. The report includes committee findings and recommendations developed from the information pre-

TRB PUBLICATIONS *(continued)*

sented and the discussions held at the conference.

2005; 97 pp.; TRB affiliates, $27.75; nonaffiliates, $37. Subscriber category: planning and administration (IA).

Maintenance Management and Services
Transportation Research Record 1877
Sorted into three parts—management, work zones, and winter maintenance—papers include a performance evaluation of pavement markings under dry, wet, and rainy conditions in the field; an evaluation of automated work zone information systems; an examination of injury severity and total harm in truck-involved work zone crashes; and a pilot study of speed–recovery duration as a measure of winter maintenance performance.

2004; 143 pp.; TRB affiliates, $36; nonaffiliates, $48. Subscriber category: maintenance (IIIC).

Pedestrians and Bicycles; Developing Countries
Transportation Research Record 1878
This three-part volume presents the initial findings on using low-cost infrared detectors to monitor movement of pedestrians; methodology to assess design features for pedestrian and bicyclist crossings at signalized intersections; characteristics of emerging road and trail users and their safety; and a stated survey assessment of the trade-offs between time, cost, and uncertainty by commuters in Hyderabad, India.

2004; 170 pp.; TRB affiliates, $37.50; nonaffiliates, $50. Subscriber category: safety and human performance (IVB).

Information Systems and Technology
Transportation Research Record 1879
This volume covers research into the online recursive algorithm for short-term traffic prediction, the development of the TrafficXML prototype for traffic simulation, a hybrid model-based and memory-based traffic prediction system, and genetically designed models for accurate imputation of missing traffic counts.

2004; 119 pp.; TRB affiliates, $33; nonaffiliates, $44. Subscriber category: planning and administration (IA).

Energy and Environmental Concerns 2004
Transportation Research Record 1880
A nationwide survey on the characteristics of heavy-duty truck idling, federal requirements and state implementation considerations of transportation control measures, engine and weight characteristics of heavy-duty diesel vehicles and improved on-road mobile source emissions inventories, an eight-step process for assessing indirect and cumulative impacts of transportation projects, and the effectiveness of locomotive horns at operating speeds.

2004; 180 pp.; TRB affiliates, $39; nonaffiliates, $52. Subscriber category: energy and environment (IB).

Geometric Design and the Effects on Traffic Operations 2004
Transportation Research Record 1881
Research covers the development of the displaced right-turn intersection, the influence of speed on Swiss design standards, a fuzzy model for the safety evaluation of new and old roads, and the lengths of double or dual left-turn lanes.

2004; 78 pp.; TRB affiliates, $30.75; nonaffiliates, $41. Subscriber category: highway and facility design (IIA).

Transportation Network Modeling 2004
Transportation Research Record 1882
Approximate procedures for the probabilistic traveling salesperson problem, methodology for determining vulnerable links in a transportation network, a simulation model for real-time emergency vehicle dispatching and routing, and dynamic routing decisions for commercial vehicle operations in real-time traffic conditions are among the transportation network modeling research reported in this volume.

2004; 209 pp.; TRB affiliates, $40.50; nonaffiliates, $54. Subscriber category: planning and administration (IA).

Traffic Flow Theory and Highway Capacity and Quality of Service 2004
Transportation Research Record 1883
This two-part volume of papers on traffic flow theory and on highway capacity and quality of service delves into such topics as the structural properties of Helbing's traffic flow model, the relationships between occupancy and density in reflecting average vehicle lengths, freeway users' perceptions of quality of service, and variations in queue discharge patterns and their implications in the analysis of signalized intersections.

2004; 202 pp.; TRB affiliates, $40.50; nonaffiliates, $54. Subscriber category: highway operations, capacity, and traffic control (IVA).

Transit: Bus, Rural Public Transportation, and Paratransit
Transportation Research Record 1884
The strategic implementation of customer-driven performance measures in Chicago, the impact of traffic congestion on bus travel time in northern New Jersey, state strategies for implementation of computer-

TRB PUBLICATIONS *(continued)*

assisted scheduling and dispatching systems for paratransit, and the analysis of delays caused by midblock jeepney stops are examined in this two-part volume on bus transit systems and paratransit and on rural public and intercity bus transportation.

2004; 82 pp.; TRB affiliates, $30.75; nonaffiliates, $41. Subscriber category: public transit (VI).

Transportation Management and Public Policy 2004
Transportation Research Record 1885
The volume presents the history of the highway trust fund, a mobile navigation guide for the visually disabled, best practices in consultant management at state departments of transportation, methodology for multicriteria decision making in highway asset management, and research implementation and information dissemination. The 2004 Charley V. Wootan Award-winning policy and organization paper, "Strategic Management at the Pennsylvania Department of Transportation: A Results-Driven Approach," also appears in this volume.

2004; 130 pp.; TRB affiliates, $36; nonaffiliates, $48. Subscriber category: planning and administration (IA).

Thermally Sprayed Metal Coatings to Protect Steel Pilings: Final Report and Guide
NCHRP Report 528
This report consists of two documents: a report on the research results of a project investigating thermally sprayed metal coatings, and a guide for the application of thermally sprayed metal coatings to protect steel pilings from corrosion. Professionals in the public and private sectors responsible for designing, installing, inspecting, and maintaining steel pilings will find this report to be of immediate interest. The guide provides information for a user to select, specify, and apply a metal coating for steel piles in freshwater, brackish, or seawater environments.

2004; 161 pp.; TRB affiliates, $18.75; nonaffiliates, $25. Subscriber categories: bridges, other structures, and hydraulics and hydrology (IIC); soils, geology, and foundations (IIIA); materials and construction (IIIB); maintenance (IIIC).

Guideline and Recommended Standard for Geofoam Applications in Highway Embankments
NCHRP Report 529
The guideline and recommended standard in this report will assist highway agencies in designing and constructing highway embankments using expandable polystyrene blocks.

2004; 58 pp.; TRB affiliates, $15; TRB nonaffiliates, $20. Subscriber categories: highway and facility design (IIA); pavement design, management, and performance (IIB); bridges, other structures, and hydraulics and hydrology (IIC); soils, geology, and foundations (IIIA); materials and construction (IIIB).

Evaluation of Indirect Tensile Test (IDT) Procedures for Low-Temperature Performance of Hot-Mix Asphalt
NCHRP Report 530
The use of the indirect tensile creep and strength test procedures, included in the American Association of State Highway and Transportation Officials' Standard Method of Test in mixture and structural design methods for hot-mix asphalt, is evaluated in this report.

2004; 52 pp.; TRB affiliates, $15; TRB nonaffiliates, $20. Subscriber category: materials and construction (IIIB).

Relationship of Air Voids, Lift Thickness, and Permeability in Hot-Mix Asphalt Pavements
NCHRP Report 531
Recommended guidelines are presented for hot-mix asphalt pavement construction to achieve satisfactory levels of in-place air voids and permeability.

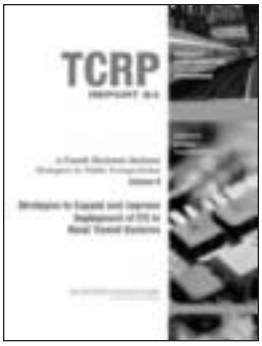
2004; 38 pp.; TRB affiliates, $14.25; TRB nonaffiliates, $19. Subscriber category: materials and construction (IIIB).

Effective Methods for Environmental Justice Assessment
NCHRP Report 532
This guidebook is designed to enhance understanding and to facilitate consideration and incorporation of environmental justice into all elements of the transportation planning process, from long-range transportation systems planning through priority programming, project development, and policy decisions. It offers practitioners an analytical framework to facilitate comprehensive assessments of a proposed transportation project's impacts on affected populations and communities.

2004; 366 pp.; TRB affiliates, $25.50; nonaffiliates, $34. Subscriber categories: planning and administration (IA); energy and environment (IB); transportation law (IC).

Automated Pavement Distress Collection Techniques
NCHRP Synthesis 334
This synthesis documents highway community practice, research, and development of techniques typically used in network-level pavement management

TRB PUBLICATIONS *(continued)*



for the automated collection and processing of pavement condition data. The study covered all phases of automated data collection and processing for pavement surface distress, pavement ride quality, rut-depth measurements, and joint-faulting measurements; technologies employed, contracting issues, quality assurance, costs and benefits of automated techniques, monitoring frequencies and sampling protocols in use, degree of adoption of national standards for data collection; and contrasts between the state of the art and the state of the practice.

2004; 84 pp.; TRB affiliates, $12.75; nonaffiliates, $17. Subscriber categories: pavement design, management, and performance (IIB); maintenance (IIIC).

Pavement Management Applications Using Geographic Information Systems
NCHRP Synthesis 335
The practice and knowledge of pavement management systems (PMS) that use geographic information systems (GIS) and other spatial technologies is examined in this synthesis, which also includes findings on how the technologies have been combined to enhance highway management. The principal issues of PMS data collection, integration, management, and dissemination are reviewed, along with applications of spatial technologies for map generation and PMS spatial analysis. Also covered are implementation-related issues, including approaches for integrating PMS and GIS and the different tools to support pavement management decisions.

2004; 65 pp.; TRB affiliates, $12; nonaffiliates, $16. Subscriber categories: pavement design, management, and performance (IIB); maintenance (IIIC).

Road Safety Audits
NCHRP Synthesis 336
Tracing the state of the practice in U.S. states, Canadian provinces, and other countries, this synthesis promotes road safety audits and road safety audit review applications to help reduce roadway crashes and fatalities.

2004; 127 pp.; TRB affiliates, $15; nonaffiliates, $20. Subscriber category: safety and human performance (IVB).

Strategies to Expand and Improve Deployment of ITS in Rural Transit Systems
TCRP Report 84, Volume 6
Choosing and sequencing investments in technologies, processes, and people to reduce costs and increase productivity present challenges to the transit manager, who must weigh the costs, benefits, and risks of changing the ways services are delivered. To assist in meeting such challenges, this report documents principles, techniques, and strategies that are used in electronic business for public transportation, and it provides information on statewide intelligent transportation systems (ITS) plans that include provisions for rural ITS initiatives.

2005; 19 pp.; TRB affiliates $13.50; nonaffiliates $18. Subscriber category: public transit (VI).

From Handshake to Compact: Guidance to Foster Collaborative, Multimodal Decision Making
TCRP Report 106 or NCHRP Report 536
This report provides examples of collaboration in multimodal decision making. The report is designed to provide practical advice to transportation professionals interested in identifying, implementing, and sustaining collaborative activities. Included with the report is a CD-ROM that provides a detailed set of case examples and describes the research methodology.

2005; 67 pp.; TRB affiliates, $15; nonaffiliates, $20. Subscriber categories: planning and administration (IA); public transit (VI).

Performance-Based Measures in Transit Fund Allocation
TCRP Synthesis 56
This synthesis explores current perspectives, practices, and experiences in the use of performance measures for the allocation of financial assistance to local transit systems. It summarizes the experiences of a variety of transit agencies while capturing key perspectives of transit and transportation officials on the relationship between system performance and funding decisions.

2004; 74 pp.; TRB affiliates, $12; nonaffiliates, $16. Subscriber category: public transit (VI).

Computer-Aided Scheduling and Dispatch in Demand-Responsive Transit Services
TCRP Synthesis 57
The current practice, successful implementation, and impediments to computer-aided scheduling and dispatch systems for demand-responsive transit service are explored in this synthesis, which also identifies past and continuing research on the topic.

2004; 79 pp.; TRB affiliates, $12.75; nonaffiliates, $17. Subscriber category: public transit (VI).

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FEATURES are timely articles of interest to transportation professionals, including administrators, planners, researchers, and practitioners in government, academia, and industry. Articles are encouraged on innovations and state-of-the-art practices pertaining to transportation research and development in all modes (highways and bridges, public transit, aviation, rail, and others, such as pipelines, bicycles, pedestrians, etc.) and in all subject areas (planning and administration, design, materials and construction, facility maintenance, traffic control, safety, geology, law, environmental concerns, energy, etc.). Manuscripts should be no longer than 3,000 to 4,000 words (12 to 16 double-spaced, typed pages). Authors should also provide appropriate and professionally drawn line drawings, charts, or tables, and glossy, black-and-white, high-quality photographs with corresponding captions. Prospective authors are encouraged to submit a summary or outline of a proposed article for preliminary review.

RESEARCH PAYS OFF highlights research projects, studies, demonstrations, and improved methods or processes that provide innovative, cost-effective solutions to important transportation-related problems in all modes, whether they pertain to improved transport of people and goods or provision of better facilities and equipment that permits such transport. Articles should describe cases in which the application of project findings has resulted in benefits to transportation agencies or to the public, or in which substantial benefits are expected. Articles (approximately 750 to 1,000 words) should delineate the problem, research, and benefits, and be accompanied by one or two illustrations that may help readers better understand the article.

NEWS BRIEFS are short (100- to 750-word) items of interest and usually are not attributed to an author. They may be either text or photographic or a combination of both. Line drawings, charts, or tables may be used where appropriate. Articles may be related to construction, administration, planning, design, operations, maintenance, research, legal matters, or applications of special interest. Articles involving brand names or names of manufacturers may be determined to be inappropriate; however, no endorsement by TRB is implied when such information is used. Foreign news articles should describe projects or methods that have universal instead of local application.

POINT OF VIEW is an occasional series of authored opinions on current transportation issues. Articles (1,000 to 2,000 words) may be submitted with appropriate, high-quality illustrations, and are subject to review and editing. Readers are also invited to submit comments on published points of view.

CALENDAR covers (*a*) TRB-sponsored conferences, workshops, and symposia, and (*b*) functions sponsored by other agencies of interest to readers. Notices of meetings should be submitted at least 4 to 6 months before the event.

BOOKSHELF announces publications in the transportation field. Abstracts (100 to 200 words) should include title, author, publisher, address at which publication may be obtained, number of pages, price, and ISBN. Publishers are invited to submit copies of new publications for announcement.

LETTERS provide readers with the opportunity to comment on the information and views expressed in published articles, TRB activities, or transportation matters in general. All letters must be signed and contain constructive comments. Letters may be edited for style and space considerations.

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- All manuscripts should be supplied 12-point type, double-spaced, in Microsoft Word 6.0 or WordPerfect 6.1 or higher versions, on a diskette or as an e-mail attachment.
- Submit original artwork if possible. Glossy, high-quality black-and-white photographs, color photographs, and slides are acceptable. Digital continuous-tone images must be submitted as TIFF or JPEG files and must be at least 3 in. by 5 in. with a resolution of 300 dpi or greater. A caption should be supplied for each graphic element.
- Use the units of measurement from the research discribed and provide conversions in parentheses, as appropriate. The International System of Units (SI), the updated version of the metric system, is preferred. In the text, the SI units should be followed, when appropriate, by the U.S. customary equivalent units in parentheses. In figures and tables, the base unit conversions should be provided in a footnote.

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