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DETAILS

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The Transportation Research Board's* 2006 Annual Report *is included in this issue as a special insert between pages 22 and 23.

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COVER: Can a variety of innovative user fees help the United States fund highway and transit systems adequately and 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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COMING NEXT ISSUE

PHOTO: FHWA

Highway driving simulator at Turner–Fairbank Highway Research Center in McLean, Virginia, is used to assess roadway designs and human factors.

The January–February 2007 *TR News* covers a variety of topics, including the integration of aesthetics into state transportation projects—particularly in the treatment of landscape elements; the rise of ethanol as a motor vehicle fuel; applying visualization technologies to improve decision making in project development; a demonstration of corridorwide assessments of landslide hazards; and the safe transport of spent nuclear fuel in the United States. Also featured is the annual summary of findings from the 2006 field visits to transportation agencies and universities in every state by TRB senior program officers, who identify trends, needs, and practical solutions and innovations.

The Future of Highway and Transit Finance

Steering Clear of the Breakdown Lane

JONATHAN UPCHURCH

The author has been a National Park Transportation Scholar sponsored by the National Park Foundation at Mesa Verde National Park, Colorado, and at Grand Canyon National Park, Arizona. From 2002 to 2004 he was a Congressional Fellow and a Professional Staff Member with the House Transportation and Infrastructure Committee. He is a past member of the TRB Technical Activities Council.

In the past year, a convergence of events has brought transportation finance to the forefront of the critical issues facing the transportation community in the United States. The Executive Committee of the Transportation Research Board confirmed this by listing finance as one of nine *Critical Issues in Transportation* in January 2006.[1]

The protracted struggle to reauthorize federal highway and transit programs produced the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) in the summer of 2005. But the multiyear effort to pass the legislation often was stymied by a revenue stream that was—until the end—unable to stretch to meet the needs for political equity among the states.

The reauthorization therefore had to tap into additional sources to generate funds to bolster revenues. Those sources included user fees for gasohol, measures to reduce user fee evasion, and a reduction in balances in the Highway Trust Fund.

Realities and Ideals

Despite these additions to the revenue stream, forecasts indicate that the Highway Trust Fund will be broke by 2009 or 2010 and therefore will be unable to maintain levels of funding in the next reauthorization cycle. "Broke" means that the monies available in the Trust Fund will be less than the amounts authorized by law for spending on highway and transit programs. If this occurs, expenditures will be limited to the amounts available in the Trust Fund, regardless of the amounts authorized by law.

With costs for construction continually increasing and with transportation needs that exceed the levels of investment in SAFETEA-LU, the prospect of an insolvent Trust Fund has created great concern about the future of highway and transit finance. To address this issue, Congress established two commissions to make recommendations on future financing.

The nation's transportation needs are extensive, as documented in the U.S. Department of Transportation's (DOT's) 2004 report on the conditions and performance of U.S. highways, bridges, and transit systems. In the report, U.S. DOT estimates that all levels of government should be spending a combined $143 billion per year to maintain and improve transportation systems. The actual spending in 2000, however, was only $81 billion—a $62 billion annual shortfall in investment.

An ideal transportation finance system would raise adequate revenues, be funded by users, and be politically acceptable. It would be easy to understand, inexpensive to administer, and equitable in a variety of ways; it would encourage efficient use of the system. The challenge is to formulate a system

[1] http://onlinepubs.trb.org/onlinepubs/general/CriticalIssues06.pdf.

Federal revenues from gasoline taxes are being eroded by the advent of vehicles with better gas mileage or powered by alternative fuels.

that holds all of these characteristics and that will serve the United States well in the decades ahead.

Finance System Sources

Before exploring future options, a review of the current U.S. system of finance—at the federal, state, and local levels—is useful. The sources of revenue are many. Each source, however, varies in importance from state to state and from the state level to the federal level.

Gas Tax

The principal user fee is the so-called gas tax—the largest source of revenue for highways at the federal and the state levels. More than one-third of total U.S. revenue available for highway spending comes from federal and state gas taxes, as does almost 51 percent of the revenue deposited to the federal Highway Trust Fund. The gas tax or fuel tax properly should be called user fees because the use of the transportation system is linked directly to payments by users.

The federal gas tax is 18.4 cents per gallon. The average state tax on gasoline is a little more than 20 cents per gallon.

In 1919 Oregon became the first state to enact a gas tax, and within 10 years all states had passed the tax. The states were the principal financiers of early highway construction.

The federal gas tax first was levied in 1932 as a source of general revenue—that is, the revenues were not bound explicitly for highway spending. Not until 1956 were the federal gas tax revenues dedicated for transportation. The Federal-Aid Highway Act and the Highway Revenue Act of 1956 established the Highway Trust Fund.

The federal gas tax rose from 1 cent per gallon in 1932 to 4 cents per gallon in 1960. The gas tax did not increase again until 1984, to 9 cents per gallon. One penny of the five-cent increase was placed in the Mass Transit Account of the Highway Trust Fund for capital projects. Of today's 18.4 cents-per-gallon gas tax, 15.44 cents is directed to the Highway Account and 2.86 cents is directed to the Mass Transit Account.

A Seattle, Washington, gas station circa 1931. After the neighboring state of Oregon levied the first state gas tax in 1919, every U.S. state and the District of Columbia followed suit within the next few years.

PHOTO: MUSEUM OF HISTORY AND INDUSTRY, SEATTLE

Federal User Fees

Although the gas tax is the largest contributor, the Highway Trust Fund has three other sources of revenue. Two come from taxes on other types of fuel—approximately 24 percent of Trust Fund revenues comes from a user fee on diesel fuel, and 16 percent comes from a user fee on gasohol. The third source comes from fees on tires, trucks, and other user charges, producing 9 percent of the Highway Trust Fund revenue.

The federal Trust Fund generates large amounts of revenue, distributes substantial funding to the states, and often is viewed as the most important source of funding for highways. Although the federal government is perceived as the largest source of highway revenue, it is not—approximately 21 percent of all revenue for highways comes from the federal government, 52 percent comes from state governments, and 27 percent comes from local governments.

State Mixes

State revenues come from a greater variety of sources than do the federal revenues. States derive revenues from tolls and from investment income—sources not in the federal mix—as well as from their own fuel taxes. In addition, states make more extensive use of general fund appropriations and of other taxes and fees than does the federal government. States also rely on bond issue proceeds for financing.

The mix of revenue sources varies considerably from state to state. Although the state gas tax is the largest source of revenue in many states, some states rely more heavily on other sources. Five states received more funds from bond proceeds than from the state gas tax in 2001, three states generated more money from a vehicle tax, and one state—Delaware—received more money from tolls than from any other source.

The gas tax rate varies tremendously among the 50 states. Georgia's tax is the lowest at 7.5 cents per gallon, and Rhode Island's is the highest, at 30 cents per gallon.

Local Contributions

User fees are the predominant source of federal and state revenue but are minor contributors at the local government level. General fund appropriations make up almost one-half, and property taxes one-sixth, of local-level revenues. Bond issue proceeds, investment income, and other taxes and fees each exceed the user fees collected by local governments. Other sources include locally enacted retail sales taxes, tolls, property taxes, benefit assessment districts, and general fund revenues.

Transit Financing

Federal grants for transit capital improvements are provided from the Mass Transit Account of the Highway Trust Fund. At the state level, many states spend some of their gas tax receipts on transit, but policies vary greatly. Ten states spend no gas tax receipts on mass transit; 19 states spend less than 1 percent on transit; and 4 states spend between 15 and 25 percent of their gas tax receipts on mass transit. Transit also receives local revenue from sales taxes, property taxes, general revenues, advertising, and fares.

Recent Revenue Additions

To increase the revenue for the federal Highway Trust Fund, several suggestions were offered during the reauthorization debate. A few significant measures were adopted in the legislation.

◆ Until recently, 2.5 cents of the per-gallon gasohol user fee was diverted to the General Fund. This source of revenue—an estimated $800 million per year—was captured for the Highway Trust Fund by the Foreign Sales Corporation–Extraterritorial Income Tax legislation enacted in October 2004.

◆ In addition, gasohol had been taxed at a rate that was 5.2 cents per gallon less than gasoline. The October 2004 law also included a provision to reimburse the Highway Trust Fund for those lost revenues, with monies from the General Fund. This added approximately $1.5 billion per year in revenue.

◆ The October 2004 legislation changed the methods for collecting fuel taxes, in an attempt to reduce fuel tax evasion—that is, the nonpayment of fuel taxes. This added an estimated $500 million to $600 million of revenue per year.

◆ On September 30, 2003, the combined balance in the highway and transit accounts of the Highway Trust Fund was $17.8 billion. Many analysts believed this balance was higher than necessary to meet obligations. The authorization levels and obligation limits in SAFETEA-LU, however, will draw the balance down. On September 30, 2005, the balance was approximately $12.8 billion. Current estimates project that the Highway Trust Fund balance will approach zero in 2009 or 2010. In effect, an unused balance is being made available for funding highways and transit.

◆ Before the Transportation Equity Act for the 21st Century, enacted in 1998, the Highway Trust Fund had earned interest on its balance. The Highway Trust Fund is now the only federal government trust fund that does not receive credit for interest earned. SAFETEA-LU did not incorporate proposals to remedy this and add earned interest as revenue to the fund. With the balance in the Highway Trust Fund falling to near zero by 2009, the interest generated would be small.

In addition, SAFETEA-LU increased the opportunities for alternative financing. The legislation allows private-activity bonds to be issued for selected highway facilities and surface freight transfer facilities. These bonds are tax-exempt and are issued by—

PHOTO: TONY SAUNDERS

The Highway Trust Fund supports transit capital improvements; New York City's Staten Island Ferry has received funds to rehabilitate terminals and purchase new vessels.

With the increased availability of fuel-efficient hybrid technology (*above*), alternative and equitable means of taxing roadway users may have to be considered—if only to prepare for the time that the current revenue system begins to fail.

or on behalf of—a local or state government to provide special financing for qualified projects. Most often the financing is for projects of a private user, and the government generally does not pledge its credit. Up to $15 billion in private-activity bonds may be issued. In October 2006, Texas became the first state to receive federal approval to use private activity bonds under SAFETEA-LU.

The reauthorization also improved and expanded the eligibility under the Transportation Infrastructure Finance and Innovation Act (TIFIA). The state infrastructure bank provisions in TIFIA, for example, were extended to all states.

Threats to the Fuel Tax

The fuel tax—that is, the combined user fees for gasoline, diesel, and gasohol—has many advantages as a revenue source for highways. Administration is easy and inexpensive, and evasion is infrequent. The fee is collected in small amounts, spread out over time, and therefore is less burdensome to the public.

There is no clamor to abolish or reduce the tax, which is relatively equitable—the amount of tax paid is generally in proportion to the mileage driven on the highway system, to the weight of the vehicle, and thus, to the damage imposed on the roadways. The fuel tax clearly links the use of roads to the financing of road construction and maintenance.

For all of these reasons, the fuel tax has been a principal source of revenue for many decades. Yet despite these many advantages, the fuel tax has shortcomings that are potential threats to revenues and to the Trust Fund:

◆ Inflation has ravaged fuel tax revenue in the past. During the 1970s, inflation reduced the buying power of fuel tax revenue by approximately 50 percent. A possible remedy is to index the fuel tax to inflation.

◆ Continuing improvements in vehicle fuel economy will reduce the consumption of gasoline, diesel fuel, and gasohol. For example, vehicle manufacturers recently have made significant improvements in the fuel efficiency of sport utility vehicles.

◆ The growing use of alternative fuels, hybrid vehicles, and electric vehicles also will reduce the consumption of traditional fuels. The magnitude of this effect and how quickly it will become significant, however, is uncertain.

◆ Electricity, natural gas, and hydrogen are gaining use as motive energy sources. These fuels are distributed outside of the established fuel distribution and taxation channels, which poses a challenge for revenue collection.

◆ The wide variation in fuel efficiency among similar-sized vehicles raises questions about the equity of fuel taxes.

◆ Over the long term, the supply of traditional fuel sources will decline, influencing a trend away from gasoline and diesel and toward other sources of energy.

Countdown to Failure?

Fuel taxes account for 91 percent of the federal Highway Trust Fund revenue. The potential threats to fuel tax revenues suggest that the effectiveness of the current revenue-producing system will degrade with time. How long will the current revenue system continue to work, and when will it begin to fail?

TRB Special Report 285, *The Fuel Tax and Alternatives for Transportation Funding*, concludes that fuel taxes can remain the primary funding source for the nation's highways for at least another decade. Other opinions are mixed, and the potential impacts are unclear. The penetration of new technologies into the marketplace is difficult to predict. A study for Oregon DOT projected that if all light vehicles sold in 2017 have a high miles-per-gallon efficiency, the state gas tax revenue will fall by 27 percent.

The consensus is to follow the issue carefully and to prepare for the time that the current revenue system begins to fail.

Commissions at Work

In the reauthorization debate, Congress recognized the need to address the issue of highway and transit finance and established two commissions to make recommendations on financing:

◆ The **National Surface Transportation Policy and Revenue Study Commission** will study long-

term alternatives to replace or supplement the fuel tax and fund the needs of the surface transportation system for at least 30 years. The commission, which held its first meeting on May 26, 2006, will recommend actions to develop alternative revenue sources for the Highway Trust Fund. The final report is due by July 1, 2007.[2] Authorized in Section 1909 of SAFETEA-LU, the commission originated in the House version of the bill.

◆ The **National Surface Transportation Infrastructure Financing Commission** was authorized to study the adequacy of Highway Trust Fund revenues for future highway and transit needs. The commission will consider alternative approaches to generating revenues for the fund and will recommend policies to achieve revenues to meet future needs. The report is due within two years after the commission's first meeting—but as of mid-October 2006, the commission had not been appointed. SAFETEA-LU Section 11142 authorized the commission, originally proposed in the Senate version of the bill.

Options to Consider

For the purposes of dialogue and debate—and for the discussions of the congressionally designated commissions—all options for additional revenue sources should be under consideration. The dialogue and debate will determine which sources best meet the characteristics of an ideal transportation finance system, including political acceptability.

At the Federal Level

Potential additional revenue sources at the federal level include the following:

◆ An alternative means of taxing highly fuel-efficient hybrid vehicles—for example, through an annual tax or a mileage-based tax—could be developed.

◆ Alternative fuels could be taxed at a per-mile-traveled rate equivalent to that of the current gas tax. Although federal taxes currently apply to liquefied petroleum gas, liquefied natural gas, and compressed natural gas, no taxes apply to hydrogen or electricity.

◆ Because tracking and taxing electricity for road use is difficult, a revenue system based on vehicle-miles traveled (VMT) is a more practical solution for electric vehicles.

◆ With the rapid advance of hydrogen fuel cell technology, a significant percentage of new cars may run on fuel cells within 10 years. A new fueling infrastructure for hydrogen will be necessary. Legislation would need to be passed to tax hydrogen as a fuel, and the new fueling infrastructure would require a mechanism for taxation.

◆ Index motor fuel taxes to inflation. In 2003 Congress considered a proposal to index motor fuel taxes retroactively to 1993, which would have increased the gas tax in 2004 by 5.45 cents—from 18.4 cents per gallon to 23.85 cents per gallon. Prospective indexing would increase the gas tax by an additional 2.76 cents per gallon by 2009. Although this proposal would have generated considerable additional revenue—$70 to $75 billion over 6 years—it did not attract sufficient political support to be included in SAFETEA-LU.

At the State Level

At the state level, potential additional revenue sources include the following:

◆ A VMT tax would ensure that transportation revenues grow along with the projected continued growth in VMT. Oregon has considered gradual implementation of a VMT tax over a 20-year period. All new vehicles would be outfitted with a tamper-proof electronic odometer to determine VMT. Owners would receive a rebate for gasoline taxes paid at the pump. The VMT tax could be paid in small increments—for example, at each refueling—or annually at the safety or emissions inspection. The self-reporting of odometer readings would have the lowest administrative cost but would create the greatest potential for evasion. If a VMT tax completely replaced a gas tax, a tax of 1 cent per vehicle-mile for light vehicles would generate as much revenue as a state gas tax of 20 cents per gallon. Nonetheless, a VMT tax is complicated and costly to collect—an accurate way to determine VMT is essential.

◆ A weight-distance tax, supported by automation and feasible with intelligent transportation system technologies, could apply to all classes of vehicles.

◆ The use of bond proceeds could increase. Approximately 14 percent of state-generated highway revenues nationwide derives from bonds. Some states have used this strategy aggressively—in 2001 six states each allocated more than 50 percent of gas tax receipts to pay bond debt.

◆ Several states have preceded the federal government in indexing the gas tax to the rate of inflation. About a dozen states currently index the gas tax, which prevents erosion of the purchasing power for highway and transit improvements.

◆ Tolling on new facilities, in selected circumstances, could be considered. Although federal law would permit up to three states to impose tolls on existing free Interstate facilities and apply the funds

[2] As of October 2006, the Senate—but not the House of Representatives—had passed legislation to extend the final report deadline to December 31, 2007.

PHOTO: AA.ROADS.COM (ALEX NITZMAN, ANDY FIELD)

Fastrak carpool lanes on Interstate 15, San Diego County, California.

for reconstruction, no state has found this politically possible.

◆ Vehicle sales taxes are another possible source of revenue.

◆ Value pricing—also known as congestion pricing—levies tolls for road use that vary according to the level of congestion, so that relatively higher prices apply to travel during peak periods. The revenues from value pricing could fund improvements in transportation facilities or services.

Additional Proposals

Bonding

Increases in user fees have not been possible in the recent political environment. Bonding therefore has advanced as a proposal to finance highways and transit. Although state governments have made significant use of bonding for transportation projects, the federal government has not. The authorization of up to $15 billion in private-activity bonds in SAFETEA-LU was one step toward the use of bonding.

A few years ago, another bonding proposal was widely circulated—to sell $80 billion of tax-credit bonds to finance highway and transit improvements. Under the tax-credit bond approach, Congress would authorize a state to issue 20- to 30-year tax-credit bonds. In contrast to conventional bonds, which pay interest annually in cash, tax-credit bonds would pay investors in credits against federal income tax liability.

The federal government, the states, and transit recipients would not be liable for repaying the bonds' principal. Instead, when the bonds are issued, a portion of the proceeds would be set aside in a sinking fund and would be invested in U.S. Treasury notes or other high-grade investments, which at maturity would be sufficient to repay the bond principal. The issuer would invest the rest of the bond proceeds in a highway or transit project.

Of the $80 billion from the sale of tax-credit bonds, $20 billion would go to a sinking fund to pay off the bonds in 30 years. In the best scenario, the remaining $60 billion would finance highway and transit programs. The Trust Fund, however, could be required to reimburse the Treasury for the revenues lost from the tax credits. In this scenario, the Trust Fund would pay the Treasury approximately $20 billion over 10 years, and only $40 billion would be available for highway and transit

Florida's SunPass transponder mounted on an automobile windshield. New technologies may be needed to track and charge for highway use.

PHOTO: AA.ROADS.COM (ALEX NITZMAN, ANDY FIELD)

programs. The proposal encountered opposition from the Department of the Treasury in 2004.

Although some states have used conventional bonds widely, some policy makers do not believe that conventional bonds should be used to support basic highway and transit programs. Bonding incurs interest, so that the gas taxes of future generations are paying off bonds instead of building new projects. Bonding cannot be sustained indefinitely. Some policy makers believe that basic highway and transit programs should continue to be supported by pay-as-you-go user fees.

Tolls

The first toll facility in the United States was a bridge in Newbury, Massachusetts, in 1656. The first toll road, established in 1785, was Virginia's Little River Turnpike, which ran for more than 60 miles from Alexandria to the Blue Ridge Mountains.

In the 20th century, tolls were used to finance high-cost projects, such as major bridges and tunnels, which would have been unaffordable otherwise. In the 1940s and 1950s, before the federal Highway Trust Fund, tolls were the only feasible way to fund several long-distance intercity roads.

The number of new toll facilities declined during the 1970s and 1980s. Only in the 1990s, when demand continued to grow and highway needs outstripped financial resources, did the number of toll facilities increase. The trend has continued into the first decade of the 21st century, and some new facilities have been constructed in areas where the travel demand would generate sufficient toll revenues. Successive reauthorizations, including SAFETEA-LU, have increased the flexibility for financing with tolls.

The traditional pay-as-you-go user fee system allows revenues to be collected for driving throughout the roadway network and allows those revenues to be spent throughout the roadway network. In contrast, tolling is a corridor-specific—or facility-specific—strategy. A public objection is that tolls require users to pay twice, through a gas tax and through a toll, for the opportunity to travel on a roadway.

HOT Lanes

Even those who object to tolling may agree that in special circumstances tolling may be a good policy. One example is the high-occupancy toll (HOT) lane, which gained expanded authorization in SAFETEA-LU.

HOT lanes are a form of value pricing. Essentially a means of managing congestion, value pricing uses a toll that becomes a source of revenue to enhance urban mobility. HOT lanes usually take advantage of unused capacity on high-occupancy vehicle (HOV) lanes. High-occupancy vehicles continue to use the HOV lane, but single-occupant vehicles also can use the lane for a fee. The toll is collected electronically, and the charge is high enough to ensure that the increase in users does not reduce the travel speed in the HOT lane. Single-occupant vehicles that pay the toll are rewarded with better travel times, reduced delays, and greater reliability in travel time.

PHOTO: MINNESOTA DEPARTMENT OF TRANSPORTATION

Rates are posted on Minnesota's MnPass HOT lane system; fees vary according to real-time traffic levels.

Facilities in California's Orange County, San Diego, Houston, Minneapolis, Denver, and Salt Lake City have shown that HOT lanes work.

Import Revenues

The National Chamber Foundation of the U.S. Chamber of Commerce has proposed that 10 percent of customs import revenues be dedicated to port and intermodal freight projects. This investment would facilitate international commerce.

Toll Facility Leases

Major sales of the operating rights for toll road facilities have provided huge infusions of cash to state and local governments.

- The Indiana Toll Road has been leased for 75 years for a lump sum of $3.8 billion. Indiana will use the proceeds to fund transportation improvements throughout the state.
- The Chicago Skyway was leased for 99 years for $1.82 billion.

New Jersey Turnpike Authority has rebuilt several major toll plazas with improved accommodations for electronic toll collection.

PHOTO: AA.ROADS.COM (ALEX NITZMAN, ANDY FIELD)

This form of financing can deliver large amounts of cash but is available only to states and jurisdictions with toll facilities that generate revenues high enough to be an attractive investment for a private operator.

Research and Revenues

Transportation needs are great, and sources of revenue must be found to meet those needs. But increasing revenue is not the only solution.

Another way to satisfy the imbalance between revenues and needs is to use the available revenues more effectively. To design and build a pavement that will last 20 years instead of 10, to build bridges that require less maintenance, and to develop less expensive construction techniques are ways to accomplish more with the available revenue.

Investments in research can lead to these outcomes, which are the equivalent of finding additional revenue. Wise investments in research will help to bridge the gap between transportation infrastructure needs and the available resources. Similarly, investments in operations and management and in the use of intelligent transportation systems can allow a more effective use of facilities and can avoid or defer more expensive infrastructure improvements.

Caution and Preparedness

External changes have affected gas tax revenues dramatically in recent decades. For example, the average fleet fuel economy for light-duty vehicles today is approximately double what it was 30 years ago. As a result of the improvement in fuel economy, today's gas tax revenue is considerably lower.

Similar external forces may pose threats to highway and transit revenues at the state and federal levels. Past experience raises caution. The transportation community must be well prepared and must identify suitable alternative ways to produce revenues as external conditions change.

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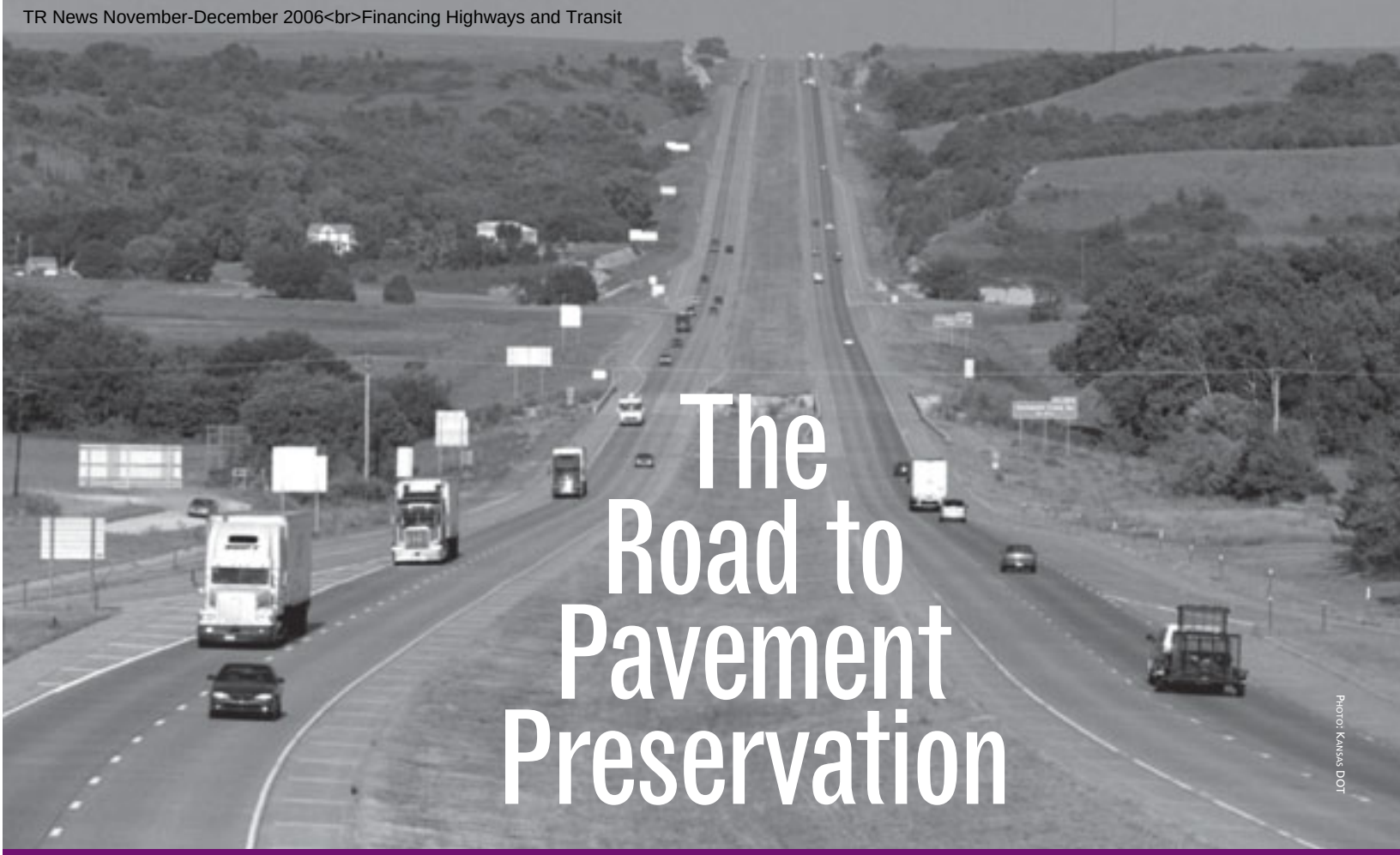

The Road to Pavement Preservation

Photo: Kansas DOT

The Kansas Department of Transportation Way

DEAN M. TESTA

The author recently retired as Chief, Bureau of Construction and Maintenance, Kansas Department of Transportation, Topeka.

Every road has bumps, potholes, and roadblocks. For the Kansas Department of Transportation (DOT) the road to a pavement preservation program has been long and trying, and sometimes painful. Only through perseverance and commitment has Kansas DOT been successful in reaching its goals.

Was the pain worth it? Most definitely, yes—because Kansas enjoys a state highway system in very good condition.

Prerequisites for Success

Five characteristics contribute to the success of a pavement preservation program (for definitions of terms, see sidebar, next page):

1. Commitment from top management and the state legislature—including dedicated funding;
2. A pavement measuring system and a means for setting goals, such as a pavement management system (PMS) or another repeatable method of measuring a pavement's expected life;
3. A relatively simple system with few restrictive rules and requirements, but a good amount of flexibility;
4. An approach that allows many different pavement actions to be applied, instead of holding to one pavement treatment or action for all situations; and
5. Agency champions to keep the pavement preservation program on track—any pavement preservation program will involve personnel from throughout the agency.

A successful pavement preservation program with all five of the factors contributing will yield tremendous benefits for the agency and the customer, greatly improving the system at the least cost. The five characteristics are often interwoven.

Commitment from the Top

Placing a substantial amount of an agency's resources into a pavement preservation program does not necessarily coincide with the agenda of the agency's top management, the governor, or the legislature. U.S. highway systems have tremendous needs, including additional capacity, new interchanges, improved access, and the updating of an aging infrastructure.

Major improvements provide elected officials with the opportunity for ribbon cutting and positive

Photo above: I-70, west of Topeka. Almost all Kansas Interstates are rated in good condition as a result of a carefully managed pavement preservation program.

Pavement Preservation Terms

The maintenance community accepts most of the following terms; some minor variations are likely.

Pavement preservation program—a formal program encompassing various strategies, data and support systems, decision-making tools, agency policies, dedicated funding, and project delivery practices to optimize the life of pavements. The program may include preventive maintenance, pavement rehabilitation, and pavement reconstruction. A pavement preservation program does not include resources for routine maintenance.

Pavement preservation—a set of cost-effective practices that extend pavement life and improve safety and motorist satisfaction while saving public tax dollars.

Preventive maintenance—a planned strategy of cost-effective treatments to a roadway system and its appurtenances that preserves the system, retards deterioration, and maintains or improves the condition of the system without substantially increasing structural capacity.[1]

Pavement rehabilitation—repairing problems that cause a pavement not to perform as intended. The repair actions return the pavement to its intended function but do not affect the roadway's line and grade. Actions generally involve multicourse hot-mix asphalt or multiple portland cement concrete pavement actions. Pavement rehabilitation is expected to last 10 to 20 years.

Reconstruction—completely removing and replacing a pavement structure, including the subgrade, elevation, and alignment changes. In general, the pavement is completely replaced, and when completed, is considered a new pavement. The reconstruction treatment should have a minimum 20-year life.

New construction—projects designed and built on new alignments or locations with new grades and with new materials. These often are called capital improvement projects. A new construction project's pavements should have an expected 20- to 30-year life.

[1] Based on the definition by the American Association of State Highway and Transportation Officials.

PHOTO: KANSAS DOT

Reconstruction of I-70 pavement near Salinas.

public exposure. Pavement preservation projects, however, do not generate media events and often are considered routine maintenance or inconveniences. Selling top management on the importance of pavement preservation therefore is difficult, with many competing needs and pressures affecting agency decisions.

Many top managers at DOTs and many legislators do not have engineering backgrounds and believe that a pavement once constructed or resurfaced will perform forever. Top managers understand routine maintenance activities such as mowing, snow removal, and pothole patching but believe that maintenance ends there.

Most top managers or chief executive officers are appointed by the governor or legislature and serve only a limited time. Planning horizons therefore are short and the managers want to be remembered for the new facility constructed during their watch. A pavement preservation program requires a long-term commitment of resources, which limits new improvement programs.

Promoting the Concept

The agency maintenance manager often must sell the concept of pavement preservation to top management, and because top management is ever-changing, this assignment never ends. When an agency begins a pavement preservation program, a substantial period of time will pass before the agency or the customer will notice systemwide improvement.

Even a well-funded pavement preservation program will vary from year to year, affecting the commitment by top management. When the pavement preservation program goals finally have been achieved, the funding levels and commitments must be continued to keep to the status quo. Yet if the pavements have a smooth driving surface and are well maintained, the public may apply pressure for new improvements—for example, for more landscaping or enhanced lighting.

Top management must buy into the concept of pavement preservation and be willing to make long-term commitments that will continue after they leave office. Additionally, the pavement preservation concept must be sold throughout the agency at all levels and across all departments.

A pavement preservation program directed by maintenance does little good if the materials or planning divisions of the agency do not consider the program important. Pavement preservation must be accepted throughout the agency as one part of—if not the most important element of—the agency's strategy to keep the system in satisfactory condition.

PHOTO: KANSAS DOT

Hot in-place recycling train, with heaters and paver, resurfaces a Kansas road.

Helpful Analogies

Several analogies can help explain the pavement preservation concept. A person buys a new vehicle (the agency constructs a new pavement), then changes the oil periodically (the agency places a crack seal, bituminous seal, overlay, or similar treatment on the pavement), to keep the vehicle running (to keep the pavement in good operating condition). A person would not buy a new vehicle and replace it or undertake a major overhaul every time the vehicle fails because of a lack of an oil change or lack of maintenance.

Another analogy is house painting. Most homeowners paint their house to preserve the investment. Similarly, the DOT must preserve the large investment in the highway system.

Measures and Goals

A successful pavement preservation program requires a formal, repeatable method of measuring the condition of the system. Measurements can show if the roadways are improving, staying the same, or losing quality. Without some form of measurement, goals cannot be set.

Many different measuring systems are in use among DOTs. Often an agency will use its PMS, which usually measures attributes such as ride, cracking, rutting, faulting, and joint distress. The data from repeated measurements can be analyzed to determine the pavement conditions and to project the system's future.

PHOTO: KANSAS DOT

Comparison between a completed lane surface, ready for traffic, after hot in-place recycling (*left*) with the adjacent lane.

No one system will work well for every state DOT. Using a PMS or other acceptable measuring system, an agency can identify potential project locations and can set priorities. Some systems address both pavement preservation and the need for reconstruction or rehabilitation.

Setting a goal for the system condition is a major component of any pavement preservation program. From the beginning, the goal should be achievable within the agency's constraints. Setting an unrealistically high goal with limited resources dedicated to pavement preservation means that the goal cannot be met and that the program will fail. Goals should be set high enough to strive for a system that the agency and the customer will accept and that can be achieved with the resources available.

The amount of resources dedicated to a pavement preservation program varies from state to state. One approach would be to use a set percentage of the total value of all the pavement on an agency's system to fund the pavement preservation program—but even a small percentage can be a staggering amount.

Other features on a highway system—such as bridges, signs, culverts, and guardrail—also require resources for preservation and maintenance. Each of these features requires a different percentage of its total value to be properly maintained.

The age of the features also affects the required resources. Bridges and culverts may be designed and built to last 50 years, but the pavement may only be designed for 30 years. The many features may be in different stages of service life and in different conditions. Each agency must make its own decision about the amount of resources required, because no one formula fits all.

Rules and Requirements

The simpler the program, the better the chance for success. A pavement preservation program does not have to be complicated. With inputs from throughout the agency, all data should be shared to avoid duplicate record keeping and to keep all departments informed.

Departments must coordinate decisions about which sections of the system should be worked on and when, as well as what project actions to take. For example, placing a thick overlay on a section of pavement scheduled to be replaced within a year or two would be foolish. Information sharing can optimize the agency's resources.

PHOTO: KANSAS DOT

A worker applies a dowel bar retrofit to prevent cracks and faulting in the concrete pavement.

PHOTO: KANSAS DOT

Workers prepare a full-depth concrete pavement patch near Wichita, Kansas. When the concrete fill has cured, the section can reopen to traffic.

The project selection process should remain flexible. A set of hard-and-fast rules about project locations and actions is not beneficial; some general rules or guidelines, however, are necessary. The program should consider how the worst sections of pavement will be addressed but should not select projects on a repair-the-worst-first basis. Selection cannot be arbitrary but should be optimized systemwide. The principle is to keep good roadways in good condition.

Some agencies would divide any dedicated resources for pavement preservation equally among the districts or regions. This apparently simple rule, however, complicates matters and is contrary to a systemwide approach. In any one year, one district or region may have greater needs than another. The simple plan is to allocate resources on a statewide or total-system-needs basis, not on a geographical basis.

What should be included in a pavement preservation program? Should preventive maintenance be combined with reconstruction and rehabilitation or should reconstruction and rehabilitation be separate from the pavement preservation program? Each agency will have to answer these questions according to its specific needs.

New construction or capital improvements normally are not part of a pavement preservation program; the pavement preservation program nonetheless should be coordinated with any capital improvement program, so that work is not performed on a section scheduled for total replacement. Sometimes pavement preservation is necessary to maintain a section until the capital improvement project is under way.

No set formulas will produce a successful pavement preservation program. The selection of projects requires engineering judgment, informed with the best available data.

Selecting Actions

No single preservation action fits all pavement conditions. The selection of actions for each project must remain flexible. Some agencies may decide to fix all pavement problems with a bituminous overlay. Although an overlay may work for many conditions, it may not be the optimal solution. A less costly action perhaps could extend the pavement life sufficiently that the remaining resources could be applied elsewhere to improve the system.

Even when surface conditions at two different locations are the same, each section may benefit from different pavement actions. Attributes such as the age of the pavement, the underlying soil conditions, the traffic volume and type, environmental concerns, and future development, among others, should be considered in selecting pavement actions.

Each project should be weighed, and the action that is least costly and most effective should be selected. Doing the right thing at the right time for the right reasons should be the driving force in selecting the project action.

Agency Champions

Successful pavement preservation programs invariably have several champions working together. A pavement preservation program needs champions throughout the agency. If one champion moves on or retires, the program is in jeopardy if the successor is not willing to take on the role of champion. A lead champion may be needed to keep the program on track and to coordinate with the other champions in the agency.

Kansas DOT Experience

In the early 1980s, Kansas DOT was investing little in contract maintenance or pavement preservation projects. The department had a bituminous seal program before 1980 but dropped the program after discovering that the surface preparation cost three times more than the bituminous seal. Kansas DOT decided that a thin overlay would be a better investment of department funds, accomplishing the same result but eliminating the preparatory work.

Yet with a limited amount of contract funds available, few contract maintenance and overlay projects were undertaken. Kansas DOT was spending the little contract funding available on locations with the worst surface conditions—a worst-first approach. In addition to routine patching, the maintenance budget paid for some cold-mix overlays, approximately 1/2 inch thick. Kansas DOT personnel knew—and public comments verified—that the system was in poor condition and was continuing to deteriorate.

Implementing the PMS

The department did not have a PMS until 1983—ratings therefore were a matter of subjective opinion by the district engineer and management. Many of the lower-volume pavements on the system were not formally designed surfaces but were the result of years of maintenance patching and an occasional cold-mix overlay.

When Kansas DOT implemented its PMS, the first run of field measurements and data verified the deteriorated condition of the system. The PMS measures and rates every approximately 1-mile section of the state highway system as good, acceptable, or poor based on such attributes as roughness, cracking, rutting, faulting, and joint distress. The 1983 PMS results indicated that 49 percent of the Interstate system was in good condition and 13 percent in poor condition; 43 percent of the non-Interstate system was in good condition and 19 percent in poor condition. Kansas DOT needed to take action.

The department's director of operations, the chief of the Bureau of Construction and Maintenance, and the chief of the Bureau of Materials and Research presented the PMS results and projections to the CEO and executive staff. To stop the deterioration of the system and make improvements, Kansas DOT needed dedicated funds for pavement maintenance by contract. Because funds were limited, the managers voluntarily proposed to eliminate 300 budgeted maintenance positions by attrition and to reduce the amount of materials being purchased for cold-mix overlays. The savings could be used to offset the cost of the proposed contract actions, assuming that the other funds would supplement the projected program.

Funds and Targets

The CEO and executive staff set aside enough contract action funds to place a 3/4-inch hot-mix asphalt overlay on the equivalent of 1,000 miles of two-lane road per year.[2] This was the initial funding for Kansas DOT's pavement preservation program.[3] The funds were not enough to accomplish all that needed to be addressed, but this was a start.

The only requirements the CEO and executive staff imposed were to work on 1,000 centerline miles per year and to assign each district a minimum of 100 miles of projects per year. The chief of the Bureau of Construction and Maintenance was responsible for all decisions about project locations and actions. The pavement preservation program could do heavier actions on some sections and lighter actions on others, as long as it took some action on 1,000 centerline miles of the system. The funds were to be spent in the context of statewide needs, not allocated by district.

PHOTO: KANSAS DOT

Before opening to traffic, this surface treated with cold in-place recycling will be rolled and then covered with a hot-mix overlay.

Working from the available PMS information, a systemwide target was set: 72 percent of the system was to be in good condition, designated Performance Level 1 (PL-1); and no more than 5 percent was to be in deteriorated condition, designated Performance Level 3 (PL-3). Kansas DOT had no experience to predict how many improvements could be accomplished with the available funds; many in the department were skeptical that the goals could be achieved.

Commitment to Improvement

When the original pavement preservation program funds became available, and contract actions were taken, the system showed some minor improvement, the result of a smoother ride on several sections of pavement. In general, any bituminous overlay will produce a smoother surface for a year or two than a cold-mix overlay will; some improvement, therefore, was expected. The funds were inadequate for any

PHOTO: KANSAS DOT

Nova chip application to a pavement in relatively good condition adds many years of service life.

[2] Approximately 2,000 lane-miles of the state's 25,780 lane-mile system.

[3] The department formally calls these funds the Substantial Maintenance Program.

PHOTO: KANSAS DOT

Reconstruction on I-635 near Kansas City.

necessary structural projects—that is, for rehabilitation or reconstruction.

In the Comprehensive Highway Program (CHP) passed in 1989, the state legislature specified funding for pavement preservation at a higher level than originally set by the CEO and executive staff. This enabled Kansas DOT not only to perform minor overlays but also to include rehabilitation and reconstruction projects. The CHP funding had no restrictions on the locations or the actions; however, the department chose to retain the 1,000 centerline-miles requirement.

As the system improved, and as administrations changed, Kansas DOT staff had to continue advising the CEO and executive staff about the importance of the pavement preservation program. The program has become the cornerstone of efforts to keep the state highway system in good condition, and Kansas DOT continues to receive favorable comments from the public.

Project Selection

Kansas DOT's PMS is the primary tool for developing a list of potential projects and project actions for the pavement preservation program. Information generated from the PMS assists in project selection.

The suggested list of candidate projects and suggested project actions from the PMS are not final, however—the chief of the Bureau of Construction and Maintenance, the chief of the Bureau of Materials and Research, and the district engineer jointly make the final decisions after an onsite review. The onsite review enables the group to consider additional factors in selecting the final action—such as past performance of the materials, traffic volume, type of traffic, new traffic generators, and recurring problems.

The candidate list consists of locations selected for the next 3 years, in order by year. The list is compiled without constraints on the number of miles of potential projects—more locations are recommended than can be addressed.

After placing constraints on mileage, the PMS generates the optimal number of miles each district should receive in the planning year to progress toward the steady-state condition. Because the program is based on statewide need, the amount of miles allocated to each district varies yearly. The chief of the Bureau of Construction and Maintenance sends to each district the PMS-generated list of potential locations for the next 3 years, along with the district's allowance of miles for the program year. The districts then select the projects from the lists.

The PMS also selects a potential action for each candidate location. Kansas DOT then formulates a first-cut program and budget.

In the beginning of the program, the PMS did a good job of picking locations, but the selection of actions was sometimes questionable. As the PMS incorporated more data, the selection of actions improved. The district applies first-hand knowledge of what needs to be accomplished and can rearrange the list of potential projects accordingly—with some constraints; the districts have flexibility in finalizing the projects.

Field Review

The next step in the development of specific projects is the field review, referred to as the 1-R Tour. The tour participants include the district engineer, the chief of the Bureau of Construction and Maintenance, and the chief of the Bureau of Materials and Research. The tour is made in March and April to examine projects to be constructed in the next calendar year. The projects will be let in the fall of the reviewing year and started during the following construction season.

The tour participants review and discuss each project location selected by the district. The discussion begins with the action selected by the PMS. The participants review the construction and maintenance history of each section. At some locations, the district will have sample cores available to furnish a better understanding of the structural condition of the section. Considering the historical information, the knowledge of the section, the potential developments near the project, any problems the maintenance crew may encounter, and visual observations, the tour selects a final project scope or action.

When Kansas DOT first began relying on the PMS, the selected scopes were accepted approximately 10 percent of the time. As data and history have been added to the PMS, the scopes have been

selected more often. Recent 1-R tours have found the PMS-selected action to be acceptable 65 percent to 75 percent of the time.

In addition to the action selected for the project, the reviewers determine some project details, such as the type of hot-mix asphalt, the asphalt grade for overlays, the type of cover material and asphalt type on bituminous seal projects, any special milling required, or unusual features to address. Pavement design personnel later review these detailed selections to maintain consistency.

Finalizing Proposals

After the 1-R tour is complete, and the project actions are confirmed within the annual budgeted amount, the pavement preservation program is ready for the fiscal year. All decisions are completed by mid-May and the districts begin developing details for contract proposals.

Kansas DOT headquarters finalizes the project proposals for construction and generates contract quantities from the details provided by the district. These details include pavement width, turnouts, side roads, number of lanes, shoulder details, overlay thicknesses, and special conditions. This information becomes the basis for the proposals.

The pavement preservation proposals are simple, and the details include a cross-section sketch of the pavement, a standard traffic control plan, and appropriate special provisions. Kansas DOT conducts the pavement preservation lettings in October, November, and December. Because rock generally is hauled from the eastern part of the state, the department lets projects in the west first. This allows the successful contractors to ship rock during the winter as back haul from grain being trucked to the east.

The projects are built during the following construction season, and the process starts over. The entire pavement preservation program is kept simple, with few rules.

No One Size Fits All

When selecting actions for individual projects, Kansas DOT does not follow a "one size fits all" approach. The department reviews and considers each section selected for an action. Actions may range from preventive maintenance to rehabilitation or minor reconstruction (see box, this page).

Programs do not always go as planned. Flexibility of funding allows the quick addition of a project in an exceptionally bad winter or if a nonselected section unexpectedly fails. Local maintenance crews are unable to handle such projects—contract help is necessary. Kansas DOT can let emergency projects within 30 to 45 days, but if waiting that long is unacceptable, the department will negotiate a contract and have the work begin immediately. Kansas DOT prefers to keep negotiated projects to a minimum.

Program Results

In making the commitment to improve the condition of its roadway system, Kansas DOT only had a vague idea of how the plans would work. Figure 1 (page 18) tracks the PMS information since 1983. The graphs show the number of PL-1 and PL-3 sections for both the Interstate and non-Interstate systems.

Kansas DOT's pavement preservation program has exceeded its original goals. With a dedicated funding program and the flexibility for either preventive maintenance or rehabilitation projects, Kansas DOT could develop longer-term plans. The system continued to improve beyond the original goals of 72 percent PL-1 and less than 5 percent PL-3. The public also noticed the improvement in overall pavement conditions, and sent unsolicited comments noting the good condition of the state highway system.

The agency revised the Interstate goals in 1999 and the non-Interstate goals in 2001. The Interstate goals today are 85 percent PL-1 and less than 3 percent PL-3; the non-Interstate goals are 80 percent PL-1 and less than 5 percent PL-3. Kansas DOT has been able to meet and sustain these goals.

The agency is now selecting project actions that are much lighter than those selected for the first highway program. More than 70 percent of the individual project actions are preventive maintenance projects; rehabilitation projects are fewer and lighter.

Kansas DOT Pavement Preventive Maintenance Program Actions

Route and crack seal
Chip seal
1-inch to 4-inch overlay
1-inch to 4-inch inlay
Heater scarification
Cold in-place recycle (4-inch)
Nova chip
Modified slurry seal
Cold milling
Portland cement concrete pavement patching
Portland cement concrete pavement dowel-bar retrofit
Portland cement concrete pavement replacement
Joint repair
Diamond grinding
Combinations of the actions above

Funding and Champions

Dedicated, adequate funding is essential for any pavement preservation program, as Kansas DOT's experience shows. Knowing that the funds would be available for the long term, the agency was able to develop long-term strategies at the project and the enterprise levels.

A major benefit of the pavement preservation program is that as soon as the system reached a good level of service, keeping the system in good condition

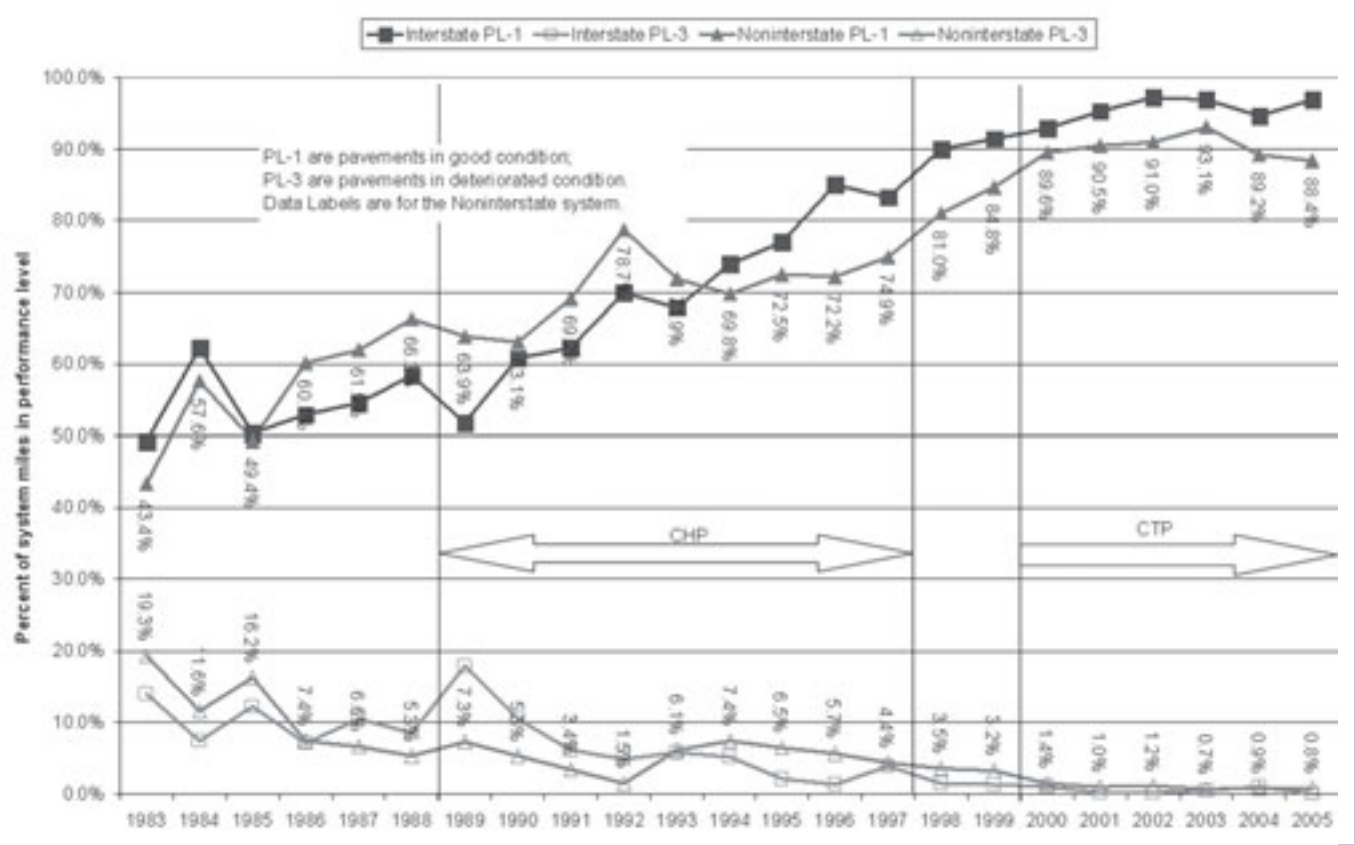

FIGURE 1 Performance levels of Kansas highway pavements, 1983–2005.

1983–1990. The pavement condition improved only slightly. Kansas Department of Transportation (DOT) had minimal funding for preventive maintenance during this period and no funding for rehabilitation projects. Much of the improvement in the ratings was attributable to the slight improvement in ride quality. The very light overlays were effective for a very short time.

1989–1997. Kansas DOT received increased funding with the passage of the Comprehensive Highway Program (CHP). The CHP specified dollar amounts for pavement preservation, and Kansas DOT had no restrictions on the selection of locations and actions—the department could select rehabilitation and preventive maintenance projects.

1997–1999. Kansas DOT elected to maintain the funding of the pavement preservation program at the same level as the CHP while awaiting a second program. This decision represented a major commitment from top management. The public continued to see improvements to the system and often voiced approval.

1999–present. The 10-year Comprehensive Transportation Program was passed in 1999, allowing for continued funding of pavement preservation. Pavement condition had little room for improvement, according to the department's measurement system. Kansas DOT wanted to keep the system in its present condition as long as possible, but the slight downturn in PL-1 is within normal annual expectations. A wet, cold winter can have a negative effect on pavement condition. The downturn in 1992 through 1994 also was related to an extremely wet year with considerable flooding.

became easier. If the maintenance manager is able to address only the failed sections, the system will continue to degrade.

Many different personnel are involved in developing and executing the pavement preservation program, and each has something to contribute. Through champions, each area shares information throughout the agency. At Kansas DOT, the main champion has been the chief of the Bureau of Construction and Maintenance, in part because the bureau chief is responsible for administering the pavement preservation program funds and for keeping the process moving and coordinated. The pavement preservation program only functions smoothly if all the champions are committed.

To be effective, pavement preservation programs must have long-term, dedicated funding and commitment throughout the agency. Kansas DOT has both, and the results have benefited the customer—the traveling public.

Conferences Explore Crossroads of Pavement Preservation and Asset Management

KATHRYN ZIMMERMAN, FRANCINE SHAW-WHITSON, LARRY GALEHOUSE, AND JAMES S. MOULTHROP

More than 300 attendees benefited from the combined programs of the 1st National Conference on Roadway Pavement Preservation and the 6th National Conference on Transportation Asset Management, held October 31–November 3, 2005, in Kansas City, Missouri. The joint sessions, organized by TRB, provided an opportunity for practitioners in asset management, maintenance, and other transportation arenas to share information, acquire new skills, and network with colleagues.

The Federal Highway Administration (FHWA) supported the asset management conference, which was cosponsored by the American Association of State Highway and Transportation Officials, the Midwest Transportation Consortium, and the National Association of County Engineers. State, federal, and local governments were represented among the registrants, as were private industry, trade associations, and universities. Approximately 130 registrants attended both conferences.

Cost-Effective Improvements

The 1st National Conference on Roadway Pavement Preservation started in the afternoon of October 31 and concluded at noon on November 1. The first sessions covered project-level decision making that public agencies use in pavement preservation programs. The range of topics included experiences with integrating preventive preservation into a pavement management system, the development of technical guides for maintenance, and lessons learned from warranties in pavement preservation contracts.

The morning sessions on November 1 were part of both conferences, with presentations highlighting the links between pavement preservation and asset management. The sessions cited pavement preservation programs as an excellent example of applied asset management concepts and illustrated how the programs use available funds cost-effectively for treatments that improve the level of service, that cause fewer disruptions to the traveling public, and that improve safety.

TRB has published the papers presented at the conference, along with others that could not be presented because of time constraints, in Transportation Research Circular E-C078, *Roadway Pavement Preservation 2005*. Each participant received a print copy of the circular, which also is posted on the TRB website.[1]

[1] www.TRB.org/publications/circulars/ec078.pdf.

Applications and Tools

The 6th National Conference on Transportation Asset Management opened with the joint morning sessions on November 1 and continued through November 3 with presentations and facilitated discussions on the theme, Making Asset Management Work in Your Organization. Sessions were tailored to meet the varied needs of participants, with some presentations for those just starting out in asset management, others for those with some experience with the concepts but wanting to learn more, and yet others for experienced users looking to enhance their capabilities.

In addition, several sessions addressed the special needs and issues of large, complex organizations; small organizations; and transit and rail. Other sessions covered asset management applications in a variety of transportation agencies, the establishment and application of performance measures, analytical issues in asset management, and best practices.

An evening poster session offered a more informal setting for participants to interact with authors. The conference wrap-up presented approaches for applying and moving forward with the lessons learned and highlighted applications from a recent international scanning tour on asset management. After the conference, participants could choose one of three FHWA-sponsored workshops, on the Highway Economic Requirements System: State Version, the use of probabilistic life-cycle cost analysis in pavement analysis, and FHWA's new web-based benefit–cost analysis tool.

TRB has published summaries of the technical sessions, along with a synopsis of pertinent discussions, in Transportation Research Circular E-C093, *6th National Conference on Transportation Asset Management*. The circular is posted on the TRB website.[2] The 7th National Conference, New Directions in Transportation Asset Management and Economic Analysis, is scheduled for New Orleans, November 6–8, 2007.[3]

Zimmerman, President of Applied Pavement Technology, Inc., Urbana, Illinois, and Shaw-Whitson, Transportation Manager at the Federal Highway Administration, Washington, D.C., were cochairs of the planning committee for the 6th National Conference on Transportation Asset Management. Galehouse, Director of the National Center for Pavement Preservation, Okemos, Michigan, and James S. Moulthrop, Senior Consultant, Fugro Consultants, LP, Austin, Texas, are cochairs of the TRB Roadway Pavement Preservation Task Force.

[2] www.TRB.org/publications/circulars/ec093.pdf.

[3] www.TRB.org/calendar/.

Outsourcing Transportation Project Delivery Functions

An Alternative Method for Getting the Job Done in Kentucky and Other States

DONN E. HANCHER, APRIL BRENNEMAN, ROBIN MEAGHER, AND PAUL M. GOODRUM

Hancher is Professor of Construction Engineering and Management; Brenneman and Meagher are Civil Engineering Graduate Research Assistants; and Goodrum is Associate Professor of Construction Engineering and Management, University of Kentucky, Lexington.

State departments of transportation (DOTs) often outsource work—that is, contract with external parties—especially for construction and less frequently for design. With increasing demands and changing resources, DOTs are investigating alternative methods for all essential functions. Outsourcing is an option that generates opportunities—as well as concerns about the effectiveness, benefits, and implementation requirements for DOTs.

DOTs must optimize efforts to gain the best output for the public budget. In the past, DOTs conducted most of their functions with their own resources, but several trends have driven the demand for outsourcing:

- The growth of the U.S. population and the resultant increase in travel demand;
- The increased magnitude of construction and reconstruction projects;
- User demands for better and quicker service and for minimal delays;
- The reduction in the DOT workforce and the loss of in-house specialty capabilities; and
- The limited ability to handle peaks in demand for services.

If outside sources can achieve successful results at a fair price, a DOT can focus on managing the process, instead of carrying out the detailed functions with its own forces. The difficulty is deciding what and how much to outsource and to handle in-house.

To help address this issue, the Kentucky Transportation Cabinet (KTC) funded a study through the Kentucky Transportation Research Center and the University of Kentucky to evaluate the feasibility of outsourcing primary development functions. The study reviewed state DOT practices for outsourcing primary project development functions and evaluated the effectiveness, benefits, and concerns. The study also evaluated the potential benefit for KTC from outsourcing primary project development functions and recommended guidelines for outsourcing.

Literature Review

A 2003 study by Warne for the National Cooperative Highway Research Program (NCHRP) reviewed the changes in outsourcing practices in the preceding 5 years and made projections for the 2 years following (*1*). Only 5 percent of outsourced activities declined during the 5-year period, but 54 percent increased, with design functions having the highest percentage of increase. The state DOTs in Warne's survey indicated an increase in outsourcing for the future, a trend attributable to the increased workload under the Transportation Equity Act for the 21st Century.

An earlier NCHRP study by Witheford also had investigated the outsourcing practices of state DOTs (*2*). A two-part survey asked what functions each DOT

outsourced, the percentage outsourced, and the experiences gained. Of the DOTs that responded, only 9 percent of all contracted activities were entirely outsourced, mostly in the areas of operations, maintenance, and other. Few activities were fully outsourced because state agencies choose to keep major tasks in-house to preserve core competencies. The survey results suggested that states retain staff to carry out most work in-house and contract out during peaks in the workloads.

The report also identified variations in outsourcing from state to state, in the activities outsourced, the proportion of work outsourced, and the influences that affected the decision to outsource. According to Witheford, the main influences on the nature and volume of the work that was outsourced included staff constraints, lack of specialty services or skills, legal requirements, and policy directives (2).

Staff constraints were the primary reason for outsourcing, because of increased workloads, the downsizing of staff, or both. Several states have statutes that mandate the outsourcing of certain percentages of work. A few states require the outsourcing of all maintenance services, but others have found it economically feasible to continue maintenance with state workforces. This diversity of the survey responses reflects the variations in the states' geographic and demographic makeup, historical and cultural aspects, state laws, and scope of responsibility for the highway network.

Witheford also identified the benefits of outsourcing for the DOTs, the contractors, and the general public (2). Those benefits are important considerations in decisions to supplement staff work forces or to free up staff for other activities when work volumes increase. Using private firms to flatten peak workloads and seasonal demands can enhance DOT staff flexibility.

As with any change in government management, impediments arise. The most prominent is the lack of in-house staff to perform work that cannot be outsourced. This underscores the importance of retaining a DOT's core competency. Moreover, the contractor forces may not be sufficient to handle the amount of work scheduled for outsourcing. Other major impediments include contract procurement, the cost of administering and monitoring contracts, the expense of outsourcing, employee issues, and the loss of in-house capabilities for emergency response.

State DOT Survey

The University of Kentucky conducted a survey in fall 2003 to gain information about outsourcing patterns among state DOTs. The responses from 30 DOTs were analyzed to determine which transportation functions had been outsourced, along with the level of satisfaction with the cost and the quality of service.

The functions that were outsourced ranged from daily routine maintenance tasks to intense capital program delivery functions that require technical design and planning. The DOTs outsourcing the most functions—15 out of 17 activities—were Connecticut, Maryland, Oklahoma, South Carolina, and Virginia. Outsourcing the least amount—9 or fewer activities—were DOTs in California, Delaware, Kentucky, and West Virginia.

Most DOTs were pleased with the quality of service or indicated no significant change but reported a loss of cost-effectiveness. Equipment purchasing and maintenance and rest areas were the two functions rated as most cost-effective in outsourcing, and equipment purchasing and maintenance, program management, and rest areas were rated most effective in quality of service.

Figure 1 presents the percentage of states that responded "Yes" to outsourcing each function. Design, right-of-way procurement, and surveying and photogrammetry were the functions most frequently outsourced, because of the expertise and time required for design, the legal ramifications associated with right-of-way procurement, and the limited resources and equipment available for surveying and photogrammetry.

Program management and contract procurement were outsourced least often. DOTs do not want to surrender the authority of managing projects or of procuring future projects. The states are responsible for facilitating transportation initiatives and therefore must have control. Each state DOT develops its own

PHOTO: KENTUCKY TRANSPORTATION CABINET

Kentucky Transportation Cabinet contract workers pave the Bluegrass Parkway in Hardin County, Kentucky.

FIGURE 1
Relative percentages of state DOTs outsourcing each function.

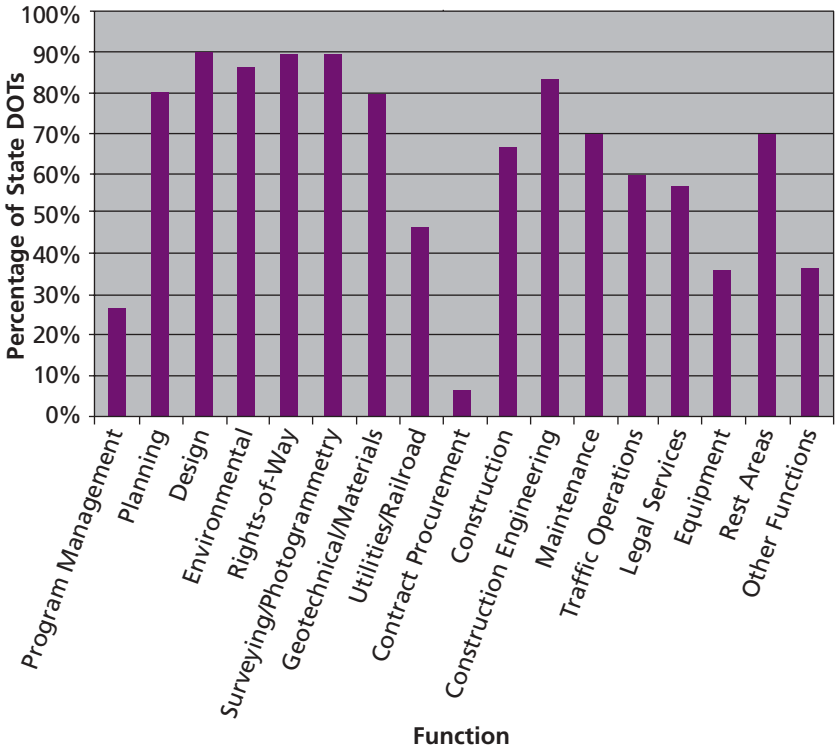

PHOTO: KENTUCKY TRANSPORTATION RESEARCH CENTER

The cable-stayed William H. Harsha Bridge, joining Maysville, Kentucky, and Aberdeen, Ohio, across the Ohio River, was a joint project of the Kentucky Transportation Cabinet and Ohio DOT, and required contracting for conceptual studies, preliminary and final designs, contract plans, and construction engineering services. The bridge opened in January 2001.

A bridge crew places concrete for the cast pier of Harrodsburg Road Bridge, U.S. 68, in Mercer County, Kentucky.

PHOTO: KENTUCKY TRANSPORTATION CABINET

contract procurement methods, which must be consistent for all endeavors.

Politics, regulations, geographic constraints, and organizational structure are among the major influences on a state's ability to achieve its transportation goals (3). These characteristics also are influential in defining a state's outsourcing needs and capabilities.

DOT Concerns

The survey identified areas of concern by soliciting qualitative comments and quantitative assessments of outsourcing. One of the greatest concerns was losing the most competent, key personnel and with them the agency's core competency. Conversely, underutilizing consultant expertise and innovation could force a DOT to keep too much work in-house.

Because outsourcing decisions are based on more than cost comparisons, the decision-making can be complex. Cost comparisons between consulting firms and government agencies can be difficult to assess because of overhead expenses.

DOTs reported that the decision to outsource must consider scheduling and needs, not only costs. Several agencies articulated concerns about relying on outsourcing as a "quick fix" to handle periods of high demand and overflow work. Nearly all state DOTs expressed major concerns about outsourcing instead of hiring new employees to replenish the state workforce. The trends in reduced staffing levels and in the retirement of technical staff are other causes for alarm as DOTs work to meet the necessary productivity levels.

Many states face staff shortages because of retirement; Kentucky was especially concerned about these shortages. The Kentucky Association of Transportation Engineers (KATE) conducted a survey in May 2004 to determine how many KTC personnel expected to retire in, or before, 2008 (KATE, unpublished data). The results indicated that 40 percent of the approximately 370 KATE members polled planned to retire before January 1, 2009.

District-Level Outsourcing

After the survey of other states, further investigation was conducted into Kentucky's outsourcing practices. Kentucky is divided into 12 districts; in fall 2004, each district was asked to complete an outsourcing survey, and a more in-depth survey was sent in spring 2005.

The first survey asked the districts to list the percentage of work they were outsourcing in such functions as planning; design; right-of-way; nonconstruction surveying; geotechnical; quality assurance and quality control (QA-QC); construction engineering inspection; road and pavement repair; bridge repair; other maintenance; snow and ice removal; traffic control and maintenance; equipment purchasing for cars, trucks, and heavy equipment; and rest areas.

The second survey asked each district to express in percentages the amount of work to be outsourced in the future, as well as the maximum percentages their district should outsource. The second survey divided several functions into specific areas.

Design was divided into Phase I and Phase II. Right-of-way was divided into appraisals, appraisal review, relocation, and property management. Materials testing and construction engineering inspection were separated from QA-QC for clarity. Maintenance was divided into road and pavement repair and bridge repair, with added functions for mowing, debris removal, and ditching and draining. Equipment purchasing was divided into sedans and trucks and heavy equipment.

Each district revealed different views on outsourcing. Some indicated that outsourcing was necessary, but others maintained that outsourcing should be kept to a minimum. Table 1 (page 25) shows the detailed results from 3 of the 12 state transportation districts, anonymously titled A, B, and C. The results for District A, an urban area, are detailed in the following discussion.

District Survey: Sample Results

District A was undecided about outsourcing 10 of the 26 functions (38 percent) and was opposed to outsourcing only 2 of the functions (8 percent). The district indicated that the majority of the functions—14 (54 percent)—could be outsourced. The quality of the outsourced work matched the cost, but there was some concern that by using outside contractors, the DOT risked losing the kind of loyalty that typifies the work of state employees.

PHOTO: MINNESOTA DOT

Snow and ice removal is commonly outsourced, often through local jurisdictions.

Planning

District A outsourced 30 percent of its planning work but was undecided if this function should be outsourced. Outsourcing 50 percent of planning was desirable, but 70 percent was the upper limit.

District A stated that the outsourcing of planning would increase because of the shortage of personnel. The quality of the outside planning services has ranged from average to good, depending on the contractor. District A reported a perception that the outsourcing of planning has been expensive but could not supply cost comparisons to support this opinion.

Design

District A outsourced 50 percent of its Phase I and Phase II design work. The district indicated that the desired amount of Phase I to be outsourced is 70 percent, and the desired amount of Phase II is 60 percent. The maximum amount that Phase I should be outsourced is 80 percent, with 60 percent the maximum for Phase II design.

The quality of work in the outsourcing of Phase I design has depended on the firm, and the cost was perceived to be high. The district realized, however, that with fewer employees, the outsourcing of Phase I design would become a necessity. For Phase II design, the quality of work from consultants has been suitable.

Right-of-Way

The right-of-way function was broken down into categories for the survey: appraisals, appraisal review, relocation, and property management.

District A responded that right-of-way appraisals should not be outsourced. Nonetheless the district has outsourced 30 percent of its appraisals and would set 50 percent as a desirable maximum level.

Most of the problems with the quality of outsourced appraisals arose in buying right-of-way contracts. The district's opinion was that some contract buyers did not have the loyalty of state employees and seldom had experience working with property owners. The perception was that outsourcing these services could therefore cost more than performing the work in-house.

Appraisal review should be outsourced—perhaps completely—according to the District A response. The district was outsourcing 70 percent of its appraisal reviews, noted as the desired amount. Outsourcing has worked well because maintaining an appraisal staff within the district is difficult. In their view, the cost was deemed reasonable.

District A opposed the outsourcing of right-of-way relocation, although the district was outsourcing 30 percent of this function and would set the maximum percentage at 50 percent. Performing the work in-house has met the needs of the public, but outsourcing relocation work has proved expensive, according to the survey response.

Nonconstruction Surveying

Nonconstruction surveying was outsourced 65 percent of the time. District A noted that this function should be outsourced at a maximum level of 75 percent. The retirement of District A staff would increase the need to outsource nonconstruction surveying. The quality of the work has been good, and the cost of outsourcing was perceived to be reasonable.

Geotechnical Exploration

Geotechnical exploration was outsourced 65 percent of the time. District A was undecided about outsourcing this function but set the desired level of outsourcing at 75 percent. The quality of the outsourced work was good, but the survey response from the district indicated that the cost was more than might have been expected if the work had been handled in-house.

Construction Materials Testing

District A was undecided about outsourcing con-

Highway work zones involve many tasks that may be outsourced.

PHOTO: KENTUCKY TRANSPORTATION RESEARCH CENTER

PHOTO: KENTUCKY TRANSPORTATION CABINET

Contractors roll an asphalt surface at a Kentucky Transportation Cabinet project site on I-65 in Jefferson County.

struction materials testing and QA-QC. The trend in the construction industry is to require contractors to perform more of this work. District A was not yet outsourcing construction materials testing but was interested in outsourcing up to 30 percent of its assignments.

The district also was not outsourcing QA-QC but would be comfortable outsourcing 40 pecent, but not more than 50 percent. The district would require some method of quality control from the contractor.

Construction Engineering Inspection

Construction engineering inspection was not outsourced in District A. A limit of 50 percent would apply.

Maintenance: Road and Pavement Repair

Road maintenance and pavement repair was broken down into the categories of patching, striping, and guardrail repair. Because of a decrease in the number of employees, District A was outsourcing this function to complete all of the necessary work in these areas.

The district already contracted for 20 percent of the patching work. The responses did not address the quality or cost of the outsourcing or provide a desirable or maximum level of outsourcing for patching maintenance.

Striping also was designated for outsourcing, with 60 percent already outsourced and 80 percent cited as the maximum and desirable level. The work has proved effective, and outsourcing was less costly than owning and maintaining a striper; however, convenience is lost with an outside group.

District A also outsourced 90 percent of its guardrail repair but identified 80 percent as the desired level and 95 percent as the maximum.

Maintenance: Bridge Repair

District A was outsourcing 40 percent of its bridge repair maintenance, but more contracts will be required if the number of employees in the district continues to decline. The desirable and maximum level for outsourcing this function is 75 percent. The district has been pleased with the quality of the work, especially with the contracts for bridge repair. One problem with general maintenance contracting, however, was the loss of quick response.

Snow and Ice Removal

For snow and ice removal, District A relies mostly on contractors, sometimes through local governments, especially in metropolitan areas. The district was outsourcing 65 percent of snow and ice removal and had established a desired and maximum level of outsourcing at 75 percent. The quality of the outsourced snow and ice removal services has been very good.

Outsourcing the work is less expensive than keeping a large inventory of trucks and employees, especially during warmer winters. Costs can escalate, however, during heavy winter snow and ice events.

Traffic Control Maintenance and Upgrade

District A outsourced 70 percent of traffic control maintenance and upgrade projects but would set a new target at 80 percent, with a maximum of 90 percent. The quality of the outsourced work has been very good.

Equipment Purchasing and Maintenance

The district had outsourced all of its sedan, pickup, and heavy equipment purchasing to the central office. Although it was cheaper to have the central office oversee the purchasing of all equipment, district control would be more convenient. The district was undecided about outsourcing the purchasing of its sedans, trucks, and heavy equipment. The maintenance of sedans and pickups was 90 percent outsourced—which also was the desired and maximum amount. The quality of the services has been very good.

Only 10 percent of heavy equipment maintenance was being outsourced, but the district would like to increase the level to 50 percent, which it noted should be the maximum amount. The quality of the outsourced work was good.

Rest Areas

All services related to rest areas were contracted out by District A. The district did not have the personnel for this work and will continue to outsource all of it. The quality has been very good and the cost in the district's view has been reasonable.

Variation in Views

Each district supplied three percentages for each function, reflecting the amount of work being outsourced, the desired amount to outsource, and the maximum amount that should be outsourced. The full report shows all of the recommended percentages (*4*), but Table 1 offers a sampling from three districts. The table indicates the variation in views about outsourcing from district to district. These variations underscore the unique needs and perceptions of each district and state; to be beneficial, outsourcing practices should account for the variations in needs from district to district or state to state while also addressing the advantages and disadvantages perceived by local staff.

To meet a heightened demand for projects with restricted resources, state DOTs successfully have outsourced many routine functions to private-sector consultants and contractors. The need to outsource is increasing, to accommodate steady work loads and decreases in staff. Cost savings, innovation, improved quality and efficiency, improved peak demand performance, speedy project delivery time, and risk management are a few of the demonstrated benefits from outsourcing.

As the comments and the recommended percentages from survey respondents show (Table 1), a considerable amount of variation is associated with the perceived outsourcing needs and actual practices of state DOTs. Because of this extreme variation among the agencies, no guidelines or best management practices have been established for outsourcing the functions and defining the responsibilities. The most logical recommendation is to review the practices of a state DOT and assess whether it is using the most practical applications of in-house and outside resources.

Outsourcing continues to be a necessity and a reality among state DOTs and is capable of delivering transportation projects in an efficient and timely manner through public–private partnerships for the improvement of transportation infrastructures. The successful use of outsourcing requires increased input and involvement from DOT management, a greater in-depth understanding of effective outsourcing practices by DOT staff who may be new to the use of outsourcing, and a more comprehensive fiscal and performance analysis to improve understanding of the cost and effectiveness of performing tasks through outside sources.

TABLE 1 Sample of Recommended Outsourcing Percentages for Each District

Functions	A Urban (%)	B Rural (%)	C Urban (%)
Planning	50	15	10
Design Phase I	70	10	50
Design Phase II	60	10	75
Right-of-way: Appraisals	0	20	50
Right-of-way: Appraisal review	70	50	25
Right-of-way: Relocation	0	0	20
Right-of-way: Property management	0	0	0
Nonconstruction surveying	75	10	90
Geotechnical exploration*	75	NR	50
Construction materials testing	30	0	20
Construction quality control	40	50	20
Construction engineering inspection	NR	NR	15
Road and pavement repair: Patching	NR	60	75
Road and pavement repair: Striping	80	90	100
Road and pavement repair: Guardrails	80	100	100
Bridge repair	75	30	75
Maintenance: Mowing	95	20	100
Maintenance: Debris removal	70	100	50
Maintenance: Ditching and draining	65	0	30
Snow and ice removal	75	0	50
Traffic control maintenance and upgrade	80	60	50
Rest areas	100	100	100
Equipment purchasing: Sedans and trucks*	—	—	—
Equipment purchasing: Heavy equipment*	—	—	—
Equipment maintenance: Sedans and trucks	90	100	100
Equipment maintenance: Heavy equipment	50	40	20

NR = nonresponse.

*Majority of function is handled by central office.

Acknowledgment

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NEW NCHRP-TCRP REPORT

COMMUTING in America III

The Third National Report on Commuting Patterns and Trends

ALAN E. PISARSKI

Author of all three editions of Commuting in America *(1987, 1996, and 2006), Pisarski is a transportation consultant in Falls Church, Virginia. He serves as Chair of the TRB History Committee, of the Data and Information Systems Section, and of the National Cooperative Highway Research Program Project Panel on Using American Community Survey Data for Transportation Planning.*

The average daily commute to work is taking longer now than it has in the past, according to *Commuting in America III* (CIA III), published in October by the Transportation Research Board and jointly sponsored by the National Cooperative Highway Research Program (NCHRP) and the Transit Cooperative Research Program (TCRP). The book is the latest decadal review of the nation's commuting—or journey-to-work—patterns. The findings are based on extensive, special tabulations prepared by the Bureau of the Census and funded by the American Association of State Highway and Transportation Officials as part of the Census Transportation Planning Package program.

CIA III reports that the average one-way travel time for a commuter in 2000 was 25.5 minutes. This represented a 3-minute increase in travel time over the average in 1990—a substantial change, considering that from 1980 to 1990 the increase was 40 seconds. The trend is even more noteworthy because from 1980 to 1990 the nation added approximately 23 million solo drivers to the commute, yet from 1990 to 2000 the number of solo drivers grew only by 13 million. This indicates that the transportation capacity inherited by this generation is being used up and that the investments in the system for future generations also are not keeping pace.

Changes and Shifts

To cope with the lengthening commute, more Americans are leaving for work during the so-called

shoulders of the peak period, between 5 a.m. and 6:30 a.m. or after 9 a.m. One result of many more workers leaving their home county to work in another county is the extension of the commute to more than 90 minutes, which the Census labels "extreme." Although the personal vehicle is still the most common mode for getting to work, transit and carpooling are increasing in many areas. More commuters are traveling from suburb to suburb instead of from suburb to central city, the CIA III data show.

During the coming decades, many baby boomers—who will start turning 65 in 2010—will leave the workplace and stop commuting. At the same time, the latest projections from the Census Bureau show that the number of younger people entering the work force will not be sufficient to replace those who will retire. Almost 20 million people ages 18 to 65 are expected to enter the work force during the years 2000 to 2010, but only about 12 million during the two succeeding decades.

These projections may underestimate the number of Americans who will be working, because it is difficult to project how many immigrants will arrive and enter the workforce and how many baby boomers will keep working after age 65. Employers will react to the challenge of finding workers by offering more flexible work schedules and other approaches to attract new workers and retain older employees.

Immigration in the past decade has increased far more than expected. Because of this influx, the nation's 30-year decline in the rate of population growth reversed sharply in the 1990s, returning to the growth rates of the 1970s. This "immigration bubble" is changing the nature of the workforce and commuting patterns.

National statistics and trends concerning commuting do not necessarily represent the experience of individual communities or of regions. This can be true for carpooling, bicycling, working at home, and—particularly—for public transportation. The differences across the nation in the availability of transit services are reflected in the uneven selection of transit modes for commuting. Transit is more prevalent in densely populated areas, and transit use grows well beyond the national average as the size of the metropolitan area increases.

Sample Findings

◆ The number of new solo drivers grew by almost 13 million in the 1990s.

◆ The number of workers with commutes of more than 60 minutes grew by almost 50 percent between 1990 and 2000. Those who had a commute of more than 60 minutes in 2005 traveled an average of 80 minutes.

◆ Men make up the majority of commuters in the early morning, from midnight to 7:30 a.m. Women tend to commute later and make up the majority of commuters after 7:30 a.m.

◆ In the 1990s the number of Americans who commute from the city to the suburbs constituted a 20 percent share of all metropolitan growth, exceeding the increase in the number of people commuting from the suburbs to the city. Travel from city to suburbs now accounts for 9 percent of commuting activity.

◆ The percentage of African-American households without vehicles dropped from 31 percent to 24 percent between 1990 and 2000 and was close to 20 percent in 2005.

◆ Although the population over age 65 grew by only 12 percent from 1990 to 2000, the number of workers over age 65 increased by 21 percent.

◆ Thirty million vehicles were added to households during 1990 to 2000, and 13 million of those were added to households that already had two or more vehicles.

◆ Approximately 4 percent of workers live in households with no vehicle.

Commuting in America III (NCHRP Report 550–TCRP Report 110) is available from the TRB bookstore for $60. Volume discounts and curriculum adoption incentives are available. For additional information and to order, call 202-334-3214 or visit the TRB bookstore online at www.TRB.org/bookstore.

Pisarski's Top 10 Commuting Tidbits

10. The proportion of workers in single-occupant vehicles is still increasing, but the rate has slowed; some areas in the West have experienced declines—a first.
9. National changes in carpooling and transit are the products of new regional shifts; typically, losses in these modes have occurred in the East and in the Midwest, with gains in the West.
8. There have been significant surges in African-American automobile ownership.
7. Immigrants' use of some modes is transitional, giving way to mainstream patterns over time.
6. There are signs of increased commuting, along with mode changes, among older workers.
5. Sharp increases have occurred in the proportion of workers traveling more than 60 and even more than 90 minutes to work.
4. The donut-shaped metropolitan area is on the rise, with big work flows into and out of the suburbs.
3. The increase in working from home is continuing, pervasive, and substantial.
2. Significant increases have occurred in the percentage of workers leaving for work before 6 a.m.
1. The number of workers leaving their home county to work has risen dramatically.

What Does the Report Reveal?

The data in CIA III indicate that work travel is an economic phenomenon and a social phenomenon, as well as a transportation issue. The report identifies a new stage in commuting patterns as the baby boom era recedes. To provide skilled workers to maintain the economy, society will need to find ways to keep aging boomers at work, to attract immigrants and rural populations, and to attract more women into the workplace.

Economic Perspective

From an economic perspective, the surge in the percentage of people working outside their county of residence has many implications. People are moving to exurban regions for desirable housing at an affordable price. Rural workers are attracted to suburban job opportunities that are locating near the periphery of metropolitan areas.

Despite congestion, workers have access to an array of jobs distributed across large metropolitan areas. Employers in turn have access to employees from an immense commuter-shed of adjacent counties, increasing productivity—one-third of the nation's population resides in 12 areas with more than 5 million people, creating massive aggregations of skilled workers. In this scenario, workers increasingly are able to live where they want and to work where they want.

Social Perspective

The substantial increase in African-American households with access to vehicles speaks volumes about rising opportunity in this country; however, it also suggests that there is a long way to go before opportunity reaches anything like parity.

As their time of residence in the United States increases, immigrant populations transition through the modes of travel to work, demonstrating the power of opportunity. Those in the United States less than five years are oriented to walking, biking, transit, and—most of all—carpooling to jobs. These modes often play an important role in immigrants' socialization. After 10 or 15 years, many of the immigrants make the transition to the automobile and adopt commuting patterns closer to the average.

Transportation Perspective

The coping options available to commuters—such as leaving for work early—may be dwindling, which could make working from home an important tool for responding to congestion. The share of commuters leaving home before 6 a.m. reveals the weaknesses in the services provided by the nation's transportation system; but this also is just one symptom of people adjusting to avoid heavy congestion in the peak periods.

The growth in working from home can be characterized as a quiet revolution. All three of the CIA reports have documented that, along with driving alone, working from home is the only mode of transportation that has grown throughout the entire period of the baby boom working years. Working from home has now surpassed walking as a way to get to work and is third behind carpooling in many metropolitan areas. Because of its importance for the older members of the workforce, working from home could be a major trend in the future.

Evolving and Emerging Patterns

In 1996, *Commuting in America II* identified 10 patterns to watch. None of the 10 has run its course yet, and it will be some time before these patterns are fully played out. Such themes as immigration, an aging workforce, and changing lifestyles are perhaps unfolding in new ways in this decade but will remain significant well into the next decade.

In addition to trends observed in the past 10 years, new patterns to watch include the following:

- Who and where will the workers be?
- Will long-distance commuting continue to expand?
- Will the role of the work trip decline, grow, or change?
- Will the value of time in an affluent society be the major force that guides commuting decisions?
- Will the value of mobility in our society be recognized?

Each of these areas of concern bears watching in the coming years, especially as the annual American Community Survey replaces the decennial census and becomes the only source of journey-to-work data from the Census Bureau.[1] Although getting to and from work every day seems mundane, the patterns will continue to change, challenging commuters and public policy makers into the future.

PHOTO: WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

[1] This challenge to state and local planning capabilities is being addressed by NCHRP Project 8-48, Using American Community Survey Data for Transportation Planning, which will produce a guidebook in 2007 for using the new annual data in the transportation planning process.

Reflections on the *Commuting in America* Series

The work on the *Commuting in America* series began more than 20 years ago, using census data to describe the emerging patterns of commuting behavior. Frank Francois, Chair of the Steering Committee for the first report, noted in the preface that "it does not purport to reflect the policy positions of any of the sponsoring organizations and should not be interpreted in this manner." The goal was "to serve as a common resource of factual information upon which policy makers can draw in shaping transportation and development actions and policies over the coming years." The third volume continues that approach and that goal.

In the conclusion to *Commuting in America III*, I looked back at the task:

What a privilege it is to be able to work on a subject that is a source of endless interest. The need to better understand transportation behavior, and as a part of that the need to better understand commuting, is still with us and, it seems, will be for a long time. The ways in which human needs and preferences play out in a spatial context, given changes in technological possibilities, in the demography of the population, and in the larger society, generates an almost endless array of patterns to investigate and stories to tell.

When I began the first volume in April 1984 at the invitation of past TRB Executive Committee Chair Peter Koltnow, I didn't recognize that this was going to be a very big part of my career's work. I have been continually delighted that it turned into that and that it has brought me into contact with so many wonderful people in our profession. It constantly reminds me how proud I am to be a part of it all.

—Alan E. Pisarski

NEW TRB SPECIAL REPORT: WORKSHOP SUMMARY

Improving Road Safety in Developing Countries

Opportunities for U.S. Cooperation and Engagement

JOSEPH R. MORRIS

The author, Senior Program Officer, TRB Division of Studies and Special Programs, served as rapporteur for the workshop.

With the rapid expansion of motor vehicle use in developing nations, road traffic–related deaths and injuries are rising sharply. More than 1 million people died from road traffic crashes in low- and middle-income nations in 2000. According to the World Health Organization (WHO), that number could nearly double by 2020. Children are particularly vulnerable—WHO calculates that in 2002, road traffic injuries were the second-leading cause of death worldwide among those 5 to 29 years old; of those who were killed, 96 percent lived in low- and middle-income countries.

The rate of serious injuries is estimated to be 20 times that of road deaths. In addition to the human toll, road traffic injuries impair the growth and development of low- and middle-income countries by draining at least 1 percent of their gross domestic product, or $65 billion, annually.

Effects and Prospects

In January 2006, the Transportation Research Board, with the Policy and Global Affairs Division and the Institute of Medicine of the National Academies, convened a workshop, "Improving Road Safety in Developing Countries: Opportunities for U.S. Coop-

PHOTO: SUSAN GALLAGHER

A crowded bus negotiates a street in Usulutan, El Salvador.

eration and Engagement." The event brought together administrators and professionals from U.S. government agencies, nongovernmental organizations, international organizations, and academic research institutions to discuss the effects of the worldwide problem of road traffic injuries on U.S. interests, as well as the prospects for further U.S. action to address the problem. The National Highway Traffic Safety Administration and the Centers for Disease Control and Prevention sponsored the workshop.

The goal was to provide a view of the diversity of U.S. interests affected by the global problem of road traffic deaths and injuries, the scope of the activities by U.S. agencies addressing the problem, and the prospects for further U.S. engagement. The discussions were intended to help government agencies gauge whether the U.S. response is in proportion to the interests at stake and to identify the next steps in a more effective response.

Key Observations

Highlights of the presentations and discussions included key observations about the problem and about the U.S. role in helping developing countries to cope with it:

◆ The scale of the road safety problem is large—1.2 million deaths annually—and is growing rapidly as motorization increases in the developing world. According to projections, road traffic injuries will cause nearly 3 percent of all deaths worldwide in 2030, up from 2 percent in 2002. Experience indicates that certain interventions to reduce road injuries have the potential to be highly cost-effective, compared with other large-scale international public health programs.

◆ The United States can assist developing countries in addressing the problem. Through decades of motorization, the United States has developed professional and institutional strengths across many sectors: data systems, road and vehicle standards, emergency medical care, intervention programs, and enforcement and adjudication.

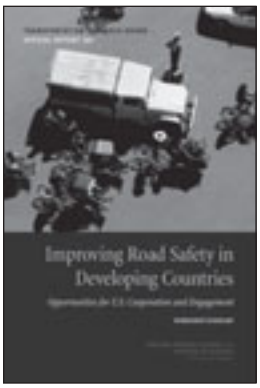
◆ Despite the efforts of government agencies and nongovernmental organizations, U.S. engagement is not sufficient to have a significant effect on the problem. In some agencies, activities aim to protect U.S. citizens traveling as workers or tourists. Other government activities address aspects that affect trade and commerce, such as vehicle safety standards and cross-border trucking. Developing nations have received some assistance for research, data systems, and professional exchanges. U.S. agencies participate in the road safety programs of the United Nations and the World Health Organization; but again, the scale of these multilateral efforts has been modest. U.S. nongovernmental organizations are participating in technical exchanges and public communication programs in developing countries.

PHOTO: MARK ROSENBERG

A broken bicycle lies among shattered glass after a collision between a bus and a cyclist in Huangshan, China. Cyclists are among the most vulnerable road users when they must share the roads with cars, trucks, and buses.

◆ According to many of the government participants, stronger and more systematic collaboration among U.S. agencies and between government and private entities would increase the effectiveness of U.S. efforts. Collaboration is important because the most effective actions would involve several sectors, including transportation, health care, emergency services, law enforcement, and education.

◆ If the United States increases its engagement, it should be guided by the experience of other nations and international organizations. This experience indicates that the most effective interventions focus on institutional capacity building in the transportation, health, enforcement, and public administration sectors; entail long-term commitments by all parties; and incorporate monitoring and evaluation of outcomes.



TRB Special Report 287, Improving Road Safety in Developing Countries: Opportunities for U.S. Cooperation and Engagement, *is available from the TRB online bookstore, www.TRB.org/bookstore; to view the book online, www.TRB.org/publications/sr/sr287.pdf.*

PHOTO: SUSAN GALLAGHER

Open-bed trucks are typical modes of transport in El Salvador.

◆ U.S. programs also could derive lessons from the response to other global health crises, including the HIV-AIDS epidemic. The lag between recognition of the epidemic and the scaling up of a response resulted in enormous numbers of deaths and illnesses, as well as increases in the costs of prevention and treatment. Mounting a large-scale response required scientific evidence of the magnitude of the threat and of the effectiveness of interventions, the political will to commit resources, and a social strategy for organizing effective interventions.

◆ Increasing the effectiveness of the U.S. response to the global road safety problem would require coordinated planning by all the relevant government agencies.

Inventory of Activities

Appointed by the National Research Council of the National Academies, the workshop planning committee (see box, below) arranged the agenda and identified program participants. In preparation for the workshop, representatives of 27 U.S. government agencies were interviewed, and an inventory of the agencies' activities and interests related to road safety in developing countries was compiled from the responses.

Susan Gallagher of Education Development Center, Inc., conducted the inventory and presented the results at the workshop. Other speakers included John Flaherty, Chief of Staff of the U.S. Department of Transportation; Maryvonne Plessis-Fraissard, Director, Transport and Urban Development, the World Bank; and Harvey Fineberg, President of the Institute of Medicine. A panel of speakers from India, Australia, the Netherlands, and Norway described cooperative traffic safety programs linking high-income and developing countries. TRB has published a summary of the presentations and workshop discussions as Special Report 287, *Improving Road Safety in Developing Countries: Opportunities for U.S. Cooperation and Engagement*.

Next Steps

Several participants suggested immediate next steps that U.S. government agencies could take in developing a more effective response to the global problem of road traffic safety. Creation of a permanent interagency body to coordinate U.S. government efforts could be a first step. Several immediate actions were suggested as part of the initial agenda of the interagency body:

◆ Complete the task of defining and documenting the U.S. interest in the problem of international road safety and of identifying the agencies and programs already involved.

◆ Engage U.S. nongovernmental organizations, determine their relevant interests and resources, and establish communications.

◆ Conduct case studies of recent significant international road safety initiatives.

◆ Coordinate a process of practical, governmentwide planning along two tracks: first, identify opportunities for more effective U.S. contributions using current resources; and second, determine the initial elements of a U.S. program if new funds became available. Plans would demonstrate that U.S. participation could support cost-effective interventions, including interventions with immediate short-term payoffs, and that the benefits would contribute to achieving overall development-related policy objectives. Specific activities that could be elements of these plans include establishing data systems, road and vehicle standards, emergency medical care, intervention programs, and enforcement and adjudication.

Planning Committee for a Workshop on Traffic Safety in Developing Nations

Mark L. Rosenberg, Task Force for Child Survival and Development, Decatur, Georgia, *Chair*
Anthony Bliss, World Bank, Washington, D.C.
T. Bella Dinh-Zarr, AAA, Washington, D.C.
J. Michael McGinnis, Institute of Medicine, Washington, D.C.
V. Setty Pendakur, Pacific Policy and Planning Associates, Vancouver, Canada

CALENDAR

TRB Meetings
2007

January

16–19 Geosynthetics Conference 2007*
Washington, D.C.

20 Data Analysis Working Group (DAWG) Forum on Pavement Performance Data Analysis
Washington, D.C.
A. Robert Raab

21–25 TRB 86th Annual Meeting
Washington, D.C.
Linda Karson

February

8–9 Disaster Planning for the Carless*
New Orleans, Louisiana
Richard Pain

April

17–18 18th Biennial TRB Visibility Symposium
College Station, Texas

25–26 National Summit on Agricultural and Food Truck Transport for the Future*
Washington, D.C.

May

6–9 11th National Transportation Planning Applications Conference
Daytona Beach, Florida
Kimberly Fisher

6–9 National Conference on Pavement Management*
Norfolk, Virginia
Stephen Maher

9–11 9th Annual Harbor Safety Committee Conference*
Chicago, Illinois

June

3–8 1st North American Landslide Conference*
Vail, Colorado

18–21 11th International Conference on Mobility and Transport for Elderly and Disabled People*
Montreal, Quebec, Canada

24–27 9th International Conference on Low-Volume Roads
Austin, Texas

24–27 3rd Urban Street Symposim
Seattle, Washington

July

7–9 TRB 2007 Summer Conference
Chicago, Illinois
Mark Norman

8–11 46th Annual Workshop on Transportation Law
Philadelphia, Pennsylvania
James McDaniel

9–11 2007 Transportation Planning and Air Quality Conference
Orlando, Florida

August

19–21 Meaningful Transit Input into Transportation Planning and Land Use: Best Practices
Peter Shaw

September

10–12 3rd National and 1st International Conference on Performance Measurement
Irvine, California
Martine Micozzi

25–27 8th International Symposium on Cold Region Development: ISCORD 2007*
Tampere, Finland

November

6–8 7th National Conference on Asset Management: New Directions in Transportation Asset Management and Economic Analysis
New Orleans, Louisiana

2008

January

13–17 TRB 87th Annual Meeting
Washington, D.C.
Linda Karson

June

23–28 7th International Conference on Managing Pavements and Other Roadway Assets*
Calgary, Alberta, Canada

August

11–16 6th International Conference on Case Histories in Geotechnical Engineering*
Washington, D.C.

October

1–3 3rd International Conference on Accelerated Pavement Testing*
Madrid, Spain
Stephen Maher

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.

RESEARCH PAYS OFF

VDOT

Very Early Strength Latex-Modified Concrete Bridge Overlays

Virginia's Quick Cure for Roadway Maintenance Delays

MICHAEL M. SPRINKEL

The author is Associate Director, Virginia Transportation Research Council, Charlottesville.

Overlays of hydraulic cement concrete usually are placed on bridge decks to extend the service life by reducing the infiltration of water and chloride ions. The overlays also improve the deck's skid resistance, ride quality, and surface appearance. Many conventional latex-modified concrete (LMC) overlays have performed well in Virginia for more than 30 years and clearly presented a cost-effective way to extend the life of bridge decks.

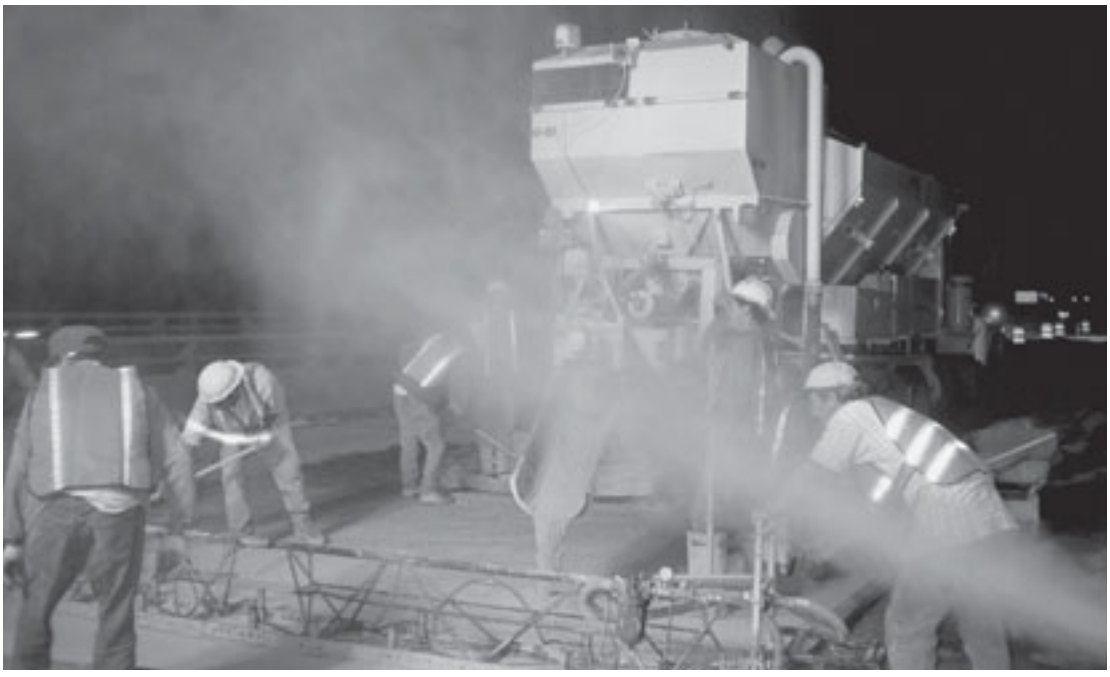
Problem

The construction of overlays has become increasingly difficult because of increases in traffic. Lanes cannot be closed for extended periods because of the resulting traffic congestion, particularly on the Interstate Highway System. To minimize traffic delays, contractors often must work at night, when the ambient air temperatures are generally lower, which increases the curing time of the concrete. The Virginia Department of Transportation (DOT) therefore was interested in a concrete that would require a short time to cure yet would last longer.

Solution

Virginia DOT has used very-early-strength latex-modified concrete (LMC-VE) for patching overlays since 1992. Many decks on Interstate 81 in Virginia were patched at night with LMC-VE. As the number and the size of the patches have increased, however, and as the patches have continued to perform well, it has become obvious that LMC-VE could be used to overlay an entire bridge deck.

In a government–industry cooperative effort, Virginia DOT decided to evaluate the LMC-VE overlay on two entire bridge decks: the first was on the Lord Delaware Bridge on Route 33 in King and Queen County in 1997; and the second was on the westbound lane of Route 620 over I-495 in Fairfax County in 1998 (*1*).



Placing an LMC-VE overlay with conventional equipment. The concrete is batched and mixed in a mobile concrete mixer and struck off with a vibrating screed. A fog spray is applied, as shown, to increase the relative humidity and help prevent plastic shrinkage cracking.

A typical LMC-VE overlay construction sequence starts by closing a lane at 9 p.m. By midnight of the first night, the concrete surface is removed by milling, and the patch area is removed with pneumatic hammers. The patching is completed by 2 a.m., and the lane opens to traffic at 5 a.m.

Between 9 p.m. and midnight of the second night, the surface is prepared by shot blasting, and the deck is prewetted. During the placement of the overlay, a fog spray increases the relative humidity to prevent shrinkage cracking, and the work is completed by 2 a.m. (see photograph, facing page). The lane opens to traffic at 5 a.m. The sequence is repeated until all lanes are overlaid.

The overlays achieve the required compressive strength in as little as 3 hours at ambient temperatures in the range of 17 to 24 degrees centigrade (62 to 76 degrees Fahrenheit). In contrast, conventional LMC overlays require 2 to 3 days or more.

LMC-VE overlays have the same mixture proportions as conventional LMC overlays—7 bags of cement per cubic yard, 3.5 gallons of styrene butadiene latex per bag of cement, and a maximum water-to-cement ratio of 0.40. For LMC-VE, the specified minimum compressive strength of 2,500 psi (ASTM C39) is achieved in 3 hours, permitting Virginia DOT to open the lane more quickly to traffic. Virginia DOT researchers determined that the very-early strength was due to the special cement, which contains approximately 1/3 calcium sulfoaluminate and 2/3 dicalcium silicate (*1*).

Chloride permeability tests (AASHTO T277) show that LMC-VE has significantly lower permeability to chloride ions than LMC and therefore could be more durable. At 28 days, the permeability of conventional LMC overlays is low and that of LMC-VE overlays is low to very low. After 1 year, the permeability of LMC overlays is low and that of LMC-VE is very low (*1, 2*).

LMC-VE overlays are less prone to cracking because they have less shrinkage than LMC and therefore can be more durable. The length change (ASTM C157) of LMC-VE specimens at 170 days is approximately 0.02 percent, compared with 0.06 percent for LMC specimens (*2*).

Like other concrete overlays, LMC-VE overlays achieve high bond strengths with the appropriate selection and use of surface preparation equipment and procedures, mixture proportions, and placement and curing procedures (*3*).

The bond strength and chloride permeability of the first LMC-VE overlay were evaluated after 9 years of service. The bond strength was adequately high. The chloride permeability was still negligible, indicating long-term protection.

Application

In 2006, an LMC-VE overlay was placed on a 5,000-square-yard deck on I-64 over the Rivanna River. Another overlay was placed on the Theodore Roosevelt Bridge, which carries I-66 into the District of Columbia. Work on these projects took place during off-peak traffic periods, often at night, to minimize delays to the traveling public.

Virginia DOT expects to increase the use of the LMC-VE overlay, and the record of success continues to grow. Because of this research, Virginia DOT now has a special provision for LMC-VE in overlay programs.

Benefits

LMC-VE can protect and repair decks with a minimum of inconvenience to the traveling public. The patches and overlays can limit lane closures to 8 hours and can be applied at night. A 3-hour curing period is adequate, depending on the temperature.

Virginia DOT research has shown that LMC-VE overlays are more durable than other concrete overlays. They are less prone to cracking because they have less shrinkage, and they are more resistant to chloride ion penetration than other overlays.

In addition, LMC-VE overlays cost about 75 percent of what conventional LMC overlays cost (*1*). The special cement required for the LMC-VE overlay, however, costs 4 times as much as the Type I and II cements for conventional LMC overlays. Although this adds approximately $90 per cubic yard of concrete, the higher cost is more than offset by the reduced cost of traffic control.

For more information contact Michael M. Sprinkel, Associate Director, Virginia Transportation Research Council, 530 Edgemont Road, Charlottesville, VA 22903, phone 434-293-1941, fax 434-293-1990, e-mail: Michael.Sprinkel@VDOT.Virginia.gov.

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2. Sprinkel, M. M. *Latex-Modified Concrete Overlay Containing Type K Cement*. FHWA/VTRC 05-R26, Virginia Transportation Research Council, Charlottesville, 2005.
3. Sprinkel, M. M. High-Performance Concrete Overlays for Bridges. Proceedings, PCI-FHWA Convention, Orlando, Florida, October 19–22, 2003.

EDITOR'S NOTE: Appreciation is expressed to G. P. Jayaprakash, Transportation Research Board, for his effort 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).

Leanna Depue

Missouri Department of Highway Safety

With three decades of service in transportation safety and a strong background in health education safety, Leanna Depue has directed the highway safety division of the Missouri Department of Transportation (DOT) since September 2005. As a full-time administrator, she works to ensure that the division meets its goal: to reduce deaths and serious injuries on Missouri roadways and to improve traffic safety through behavioral and engineering programs that target speeding, impaired driving, and safety enhancement to the roadway.

An advocate for collaboration among safety researchers and practitioners, Depue applies this approach in advising the grant programs of the National Highway Traffic Safety Administration, the Federal Motor Carrier Safety Administration's Motor Carrier Safety Assistance Program, and the Federal Highway Administration's Safe Routes to School and Highway Safety Improvement programs.

"Throughout the years, I've focused on using a collaborative process to identify problems, build coalitions, and expend resources in an evidence-based manner."

"Throughout the years, I've focused on using a collaborative process to identify problems, build coalitions, and expend resources in an evidence-based manner," she explains. "This type of process can take many of us outside of our comfort zones, but ultimately helps researchers and practitioners work together to achieve positive results."

In October 2003, during Depue's tenure as director of the Missouri Safety Center at Central Missouri State University, Warrensburg, the state was asked to develop a Comprehensive Highway Safety Plan (CHSP) as part of the American Association of State Highway and Transportation Officials' (AASHTO's) Lead States Initiative, which aims to reduce the fatality rate on U.S. highways. Depue was appointed to facilitate Missouri's CHSP development, and under her leadership a working group of representatives from the Missouri Department of Health and Senior Services, Highway Patrol, DOT, and Missouri Safety Center at Central Missouri State University met to develop the plan.

After meetings with key safety partners, the CHSP working group met several times to identify guiding principles, discuss key strategies, address primary emphasis areas, and conduct data analysis to identify problem areas. Data were carefully analyzed over a 3-year period to establish and identify trends; the analysis included data on crash type, driver age, linked hospital and crash reports, and demographics.

"Several drafts of the CHSP and a fatality reduction goal were reviewed by the working group," Depue recalls. "A final draft document was then sent out to safety partners throughout Missouri for comment, and revisions were made by our group as appropriate."

The completed document, *Missouri's Blueprint for Safer Roadways*, was published in November 2004. The final plan included an Essential Eight, four emphasis areas, and 17 targets accompanied by strategies for use in attaining the goal of highway fatality reduction. Because the implementation of the blueprint targeted the state and regional levels, statewide meetings were held to establish regional coalitions and to expand partnerships.

"I worked hard to ensure that our planning partners were involved in the state and regional coalition planning process," Depue notes. "Two metropolitan planning organizations now serve on the executive committee of the Coalition for Roadway Safety, and our regional planning partners also serve on regional coalitions."

As a result of Depue's efforts, 10 regional coalitions are working with the Missouri state coalition to implement strategies to help reduce annual highway fatalities to less than 1,000 by 2008. Success would mean the state's lowest highway crash-related fatality count since 1993.

Depue's involvement with TRB began in 1992 when she joined the Transportation Safety Management Committee; she served as chair from 1998 to 2003. Depue, who serves as vice chair of the AASHTO Standing Committee on Highway Traffic Safety Subcommittee on Safety Management, currently chairs the Safety Section of the System Users Group. She is a member of the National Cooperative Highway Research Program Project Panel on AASHTO Strategic Highway Safety Plan Implementation Support, the Task Force on the Development of the Highway Safety Manual, the Committee on Research Priorities and Coordination in Highway Infrastructure and Operations Safety, and the Strategic Highway Research Program II Technical Coordinating Committee for Safety Research.

Educated at Southern Illinois University at Carbondale, Depue earned a bachelor's degree in physical education in 1972 and a master's degree and doctorate in health education and safety in 1973 and 1983, respectively. She has received the National Safety Council's Distinguished Service to Safety Award, the Hunter Education Association's Past President's Award, and Southern Illinois University's Alumni Achievement Award.

Imad L. Al-Qadi

Illinois Center for Transportation

Integrating the worlds of academia, research, and practice is all in a day's work for scholar and transportation engineer Imad Al-Qadi. As the founding director of the Illinois Center for Transportation (ICT), an innovative partnership between the Illinois Department of Transportation and the University of Illinois at Urbana–Champaign, Al-Qadi conducts research and promotes the implementation of new technologies, with the goal of strengthening the partnership between academia, industry, and transportation agencies.

Since 2004, Al-Qadi has served as the director of the Advanced Transportation Research and Engineering Laboratory (ATREL) at the University of Illinois at Urbana–Champaign. ATREL combines transportation research and education within the university's highly-ranked Department of Civil and Environmental Engineering.

"As a professor I emphasize the connection between theory, modeling, and hands-on engineering. Knowledge in these three areas is essential for the transportation leaders of tomorrow."

In the past two decades, Al-Qadi's research has led to several advances. In 1993, he advocated nondestructive testing for transportation infrastructure and chaired the first workshop on the subject under the sponsorship of the National Science Foundation (NSF) and the Federal Highway Administration (FHWA). His research and leadership in nondestructive testing contributed to the development of several now widely adopted electromagnetic techniques to characterize civil engineering materials, predict internal flaws, and measure pavement layer thicknesses.

In addition, Al-Qadi has worked extensively in the field of pavements and hot-mix asphalt. In 1998, his work culminated in the creation of the Virginia Smart Road, a 1.6-mile pavement testing facility that he designed and outfitted with instruments, assisted by his students. The facility has provided insight into pavement response to loading and the environment, and has aided development of novel pavement modeling, ground-penetrating radar signal analysis, and pavement interface technologies.

His research also encompasses the use of geosynthetics to stabilize and reinforce pavements. He is currently leading a national research effort on wide-base tires and on the modeling of pavement–tire loading; the North American effort to develop guidelines for performance-based crack sealants; and performing studies on pavement reinforcement and reflective cracking.

Al-Qadi has forged cooperative links with the transportation industry and government agencies. He has served as principal investigator on more than 70 projects sponsored by NSF, the first Strategic Highway Research Program, the National Cooperative Highway Research Program, and FHWA.

Editor-in-chief of the *International Journal of Pavement Engineering*, associate editor of *Research on Nondestructive Evaluation*, and a past editor of the *Construction and Building Materials Journal*, Al-Qadi has authored or coauthored more than 300 publications, delivered many transportation-related presentations and lectures, and has served as a transportation consultant to many national and international corporations and government agencies.

A registered professional engineer and a fellow of the American Society of Civil Engineers (ASCE), Al-Qadi has been associated with TRB for more than 20 years. He has served on many TRB committees, task forces, and panels. He currently chairs the TRB Maintenance Section, and has chaired the TRB Committee on Sealants and Fillers for Joints and Cracks Committee and the Geosynthetics in Flexible Pavement Systems Subcommittee.

In addition to his research and leadership roles, Al-Qadi teaches undergraduate and graduate courses on civil engineering materials, pavement design, management systems and rehabilitation, asphalt technology, assessment of infrastructure condition, and nondestructive evaluation.

"As a professor I emphasize the connection between theory, modeling, and hands-on engineering," Al-Qadi notes. "Knowledge in these three areas is essential for the transportation leaders of tomorrow."

A native of Nablus, Palestine, Al-Qadi graduated in 1984 with a bachelor's degree in civil engineering from Yarmouk University in Jordan and received master's and doctorate degrees in civil engineering from the Pennsylvania State University in 1986 and 1990, respectively. His awards include the Limoges Medal of Merit, the International Geosynthetic Society Award, and the 2002 Virginia Tech College of Engineering Award for Excellence in Research. He received TRB's D. Grant Mickle Award for 2006, and is the only pavement academic to receive the National Science Foundation's Young Investigator Award.

In 1990, he joined the faculty of the Charles E. Via, Jr., Department of Civil and Environmental Engineering at Virginia Tech, becoming a professor in 1998 and the Charles E. Via, Jr., Professor in 2002. He was named as the Founder Professor of Engineering at the University of Illinois at Urbana–Champaign in 2004.

IN MEMORIAM

Thomas D. Larson 1929–2006

Larson

Former Federal Highway Administrator and TRB Executive Committee Chair Thomas Larson died in State College, Pennsylvania, on July 20, at the age of 77. In his distinguished and influential career, Larson took on the roles of researcher, teacher, administrator, policymaker, and consultant, emphasizing the connections between transportation policy, research, and innovation. In 2003, he was honored with the Frank Turner Medal for Lifetime Achievement in Transportation.

Born in Philipsburg, Pennsylvania, Larson earned bachelor's, master's, and doctorate degrees in civil engineering from the Pennsylvania State University (Penn State). He taught at the university from 1962 to 1979 and founded and directed the Pennsylvania Transportation Institute.

In 1979, Larson was appointed Pennsylvania secretary of transportation, a position he held until 1987. As secretary, he tripled the commonwealth's state highway construction budget and enacted many changes in production and contracting that saved the Pennsylvania Department of Transportation (DOT) millions of dollars and helped boost the department's image.

In 1987, Larson returned to Penn State as Pennsylvania Professor of Government and Management and as a special assistant to the university's president. Two years later, President George H. W. Bush selected Larson to lead the Federal Highway Administration (FHWA), where he served until 1993. As FHWA's Executive Director, he developed the 1990 National Transportation Policy, which earned him the U.S. DOT's highest award, the Secretary's Gold Medal. Larson also led the department's negotiations with Congress for the Intermodal Surface Transportation Efficiency Act of 1991.

COOPERATIVE RESEARCH PROGRAMS NEWS

Bridge Deck Design Criteria and Testing

Light in weight and able to increase live-load capacity, steel grid and fiber-reinforced polymer (FRP) are finding increased use in the construction of modern bridge decks on stringers and floor beams. Because conventional, steel, and FRP decks differ, specific design criteria must be stipulated to ensure deck serviceability and performance, and different testing procedures may be necessary to evaluate and validate deck designs.

Current design criteria rely on limited analytical and experimental studies that may overlook key characteristics of new deck systems, and the testing procedures may not adequately address the design elements or materials used in the systems. Design criteria and testing procedures are needed therefore to identify factors that influence the strength, durability, and long-term performance of bridge decks. Also needed are recommendations for design criteria and testing procedures applicable to different types of decks.

Purdue University has been awarded a $499,836, 36-month contract [National Cooperative Highway Research Program (NCHRP) 10-72, FY 2006] to recommend design criteria and testing procedures for bridge decks, for consideration and adoption by the American Association of State Highway and Transportation Officials (AASHTO) as part of the AASHTO Load and Resistance Factor Design bridge design specifications. The research will include steel grid decks, decks with FRP materials, and other innovative bridge decks on stringers and floorbeams.

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

SELECTING RESEARCH PROJECTS—The selection of Transit Cooperative Research Program (TCRP) projects for Fiscal Year 2007 was the subject of discussions at the October 19–20 meeting of the TCRP Oversight and Project Selection Committee (TOPS). The TOPS Committee identifies high-priority projects within TCRP and defines project funding levels and expected products. Participants included (*left to right:*) TCRP Manager Chris Jenks; Barry Barker, Transit Authority of River City; Robert Prince, Jr., DMJM Harris AECOM; Michael Scanlon, San Mateo County Transit; Beverly Scott, Sacramento Regional Transit District; and Kathryn Waters, Dallas Area Rapid Transit.

Larson became involved in TRB in 1959 at the urging of his graduate school professor. It was the beginning of what he called an annual pilgrimage, and he attended every one of the next 46 TRB Annual Meetings. Larson served on many TRB committees in many capacities. He chaired the TRB study committee that recommended creation of a strategically targeted program of highway research, which resulted in the establishment of the $150 million Strategic Highway Research Program (SHRP). Larson also served as chair of the first SHRP Executive Committee.

Other committees and panels benefiting from his contributions were the standing committees on the Performance of Concrete, Taxation and Finance, Manpower Management, Mineral Aggregates, Transportation History, and the NCHRP Project Panel on Administration of Highway and Transportation Agencies. Larson also authored the first NCHRP report, Special Report 80, *A Critical Review of Literature Treating Methods of Identifying Aggregates Subject to Destructive Volume Change When Frozen in Concrete and a Proposed Program of Research*.

In May 1998, Larson testified at a Congressional hearing on the role of the National Academies in science policy: "TRB has become an organization that pushes the frontiers of technical capability, quickly gets improved techniques into practice, brings its expertise objectively into public decision making, and yet remains flexible enough to reshape itself in response to changing needs."

He was elected to the National Academy of Engineering in 1985, and he was a recipient of many awards, including the *Engineering News-Record* Construction Man of the Year; the George S. Bartlett Award, awarded jointly by the American Association of State and Highway Transportation Officials, the American Road and Transportation Builders Association, and TRB; TRB's W. N. Carey, Jr., Distinguished Service Award; Penn State's Distinguished Alumnus Award; the American Society of Civil Engineers' President's Medal; and the Council of University Transportation Centers Distinguished Service Award.

Lowell B. Jackson 1931–2006

Jackson

Lowell Jackson, former Wisconsin secretary of transportation, Federal Highway Administration (FHWA) deputy administrator, Colorado Department of Highways executive director, and chair of the TRB Executive Committee, died on August 12. He was 75.

With a transportation career that spanned more than four decades, Jackson enjoyed a national reputation. In 1979, he was appointed Wisconsin secretary of transportation by Governor Lee Dreyfus, whose campaign Jackson helped bolster by organizing a door-to-door-style campaign modeled after Harry Truman's whistle-stop tour.

Jackson went on to serve as secretary of the Wisconsin Department of Industry, Labor, and Human Relations in 1981, before resigning in 1982 to launch his own campaign for the Republican nomination for the Wisconsin governorship. Although he did not win the nomination, he formed a friendship with political rival Governor Anthony Earl.

In 1983, Earl reappointed Jackson as Wisconsin secretary of transportation. At the same time Jackson became involved in TRB, serving first as a member of the Executive Committee and the Subcommittee on Planning and Policy Review. He later chaired the Executive Committee (1987) and the Committee for the Study of Approaches for Increasing Private-Sector Involvement in the Highway Innovation Process. He served on several NCHRP project panels, including the panels on Using Market Research to Improve Management of Transportation Systems and the Executive Management Information Systems for State Departments of Transportation.

Jackson retired from the Wisconsin Department of Transportation in 1986 and went on to serve as executive director of the Colorado Department of Highways in 1987 and as the Federal Highway Administration's deputy administrator from 1988 to 1989. After a lifetime of public service, he joined Greenhorne and O'Mara, Inc., in 1989, and directed the firm's transportation practice until retiring in 1995.

Born in Milwaukee, Wisconsin, Jackson earned a bachelor's degree from Purdue University in 1953 and served on active duty in the U.S. Army Corps of Engineers from 1954 to 1956 at Fort Belvoir, Virginia; Fort Leonard Wood, Missouri; and in Nuremburg, Germany. After military service, he returned to Purdue and completed a master's degree in civil engineering in 1957.

A registered professional engineer, Jackson received Purdue's Distinguished Engineering Alumnus Award in 1984 and the American Society of Civil Engineers' Civil Government Award and President's Medal in 1987 and 1988, respectively.

NEWS BRIEFS

Census Profiles Motorcoach Industry

The motorcoach industry is regaining strength after a decline following the terrorist attacks of September 11, 2001, according to two new surveys from the American Bus Association (ABA). Four U.S. and Canadian motorcoach organizations collected data for the ABA *Motorcoach Census 2005*, the first industry census since 1999 to examine passenger traffic, vehicle count, mileage, demographics and other important data in the United States and Canada.

The 2005 census is supplemented by *Motorcoach Census 2006 Update*, a smaller survey that polls the industry on passenger traffic, vehicle count, and mileage. The surveys are composed of data in the United States and Canada.

Motorcoach 2005 data show that approximately 3,500 businesses employ more than 163,000 people and operate more than 38,000 coaches, which are responsible for more than 595 million passenger trips. According to the *Update 2006* data, passenger trips between 2004 and 2005 have increased by 6 percent to 631 million. The surveys also report other estimates for the industry:

- Nearly half (47.9 percent) of motorcoach operators face competition from transit agencies;
- Nearly 7 in 10 carriers (69.6 percent) purchase fuel only at retail rates;
- Nearly all carriers (96.3 percent) provide charter service; and
- More than 48 percent operate nonmotorcoach passenger vehicles that generate revenue.

For the complete 2005 Motor Coach Census *and the* 2006 Motorcoach Census Update, *visit www.buses.org/home/.*

Highway Investment Software Updated

The Federal Highway Administration (FHWA) has released an updated version of the Highway Economics Requirements System–State Version (HERS–ST) software. HERS–ST 4.0 is designed for state and regional agencies and has expanded capabilities for evaluating the relationship between highway investment and system condition, performance, and user cost levels. The software can simulate future highway condition and performance levels and uses engineering principles to identify deficiencies. Improvements for implementation also can be simulated, taking into account travel time, safety, emissions, and vehicle operating costs.

HERS–ST 4.0 also includes an updated graphical interface; and an Immediate Year feature, which assists in planning for the construction of a new highway facility midway through a state's planning cycle.

Many state departments of transportation have used HERS–ST for several years, 20 states now use the software, and 10 states are investigating the possibility of incorporating the software into their decision-making process.

For an overview of the HERS–ST 4.0 software and to download a copy, visit www.fhwa.dot.gov/infrastructure/asstmgmt/hersindex.htm.

INTERNATIONAL NEWS

Safety Improves on European Roads

Preliminary data on Western, Central, and Eastern European road safety for 2005 reveal positive trends, according to the European Conference of Ministers of Transport. For the second consecutive year, road fatalities are decreasing in the countries of the Community of Independent States (CIS), which includes Russia, Belarus, Ukraine, Armenia, Kazakhstan, Moldova, and other nations.

The largest drop in road traffic fatalities occurred in Western Europe, which experienced a decline of 6.5 percent. The decrease was accompanied by a drop in the number of accident victims, despite a 4.2 percent increase in the number of accidents. Of the Western European nations, only Belgium, Finland, and Turkey experienced an increase in the number of accident victims for 2005.

Despite disappointing statistics for 2004, the 2005 data for Central and Eastern Europe show a 2.3 percent fatality decrease and demonstrate a positive trend in the decrease of fatal accidents since 2000. The CIS also reported a decrease in fatalities, largely because of a reduction in the fatality rate on Russian roadways.

For more information, visit www.cemt.org.

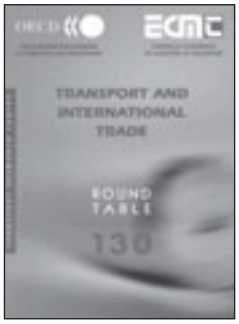
A stretch of Austria's A2 autobahn, near the village of Wiener Neudorf and the city of Moedling.

Bicycle
David Herlihy. Yale University Press, 2006; 470 pp.; $25; 0-300-10418-9.
Herlihy traces the history of the bicycle, from the earliest draisines and velocipedes to modern-day, high-tech road and mountain bicycles. Divided into five parts and 15 chapters, the book presents a comprehensive genealogy of the bicycle, supplemented with archival photos, news clippings, and advertisements.

From the initial attempts to create a "mechanical horse," to the designs of the "boneshaker" and "high wheel" eras, to the revolutionary safety bicycle—whose basic design has remained relatively unchanged for the past 121 years—the author focuses on the key personalities, public opinions, patent disputes, and inspirations that have surrounded the bicycle throughout its many stages of development.

ECMT Round Table 130: International Transport and Trade
D. Hummels, J. Wilson, X. Luo, H. Broadman, and A. Venables. OECD, 2006; 108 pp.; $54; 92-821-1338-8.
This book originates from the 130th meeting of the Round Table on Transportation Economics, held in Paris, October 2004. Topics include the structure and development of international transport costs in recent decades, the benefits expected from investment in international transport facilities, and the reduction of border-crossing costs.

Background papers are provided by David Hummels of Purdue University, Anthony Venables of the London School of Economics, and Harry Broadman and John S. Wilson of the World Bank. Authors attest that with the removal of many trade-policy barriers, further international economic integration will depend largely on the reduction of trade costs that originate in the transport sector.



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

TRB PUBLICATIONS

Transit: Planning, Management and Maintenance, Technology, Marketing and Fare Policy, and Capacity and Quality of Service
Transportation Research Record 1927
Studies in this five-part volume focus on such topics as coordinating public and school transportation in Iowa; using a performance-based approach for funding public transit; introducing noncontact, smart-card technology in rural New Mexico; evaluating the accuracy and value of automatic passenger counters; and examining the quality of service in an urbanized area in Ontario, Canada, using the revised *Transit Capacity and Quality of Service Manual*.

2005; 286 pp.; TRB affiliates, $47.25; nonaffiliates, $63. Subscriber category: public transit (VI).

Design of Structures 2005
Transportation Research Record 1928
This eight-part volume covers research on general structures; steel bridges; concrete bridges; dynamics and field testing of bridges; seismic design; tunnels and underground structures; culverts and hydraulic structures; and structural fiber-reinforced plastics. Specific studies include an examination of 10 technologies used in Europe and Japan for prefabricated bridge elements and an evaluation of the earthquake response capabilities of bridges in western Washington State.

2005; 251 pp.; TRB affiliates, $45.75; nonaffiliates, $61. Subscriber category: bridges, other structures, and hydraulics and hydrology (IIC).

Bituminous Paving Mixtures 2005
Transportation Research Record 1929
The effect of lime modification on hot-mix asphalt, how the addition of recycled asphalt pavement changes some properties of asphalt mixtures, and whether a lower compaction level can be used for designing stone matrix asphalt are among the subjects explored in this volume. Other papers present test results for the Superpave® gyratory compactor and compare the efficacy of various types of pavement surfaces in New Jersey.

2005; 247 pp.; TRB affiliates, $45.75; nonaffiliates, $61. Subscriber category: materials and construction (IIIB).

Transit: Intermodal Transfer Facilities, Rail, Commuter Rail, Light Rail, and Major Activity Center Circulation Systems
Transportation Research Record 1930
This four-part volume encompasses such topics as Utah's connection protection system—the first in the United States—for light rail to bus; the effects of rail transit on transportation performance in major U.S.

TRB PUBLICATIONS *(continued)*

cities; the differences between British and French light rail strategies; and lessons learned from a light rail pilot project that failed in the Netherlands.

2005; 112 pp.; TRB affiliates, $34.50; nonaffiliates, $46. Subscriber category: public transit (VI).

Planning and Analysis 2005
Transportation Research Record 1931
How a policy shift in the Netherlands from the national to the regional level created opportunities for engineers and spatial planners to collaborate and how a small town in Oregon managed a combined state highway–main street project are among the research subjects in this volume. Another paper presents three case studies on improved relationships between states and Native American governments.

2005; 136 pp.; TRB affiliates, $37.50; nonaffiliates, $50. Subscriber category: planning and administration (IA).

Finance, Economics, and Economic Development 2005
Transportation Research Record 1932
Researchers consider the replacement of declining fuel tax revenues in Oregon with fees based on vehicle miles traveled; variations in costs of highway investment compared to the Federal Highway Administration's Highway Economic Requirements System; the merits of no-queue tolling, time-of-day pricing, and auto restraint policies; and how to create public support for road pricing proposals.

2005; 187 pp.; TRB affiliates, $41.25; nonaffiliates, $55. Subscriber category: planning and administration (IA).

Preservation of Roadway Structures and Pavements
Transportation Research Record 1933
Bridges, pavement, crack sealants, and long-term pavement performance are the subjects of this four-part volume. Specific studies address such topics as quality control measures for underwater inspection of bridges, integration of bridge and pavement systems in a management system in Canada, and best practices in chip seal design and construction from 42 states.

2005; 125 pp., TRB affiliates, $34.50; nonaffiliates, $46. Subscriber category: maintenance (IIIC).

Traffic Flow Theory 2005
Transportation Research Record 1934
Papers in this volume are sorted into three parts: traffic flow theory and car following, queuing and lane-changing behavior, and microscopic traffic simulation models. Researchers introduce a new car-following model to capture key motorway flow characteristics and a versatile traffic microsimulation model for rural roads.

2005; 263 pp.; TRB affiliates, $45.75; nonaffiliates, $61. Subscriber category: highway operations, capacity, and traffic control (IVA).

Information Systems and Technology
Transportation Research Record 1935
Included are a pilot study to help engineers and operators make decisions for a network of toll roads; an advanced imputation method to address the problem of incomplete data on intelligent transportation systems; and a multiobjective ant algorithm for the siting of emergency service facilities.

2005; 169 pp.; TRB affiliates, $39.75; nonaffiliates, $53. Subscriber category: planning and administration (IA).

Soil Mechanics 2005
Transportation Research Record 1936
The volume's four parts present investigations in cementitious, chemical, and mechanical stabilization; design of foundations and structures; subsurface drainage and reliability in design and performance of pavement; and compaction, nontraditional computing methods, and other issues in geotechnical engineering. Papers address a variety of topics, such as the stabilizing of unpaved roads and detecting damage caused to integral bridges by thermal displacements.

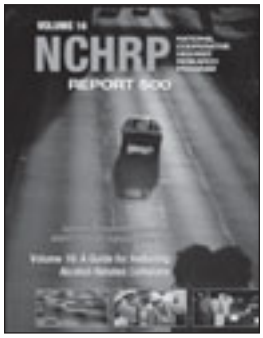
2005; 237 pp.; TRB affiliates, $44.25; nonaffiliates, $59. Subscriber category: soils, geology, and foundations (IIIA).

Guidance for Implementation of the AASHTO Strategic Highway Safety Plan: A Guide for Reducing Alcohol-Related Collisions
NCHRP Report 500, Volume 16
This volume of *NCHRP Report 500* provides strategies that can be employed to reduce crashes involving alcohol. These strategies have the following four objectives: (1) to reduce excessive drinking and underage drinking; (2) to deter driving after drinking through effective DWI law enforcement; (3) to improve the system for prosecuting, imposing sanctions against, and treating DWI offenders; and (4) to control the most recalcitrant offenders.

2005; 98 pp.; TRB affiliates, $17.25; nonaffiliates, $23. Subscriber category: safety and human performance (IVB).

Guidance for Implementation of the AASHTO Strategic Highway Safety Plan: A Guide for Reducing Work Zone Collisions
NCHRP Report 500, Volume 17
Strategies that can be employed to reduce the number of work zone crashes are reviewed in this volume

TRB PUBLICATIONS *(continued)*



of *NCHRP Report 500*. The strategies are grouped by objective into six areas: reduce the number, duration, and impact of work zones; improve work zone traffic control devices; improve work zone design practices; improve driver compliance with work zone traffic controls; increase knowledge and awareness of work zones; and develop procedures to manage work zones effectively.

2005; 165 pp.; TRB affiliates, $21; nonaffiliates, $28. Subscriber category: safety and human performance (IVB).

Surface Transportation Security: System Security Awareness for Transportation Employees
NCHRP Report 525, Volume 7
This CD-based, interactive, multimedia training course is designed to help transportation employees, supervisors, and managers define their roles and responsibilities in transportation system security, recognize suspicious activities and objects, observe and report relevant information, and minimize harm to themselves and others. Course modules focus on system security, reducing vulnerability, suspicious activity, suspicious objects, priorities, and preparation.

2006; TRB affiliates, $11.25; nonaffiliates, $15. Subscriber categories: planning and administration (IA); highway operations, capacity, and traffic control (IVA); safety and human performance (IVB); security (X).

Transportation Security: Guidelines for Transportation Emergency Training Exercises
NCHRP Report 525, Volume 9, and TCRP Report 86, Volume 9
This joint report was developed to assist transportation agencies in implementing drills and exercises in alignment with the National Incident Management System. The report describes the process of emergency exercise development, implementation, and evaluation. In addition, the available literature and materials to support transportation agencies—such as state departments of transportation, traffic management centers, and public transportation systems—are described.

2006; 168 pp.; TRB affiliates, $31.50; nonaffiliates, $42. Subscriber categories: planning and administration (IA); operations and safety (IV); aviation (V); public transit (VI); rail (VII); freight transportation (VIII); marine transportation (IX); security (X).

Surface Transportation Security: A Guide to Transportation's Role in Public Health Disasters
NCHRP Report 525, Volume 10
The development of options for transportation response to an extreme event involving chemical, biological, or radiological agents is presented systematically for transportation managers. Technical information is provided on chemical, biological, and radiological threats, including the vulnerabilities of the transportation system to these agents and the consequence-minimization actions that may be taken in response.

2006; 123 pp.; TRB affiliates, $29.25; nonaffiliates, $39. Subscriber categories: planning and administration (IA); operations and safety (IV); aviation (V); public transit (VI); rail (VII); freight transportation (VIII); marine transportation (IX); security (X).

Surface Transportation Security: Disruption Impact Estimating Tool—Transportation (DIETT): A Tool for Prioritizing High-Value Transportation Choke Points
NCHRP Report 525, Volume 11 (with supporting material on CD-ROM)
Transportation, security, and emergency-preparedness planners can use this book in identifying and prioritizing potential high-value transportation choke points (TCPs), such as bridges, tunnels, and passes. DIETT is an electronic analytical tool that calculates direct transportation and economic impacts, or costs, of an event that precedes the appearance of a TCP, and it prioritizes TCPs accordingly. In addition to the information on DIETT, this report includes installation instructions and a user guide.

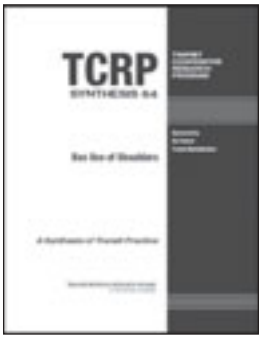
2006; 25 pp.; TRB affiliates, $21.75; nonaffiliates, $29. Subscriber categories: planning and administration (IA); operations and safety (IV); freight transportation (VIII); security (X).

Analytical Tools for Asset Management
NCHRP Report 545 (with supporting materials on CD-ROM and users guides)
Two software tools are examined—AssetManager NT and AssetManager PT—that support trade-off analysis for transportation asset management. AssetManager NT analyzes investment versus performance across infrastructure categories in the highway mode over a 10- to 20-year timeframe. AssetManager PT demonstrates the impacts of investment choices on a short-term program of projects. The software and users guides are included on the accompanying CD-ROM and are designed to help state departments of transportation and other transportation agencies identify, evaluate, and recommend investment decisions for managing the agency's infrastructure assets.

2005; 61 pp.; TRB affiliates, $23.25; nonaffiliates, $31. Subscriber categories: planning and administration (IA); pavement design, management, and performance (IIB); bridges, other structures, hydraulics and hydrology (IIC).

BOOK SHELF

TRB PUBLICATIONS *(continued)*



Incorporating Safety into Long-Range Transportation Planning
NCHRP Report 546 (on CD-ROM)
The transportation planning process is described, with discussion on where and how safety can be addressed and integrated effectively into long-range planning at the state and metropolitan levels. The guidance manual, on the accompanying CD-ROM, offers descriptions of a variety of analytical tools and software applications for conducting safety analyses. The CD material is presented in an interactive electronic format for easy use as a tool for planning practitioners.

2006; TRB affiliates, $21.75; nonaffiliates, $29. Subscriber categories: planning, administration, and environment (I); operations and safety (IV); public transit (VI); freight transportation (VIII).

Simple Performance Tests: Summary of Recommended Methods and Database
NCHRP Report 547
The theory behind the test methods is summarized, along with descriptions of three recommended simple performance tests for permanent deformation of hot-mix asphalt. A set of appendices on an attached diskette includes test data for all three tests and relevant documents prepared during the research.

2006; 15 pp.; TRB affiliates, $21; nonaffiliates, $28. Subscriber category: pavement design, management, and performance (IIB).

A Guidebook for Including Access Management in Transportation Planning
NCHRP Report 548
This easy-to-use guidebook shows how to incorporate access management into the transportation planning process. The guidance is organized by type of plan—for example, overall planning process, long-range plans, programming, and corridor and subarea planning—and by jurisdictional level—for example, state, metropolitan planning organization, and local.

2005; 75 pp.; TRB affiliates, $16.50; nonaffiliates, $22. Subscriber category: planning and administration (IA).

Inspection and Management of Bridges with Fracture-Critical Details
NCHRP Synthesis 354
This synthesis focuses on inspection and maintenance of bridges with fracture-critical members as defined by the *AASHTO LRFD Bridge Design Specifications*. The objectives were to survey and identify gaps in the literature; to determine practices and problems with how bridge owners define, identify, document, inspect, and manage bridges with fracture-critical details; and to identify research needs.

2005; 75 pp.; TRB affiliates, $20.25; nonaffiliates, $27. Subscriber categories: bridges, other structures, and hydraulics and hydrology (IIC); maintenance (IIIC).

Transportation Technology Transfer: Successes, Challenges, and Needs
NCHRP Synthesis 355
Successful technology transfer practices are documented in this synthesis, which also discusses the challenges encountered and identifies the needs of those responsible for sponsoring, facilitating, and conducting technology transfer activities and processes. Areas of interest include organizational structures; political and legal aspects affecting technology transfer; financial, personnel, technology, facilities, and equipment resources; strategies and tools; and performance evaluation. This synthesis is intended to expedite innovations into practice, to increase safety, enhance performance, and reduce costs.

2005; 85 pp.; TRB affiliates, $21; TRB nonaffiliates, $28. Subscriber categories: planning and administration (IA); maintenance (IIIC).

Pavement Markings—Design and Typical Layout Details
NCHRP Synthesis 356
Identified in this report are variations in pavement marking designs, practices, and policies as provided by 48 of 50 state departments of transportation, as well as by transit agencies from the District of Columbia, Puerto Rico, and four cities. The information will be useful to state and local government agencies that are developing or revising their pavement marking design standards. This synthesis, however, does not specifically address the safety aspects or cost-effectiveness of the pavement marking layout policies and practices of the various agencies.

2006; 138 pp.; TRB affiliates, $24.75; TRB nonaffiliates, $33. Subscriber category: highway operations, capacity, and traffic control (IVA).

Bus Use of Shoulders
TCRP Synthesis 64
Transit agencies' policies and regulations that permit buses to use shoulders on arterial roads or freeways to bypass congestion either as interim or long-term treatments are documented and summarized. The transit and highway perspectives are explored for jurisdictions that allow bus use of shoulders and for those that have considered, but have not implemented, these treatments and the reasons why.

2006; 91 pp.; TRB affiliates, $26.25; nonaffiliates, $35. Subscriber category: public transit (VI).

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INFORMATION FOR CONTRIBUTORS TO

TR NEWS

TR News welcomes the submission of manuscripts for possible publication in the categories listed below. All manuscripts submitted are subject to review by the Editorial Board and other reviewers to determine suitability for *TR News*; authors will be advised of acceptance of articles with or without revision. All manuscripts accepted for publication are subject to editing for conciseness and appropriate language and style. Authors receive a copy of the edited manuscript for review. Original artwork is returned only on request.

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 also should 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 improve a reader's understanding of 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 photographs 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 appears. 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 in 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 described 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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Commuting in America III

The Third National Report on Commuting Patterns and Trends

TRB has released *Commuting in America III*, the third in a series of decadal reviews of journey-to-work patterns in the United States by transportation consultant Alan E. Pisarski. With 155 figures, 79 tables, and approximately 100 highlighted key facts, *Commuting in America III* provides snapshot views of commuting patterns and trends derived principally from an analysis of the 2000 decennial U.S. Census.

The report explores

- Population and worker trends,
- The demographics of a changing population and households,
- Vehicle availability,
- Modal use,
- Travel times,
- Congestion, and
- Work locations.

Commuting in America III identifies important trends associated with single-occupant vehicle use, carpooling and transit use, automobile ownership among African-Americans, the role of immigrants, mode changes, the length of commutes, travel flow, the impact of working from home, early commutes, multicounty commutes, and more.

Commuting in America III is a must-have reference for the transportation community—for academics, practitioners, and decision makers—for all who need to understand how public policies and commuter behavior have affected or may affect commuting patterns.

Commuting in America III: The Third National Report on Commuting Patterns and Trends is available from the TRB bookstore at 202-334-3213 or www.TRB.org/CIAIII. [National Cooperative Highway Research Program Report 550–Transit Cooperative Research Program Report 110, ISBN 0-309-09853-X; 196 pages, 8.5 x 11, paperback (2006), $60.00.]

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