Public Roads

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Avoiding Fraud
Mobility Services
Vanguard Technologies

U.S. Department of Transportation
Federal Highway Administration

Public Roads

—featuring developments in Federal highway policies, programs, and research and technology—

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Front cover—Cost-effective public transportation can be particularly important to people with disabilities, such as this man exiting a bus in a wheelchair. An article in this issue of PUBLIC ROADS, "Mobility Services for All" on page 18, describes interagency efforts to deploy intelligent transportation systems to help coordinate human service transportation programs. *Photo by John A. Rizzo.*

Back cover—Replacement of a bus stop was one component in this construction project on Florida Avenue in Washington, DC, in 2007, involving closure of one lane of the busy four-lane street. To learn how modeling tools can improve mobility in work zones such as this one, see "QuickZone: Modeling In the Zone" on page 24 of this issue of PUBLIC ROADS. *Photo by Tim Breen for FHWA.*

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Guest Editorial

Ringing in a New Year of Vigilance

J. Richard Capka

Calvin L. Scovel III

As the Nation heralds the New Year, many of us will make resolutions to improve our personal and professional lives. One resolution that could have a significant, positive effect on the goals of transportation agencies is to renew our commitment to improve contract oversight and stewardship of taxpayer dollars. This step, in turn, potentially could stretch the budgets of transportation agencies by millions.

To meet transportation goals, every year Federal, State, and local agencies award contracts and grants for construction, maintenance, and operation of the Nation's highways. Not all of those funds, however, are spent as intended. In fact, the U.S. Department of Transportation's Office of Inspector General (OIG) has seen an increase in the number of fraud investigations. Five years ago, 158 contract procurement and grant fraud investigations were underway; today that number has increased by almost 70 percent, to 228 investigations. Although some of this increase can be attributed to a heightened OIG emphasis on these types of investigations, the bottom line is that fraud under any circumstances is unacceptable. The impacts of fraud are especially severe given that the transportation community's current fiscal resources are unable to meet growing demands.

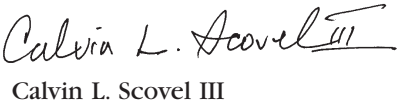
The Federal Government and State departments of transportation (DOTs) share responsibility for stewardship and oversight and are accountable for taxpayer investments in the transportation system. Therefore, it is incumbent on all transportation providers to promote efforts aimed at preventing and detecting fraudulent schemes. Education and outreach at all levels of government are critical to this shared responsibility.

To help with oversight, the Federal Highway Administration (FHWA) is working with States to equip them with tools to manage the responsibilities associated with using Federal funds. In addition to sharing lessons learned, FHWA encourages State DOT employees to attend its course Contract Administration Core Curriculum, which can help educate staff about ways to detect fraud, waste, and abuse.

OIG also supports a number of efforts to heighten awareness of fraud in transportation programs and activities, promote stewardship and oversight, and encourage communication and dialogue. These efforts include cosponsoring a biennial National Fraud Awareness Conference on Transportation Infrastructure Programs (the next one will be held July 28–31, 2008, in Chicago, IL) and operating a national fraud hotline (1–800–424–9071) that provides a mechanism for individuals to report suspected instances of fraud.

Two articles in this issue of PUBLIC ROADS—"Upholding the Public Trust" and "Is Your Construction Project a Victim of Crime?"—are intended to help government employees and contractors recognize and identify various types of fraud practices. The best tool, however, always will be careful and vigilant oversight and stewardship of the public's investment in the transportation system.

J. Richard Capka
Administrator
Federal Highway Administration



Calvin L. Scovel III
Inspector General
U.S. Department of Transportation

Upholding the Public Trust

by Jim H. Crumpacker

Golden Gate Bridge District Engineer Denis Mulligan (left) shows USDOT Inspector General Calvin L. Scovel III areas where substandard concrete was used on a nonstructural location of the San Francisco bridge during a federally funded project. *Photo: USDOT.*

An interview with USDOT's Inspector General highlights efforts to protect the integrity of taxpayer dollars.

With passage of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), the U.S. Congress and President George W. Bush provided funding for highways, highway safety, and public transportation totaling $244.1 billion—the largest surface transportation investment in the Nation's history. Along with this major investment in transportation comes an even greater responsibility to use those taxpayer funds wisely and uphold the public trust.

Today, the highway transportation community faces significant pressures to handle more challenges with fewer resources due to stretched budgets, reduced staff, the cumulative demands of maintaining an ever-growing infrastructure, and a host of other factors. To accomplish their missions, most transportation agencies rely on contract services and products for which they have oversight accountability.

"Public employees who work to ensure we get what we pay for are

the eyes and ears of the taxpayer," said Mary J. Richards, president of the Massachusetts Organization of State Engineers and Scientists, at the 2004 National Fraud Awareness Conference cosponsored by the U.S. Department of Transportation's (USDOT) Office of Inspector General (OIG), the American Association of State Highway and Transportation Officials (AASHTO), and others. "Their duties involve the verification that work performed by private contractors meets the required specifications, both in materials used and in construction practices rendered. The number of these professionals has been drastically reduced, and the ranks of private contractors [have] been increased so dramatically that the lack of oversight on public construction projects has spawned an even greater potential for the waste, fraud, and abuse of tax dollars."

Transportation agencies need to be concerned because the consequence of fraud, waste, and abuse is that less money is available to meet program objectives, not to mention that public confidence in transportation programs is compromised. This is especially critical at a time when infrastructure needs are increasing and the Nation's fiscal resources are struggling to meet these growing demands.

Fraud in highway construction projects is more common than one might think, is increasingly sophisticated, and crosses geographical boundaries. USDOT's OIG currently is investigating 228 contract and grant fraud cases across the country, compared with 158 investigations that were underway 5 years ago. The surge in investigations suggests that transportation managers need to be increasingly vigilant.

One challenge OIG recently cited in Congressional testimony is an example of the funding that might be made more available if the transportation community could be more vigilant and collectively reduce fraud, waste, and abuse by only 1 percent. This would net an additional $8 billion for critically needed transportation projects (based on $800 billion invested by the Federal Government and States in highway projects over the last 6 years). That is enough money to fund 16 new major highway projects or, put another way, might represent an additional $160 million per State.

Types of Contract Improprieties

Bid Rigging. In bid rigging, conspiring competitors raise prices to purchasers—often Federal, State, or local governments—who have solicited competing bids in order to acquire goods or services. Essentially, competitors agree in advance who will submit the winning bid on a contract that is being let through a competitive bidding process. Bid rigging includes colluding for bid suppression (agreement among bidders to withdraw or suppress bidding), complementary bidding (courtesy bidding purposely high), bid rotation (where bidders take turns being the low bidder), and subcontracting (a low bidder will agree to withdraw its bid in favor of the next low bidder in exchange for a lucrative subcontract that divides between them the illegally obtained higher price).

Price Fixing. In price fixing, competitors agree to raise, fix, or otherwise maintain the price at which their goods or services are sold. It is not necessary that the competitors agree to charge exactly the same price or that every competitor in a given industry join the conspiracy. Price fixing includes actions that establish or adhere to price discounts; hold prices firm; eliminate or reduce discounts; adopt a standard formula for computing prices; maintain certain price differentials between different types, sizes, or quantities of products; adhere to a minimum fee or price schedule; and fix credit terms.

Product Substitution. Product substitution involves the introduction of counterfeit and/or substandard material or other forms of unauthorized product substitution, when one product or service is purchased, but the actual product or service delivered is misrepresented or contains undisclosed substitutions.

Bribery. Bribery occurs when a person or company directly or indirectly gives, offers, or promises anything of value to any public official or person who has been selected to be a public official or offers or promises any public official or any person who has been selected to be a public official to give anything of value to any other person or entity, with intent. Bribery involves influencing any official act; influencing a public official to commit or aid in committing, colluding in, or allowing any fraud; creating an opportunity for the commission of any fraud on the United States; or inducing a public official to do or omit to do any act in violation of the lawful duty of such official or person.

Kickback. A kickback is money paid for referral of business for a contract—without the knowledge of a customer and without the customer's best interests in mind.

Conflicts of Interest. A conflict of interest occurs when an employee in a decision-making position has a direct or indirect interest, particularly a substantial financial interest, that influences the individual's ability to perform job duties and fulfill responsibilities. A conflict of interest occurs in a situation where an official's private interests may benefit from his or her public actions.

False Claim. A false claim is an act of knowingly making, using, or causing to be made or used a false record or statement that results in payment or approval by a Federal, State, or local government.

Labor and Materials Overbilling. An invoice submitted for work not performed is known as overbilling.

Disadvantaged Business Enterprise (DBE) Fraud: DBE fraud is the act of a business to misrepresent its standing as a DBE to win contract awards.

Corruption of Public Officials: Corruption involves the lack of integrity or honesty and the use of a position of public trust for dishonest personal gain.

Proactive and effective fraud prevention, detection, and prosecution are achievable only through a well-coordinated, multidisciplinary, intergovernmental approach. The Federal Highway Administration (FHWA), OIG, State departments of transportation (DOTs), and industry partners must work together to protect highway projects from fraud and maintain public confidence in the integrity of the Nation's transportation system.

To help transportation agencies recognize and prevent fraud, some of the most prevalent fraud types were discussed with USDOT Inspector General Calvin L. Scovel III. Inspector General Scovel provided tips for detecting fraud schemes and described some of OIG's efforts to educate contracting officers, project managers, and others. (For examples of specific fraud schemes and ways to detect them, see a companion article in this issue of PUBLIC ROADS, "Is Your Construction Project a Victim of Crime?" on page 9.)

Actual Scenario: A Fraud Example

Shortly before the deadline for submitting electronic bids for several contracts, representatives of three paving contractors divided the market and agreed which of them would be the low bidder on each contract. They shared their "winning bids" and needed only to ensure that their "unsuccessful bids" were higher than the winning bid. The contractors' goal was to rotate preselected winning bids with comfortable profit margins, while at the same time creating the appearance of open competition. Following a Federal investigation resulting in criminal indictments, the contractors pled guilty to fraud-related charges and were jailed, and their companies were ordered to pay $3 million in restitution.

Were there any clues that might help contracting officers detect bid rigging as in the above scenario? Yes, although bid rigging, price fixing, and other collusion can be difficult to detect.

Collusive agreements usually are reached in secret, with only the participants having knowledge of the scheme. Suspicions may be aroused, however, by unusual bidding or pricing patterns or something a vendor says or does. According to the U.S. Department of Justice's *An Antitrust Primer for Federal Law Enforcement Personnel*, several clues might make a contracting official suspect collusion, such as bid or price patterns that seem at odds with a competitive market:

- The same company always wins a particular procurement. This situation may be more suspicious if one or more companies continually submit unsuccessful bids.
- The same suppliers submit bids, and each company seems to take a turn being the successful bidder.
- Some bids are much higher than published price lists, previous bids by the same firms, or engineering cost estimates.
- Fewer than the normal number of competitors submit bids.
- A company appears to be bidding substantially higher on some bids than on other bids, with no apparent cost differences to account for the disparity.
- Bid prices drop whenever a new or infrequent bidder submits a bid.
- A successful bidder subcontracts work to competitors that submitted unsuccessful bids on the same project.

What exactly is fraud?

Simply put, fraud is an intentional misrepresentation for personal or corporate gain involving deception to gain an unfair advantage over another. In an actual scenario I have encountered (see "Actual Scenario: A Fraud Example" on the left), contractors misrepresented that they were bidding competitively for State DOT contracts, when in fact they were cooperating unfairly to increase job profits by driving up prices.

What kinds of fraud are you finding in highway construction?

Highway fraud cases can involve a whole host of schemes. They typically include bid rigging, price fixing, product substitution, bribery and kickbacks, conflicts of interest, false statements and claims, labor and materials overbilling, Disadvantaged Business Enterprise (DBE) fraud, and corruption of public officials.

One example is a product substitution scheme in which a State concrete manufacturer falsely certified that concrete catch basins used on a major highway project met contract specifications. A State inspector noted that a concrete supplier had delivered a truckload of precast basins only a day after the custom design, including a framework of reinforcing steel, was approved. Precast concrete structures normally must cure for at least a week before shipment. In addition, handwritten markings on one of the catch basins indicated that the basin was standard stock, not a custom product. The manufacturer subsequently pled guilty and was forced to pay a fine and restitution totaling half a million dollars.

In another case, a manufacturing representative for a paint company that offers highway striping services paid more than $840,000 in restitution for his role in bribing State officials to use his company's products exclusively on all of that State's DOT projects. We were able to develop this case based on a tip received from a Federal Bureau of Investigation (FBI) confidential informant.

Yet another investigation resulted in the owner of a sham "false front" DBE firm being convicted on 22 charges of racketeering (includes various illegal activities such as bribery, mail and wire fraud, and extortion) and fraud, sentenced to more than 7 years in prison, and ordered to forfeit the contract and make restitution of $652,000.

Additional examples of the instances of fraud we have helped to uncover and prosecute can be found on our Web site at www.oig.dot.gov.

Are there any recent trends in contract fraud cases?

OIG is starting to see an increase in quality control testing fraud, which involves a contractor's misrepresentation of quality control test results to earn contract incentives, avoid contract disincentives, or avoid production shutdown or required removal of deficient material in order to limit costs or increase profits. To leverage scarce State oversight resources, many State DOTs partner with industry and directly perform quality assurance materials testing only to the extent needed to confirm more extensive quality control testing by contractors.

OIG recently has investigated cases in which contract employees manipulated results from quality control tests to falsely earn contract incentives or avoid potentially costly project delays. In one such case, a contract State paving crew foreman discarded poor quality asphalt test cores from designated quality control locations and replaced them with test cores known to be of high quality in order to maximize quality-incentive payments. This case was initiated when a member of the contract asphalt-paving crew tipped off a State resident engineer who in turn contacted OIG. Five contract employees lost their jobs as a result of the fraud, and the company paid $200,000 to settle a civil complaint with the U.S. Attorney's Office.

How big of a problem is highway construction fraud?

No one knows for certain; however, according to research conducted by the Association of Certified Fraud Examiners, U.S. organizations lose an estimated 5 percent of annual revenues to fraud. Although we cannot say this percentage translates directly to highway construction fraud, we know from experience that the risks of fraud, waste, and abuse increase substantially when large sums of money are involved.

As a result of an investigation that disclosed evidence of fraud involving the Golden Gate Bridge (shown here), felony charges were filed against a contractor and its officials. *Photo: USDOT.*

I believe the problem is bigger than ever before, if only because transportation spending is higher than ever before. For example, SAFETEA-LU, signed into law in 2005, provided for more than $244 billion in transportation projects over 6 years—the largest surface transportation reauthorization in the Nation's history—and this does not consider what the States spend on transportation.

How important are State DOTs in preventing or uncovering contract fraud?

State DOTs are critically important, as they are the first line of defense in preventing contract and grant fraud. They are where the rubber meets the road, so to speak. The Federal Government generally provides funding, but the States actually award contracts and perform the detailed oversight. States ensure that claims are valid, internal controls are in place, and irregularities are detected and addressed promptly. In fact, the States certify that they have the necessary controls in place, and the Federal Government and others rely heavily on these certifications. In other words, preventing or uncovering contract fraud depends, to a great extent, on the integrity and strength of State programs.

Can you provide any specifics on steps that transportation oversight providers at State and local levels can take as a more effective deterrent to contracting fraud?

OIG recommends requiring contract, grant, and cooperative agreement recipients to certify periodically that they are aware of and have complied with all applicable contract and Federal requirements, as appropriate. For example, recipients might be required to certify that labor costs, material quantity and quality, and travel and overhead costs are accurate and comply with contract provisions on each invoice submitted for government payment.

Currently, the use of certifications varies greatly depending on the level of government (Federal, State, or local) and type of procurement involved. Identifying false statements related to certifications such as these

Connecticut DOT

State inspection staff broke open this concrete catch basin and discovered that these units, used on a major highway project, failed to meet contract specifications.

can assist greatly in deterring fraud and in the pursuit of criminal prosecutions and civil false claims actions.

How does OIG learn about potential fraud?

OIG learns about fraud in a variety of ways, most often by receiving a tip. Anyone who wants to report suspected fraud to OIG can call our hotline at 800–424–9071, use the online complaint form found at www.oig.dot.gov/hotlineform.jsp, or send an e-mail to hotline@oig.dot.gov. Individuals who contact OIG are encouraged to identify themselves so OIG can work with them in case additional questions arise as we evaluate or pursue the allegations; however, they are not required to do so and can remain completely anonymous.

OIG works carefully to understand the motives of individuals who supply information and to screen the tips we receive to determine which merit further inquiry. Not all tips will result in an inquiry or investigation; however, OIG appreciates every tip we receive. DOT employees and employees of DOT contractors who report fraud are entitled by Federal law to whistleblower protection from employer attempts at reprisal. Many States provide similar protections at the State level. (For more information, see the U.S. Office of Special Counsel's Web site at www.osc.gov.)

Other ways of learning about fraud include audit reviews and notification from other law enforcement agencies.

How do OIG investigators prove fraud?

Fraud investigations use both overt and covert techniques to obtain evidence. Regardless of the fraud scheme, essential steps to proving a crime include interviews, document examinations, and observations. OIG special agents sometimes employ technical equipment and sophisticated techniques to capture and document critical information via covert photographic and video surveillance, clandestine electronic monitoring and recording, and vehicle tracking. Many techniques are particularly effective when fraud is ongoing and subjects are unaware of any investigation. If the "bad guys" had advance warning of a criminal investigation, they might destroy documents, purge electronic records, and "get their stories straight"—actions that could easily derail an investigation. An example of more overt investigative techniques includes compelling the production of documents and electronic data using subpoenas and search warrants.

OIG special agents receive their basic training at the Federal Law Enforcement Training Center in Glynco, GA, and continue to receive refresher training throughout their careers. They are authorized to make arrests without warrants, and they routinely carry firearms.

What is OIG doing to detect and deter fraud in highway construction?

During fiscal year 2006, OIG's nearly 100 criminal investigators spent just over 40 percent of their time on contract and grant fraud cases. Many of these investigations were conducted with the FBI, State law enforcement agencies, and others. To foster these working relationships, OIG has cohosted nationwide biennial conferences on fraud awareness since 2000 and has participated in numerous other outreach and liaison activities. For example, OIG special agents frequently present briefings on highway construction fraud at FHWA and industry conferences. The briefings heighten awareness of illegal construction fraud activity and help ensure that Federal and State contracting officers and project managers and contractors know about mechanisms available for reporting suspected fraud and the consequences of fraud. In addition, OIG auditors continually look for fraud indicators, such as the absence of effective management controls, for referral to investigators. Auditors make recommendations to strengthen lax controls when found and follow up, as appropriate, to determine whether corrective actions were taken and, if so, whether they were effective.

What is the purpose of fraud awareness conferences, and who attends?

The purpose of our biennial conference is to provide information about how to detect, prevent, and deter fraud and to foster relationships among agencies. A typical agenda includes discussion of topics such as oversight; stewardship; fraud, waste, and abuse prevention; detection; investigations; and prosecutions. Our overall goals for these conferences are to (1) sharpen awareness of fraud schemes, (2) share best practices, and (3) strengthen all-important working relationships. The next conference is scheduled for July 28–31, 2008, in Chicago, IL.

The last biennial fraud awareness conference was cosponsored with AASHTO, FHWA, and others

This OIG special agent uses binoculars from the front seat of his car while participating in a surveillance operation. *Photo: USDOT.*

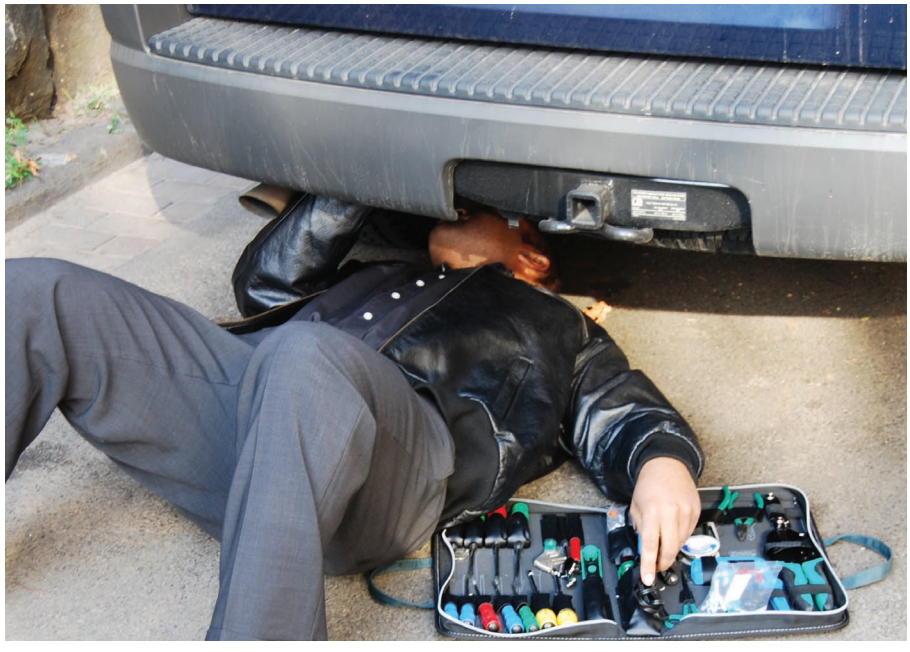
in Orlando, FL, in 2006. About 350 transportation professionals from 45 States attended, including Federal, State, and local officials from a variety of disciplines: auditors, accountants, engineers, analysts, attorneys, investigators, contracting officers, and project managers. In addition, many industry representatives were in the audience or spoke at the podium.

The Transportation Oversight Providers Network (TOPnet) was developed as an outgrowth of the 2004 fraud awareness conference. What is TOPnet?

TOPnet, a Web-based tool found at www.TOPnet.gov, is the creation of a diverse group of Federal, State, and local transportation oversight providers who decided to take action based on discussions at the 2004 conference held in Seattle, WA. Their discussions highlighted the need for greater and more effective interagency interaction in combating the increasingly complex fraud, waste, and abuse faced by transportation professionals today at all levels of government. The vision is to work *collaboratively* among *all levels* of government to *share* information and *enhance* interagency communication for the purpose of *strengthening* oversight.

TOPnet features three distinct modules containing publicly available information in an easy-to-use format: (1) a national directory of contact information for approximately 750 oversight providers at all levels of government; (2) a searchable database of suspended or debarred companies and individuals and other judicial actions in transportation-related matters at all levels of government; and (3) a reading room for member organizations to post press releases concerning investigations and audits, as well as other transportation-related news and events.

We are currently working with AASHTO to enhance the Web site and transition its day-to-day management to AASHTO. We expect to complete these initiatives sometime this spring.



Another OIG special agent installs a global positioning system tracking device under a vehicle. *Photo: USDOT.*

USDOT

USDOT's OIG cosponsored the 2006 National Fraud Awareness Conference on Transportation Infrastructure Programs (one session is shown here) in Orlando, FL. The next conference is scheduled for July 2008 in Chicago, IL.

What thoughts do you have about USDOT's updated suspension and debarment order now that it has been out for over 2 years?

The goal of the suspension and debarment order "Governmentwide Debarment, Suspension, and Ineligibility," issued by former USDOT Secretary Norman Y. Mineta in June 2005, was to strengthen procedures to ensure that only responsible persons participate in USDOT procurement and nonprocurement programs. The order imposes a 45-day time limit on making decisions about suspensions and debarments. It also requires that if a decision is made not to suspend or debar, then a written explanation with reference to a specified list of mitigating factors and remedial measures must be provided. (See www.dot.gov/ost/m60/grant/DOT_Order_4200.5D.pdf to view the order.)

Since publication, the new order has increased accountability and led to more indicted or convicted parties being referred to operating administrations for suspension and debarment actions. These are important changes. Taking away the ability to bid on contracts is an appropriate action to protect the government from contractors who have demonstrated through their fraudulent acts that they cannot act responsibly when working for the taxpayer.

Final Thoughts

In a perfect world, transportation professionals would not have to worry about fraud, waste, or abuse, and perhaps there would be no need for vigilant stewardship and oversight. One only has to look at the headlines on the evening news, however, to be reminded that the world is not perfect.

No program, at any level of government, is immune to fraud, waste, or abuse. Fraud in highway construction projects results in fewer resources for important transportation projects and cannot be tolerated. All those in the transportation community must be knowledgeable about the various types of fraud schemes and be willing to take the necessary actions to mitigate the negative consequences caused by those who commit these crimes.

The public relies on professionals such as construction managers, resident engineers, inspectors, contractors, and auditors to do the right thing every day in conducting the public's business. Continued vigilance, in conjunction with effective internal controls and oversight mechanisms, are essential to mitigating the extent to which fraud and abuse cheat American taxpayers and erode public confidence in the integrity of our transportation system and those who build, operate, and maintain it.

From the "TOPnet" homepage (shown here), site users can access a directory of transportation oversight providers; review suspensions, debarments, and administrative and judicial actions; or visit the reading room for news and best practices.

Jim H. Crumpacker is OIG's director for National Investigative Programs and Operations. In this position, he leads a staff responsible for monitoring and focusing on nationwide safety (including aviation, motor carrier, and hazardous materials) and contract procurement and grant fraud investigative efforts and supporting investigative operations. He also manages OIG's Computer Crimes Unit. He previously served as a director in OIG's surface transportation and maritime audit group (2003–2005) and as the Inspector General's representative to the U.S. Department of Homeland Security to work relief and recovery oversight issues in the aftermath of the 2005 Gulf Coast hurricanes. Crumpacker holds a bachelor's degree in business administration in finance and a master's of science degree in public administration. He also is a Certified Internal Auditor and a Certified Fraud Examiner.

For more information, see www.oig.dot.gov or contact Jim H. Crumpacker at 202–366–1420 or jim.crumpacker@oig.dot.gov.

Is Your Construction Project a Victim of Crime?

"Red flag" indicators offer insights to help contracting officers, project managers, and others detect fraud schemes.

by Jim H. Crumpacker

The consequences of fraud within the transportation community can be staggering—with millions of dollars potentially siphoned off from agency budgets each year. Such fraud also can result in opportunity costs, loss of public trust in transportation officials and programs, project delays, increased costs, deployment of inferior transportation products or systems, funding shortfalls, and unmet program goals. All of these results adversely affect the entire transportation network. In recent years, the U.S. Department of Transportation's (USDOT) Office of Inspector General (OIG) has noted that transportation officials and project managers are devoting more attention to mechanisms that detect and prevent fraud. (See the companion article, "Upholding the Public Trust," on page 2.)

Special agents in OIG are responsible for investigating fraud schemes that involve Federal funds and programs. Brief descriptions of these schemes, along with sample "red flag" indicators for each scheme, are offered here as a tool for transportation professionals to help them detect fraud when doing business on behalf of the American public. It is important to note that the presence of one or more indicators does not necessarily prove fraud, nor are the indicators shown all-inclusive for each of the schemes described.

(Above) OIG special agents occasionally use concealed recording devices during investigations involving allegations of fraud and corruption. *Photo: USDOT.*

Bid Rigging and Collusion

In bid rigging and collusion, contractors misrepresent that they are competing against each other when, in fact, they agree to cooperate on the winning bid to increase job profit. Watch for:

- Unusual bid patterns: too close, too high, round numbers, or identical winning margins or percentages
- Different contractors making identical errors in contract bids
- Bid prices dropping when a new bidder enters the competition
- Rotation of winning bidders by job, type of work, or geographical area
- Losing bidders hired as subcontractors
- Apparent connections between bidders: common addresses, personnel, or telephone numbers
- Losing bidders submitting identical line item bid amounts on nonstandard items

Materials Overcharging

Under this fraud scheme, a contractor misrepresents how much construction material was used on the job and then is paid for excess material to increase job profit. Watch for:

- Discrepancies between contractor-provided quantity documentation and observed data, including yield calculations
- Refusal or inability to provide supporting documentation
- Contractor consistently loading job materials into equipment

away from inspector oversight
- Truck weight tickets or plant production records with altered or missing information
- Photocopies of quantity documentation where originals are expected
- Irregularities in color or content of weight slips or other contractor documents used to calculate pay quantities

Time Overcharging

In a time overcharging scheme, a consultant or contractor misrepresents the distribution of employee labor on jobs in order to charge for more work hours, or a higher overhead rate, to increase profit. Watch for:

- Unauthorized alterations to timecards and other source records
- Billed hours and dollars consistently at or near budgeted amounts
- Timecards filled out by supervisors, not by employees
- Photocopies of timecards where originals are expected
- Inconsistencies between consultant's labor distribution records and employee timecards

Product Substitution

In a scheme involving product substitution, a contractor misrepresents the product used in order to reduce costs for construction materials. Watch for:

- Any mismarking or mislabeling of products and materials
- Contractor restricting or avoiding inspection of goods or services upon delivery
- Contractor refusing to provide supporting documentation regarding production or manufacturing
- Photocopies of necessary certification, delivery, and production records where originals are expected
- Irregularities in signatures, dates, or quantities on delivery documents
- High rate of rejections, returns, or failures
- Test record reflecting no failures or a high failure rate but contract is on time and profitable
- Unsigned certifications

Disadvantaged Business Enterprises (DBE) Business Fraud

Under this fraud scheme, a contractor misrepresents who performed the contract work in order to increase job profit while appearing to be in compliance with contract goals for involvement of minority- or women-owned businesses. Watch for:

- Minority owner lacking background, expertise, or equipment to perform subcontract work
- Employees shuttling back and forth between prime contractor and minority-owned business payrolls
- Business names on equipment and vehicles covered with paint or magnetic signs
- Orders and payment for necessary supplies made by individuals not employed by minority-owned business
- Prime contractor facilitated purchase of minority-owned business
- Minority-owned business owner never present at job site
- Prime contractor always uses the same minority-owned business

Unauthorized alterations to timecards like those shown here is a type of fraud in which a contractor misrepresents employee labor, for example, by charging for more work hours in order to increase profit.

Quality-Control Testing Fraud

In this scheme, a contractor misrepresents the results of quality control (QC) tests to earn contract incentives falsely or to avoid production shutdown in order to increase profits or limit costs. Watch for:

- Contractor employees regularly taking or labeling QC samples away from inspector oversight
- Contractor insisting on transporting QC samples from the construction site to the lab
- Contractor not maintaining QC samples for later quality assurance (QA) testing
- Contractor challenging results or attempting to intimidate QA inspectors who obtain conflicting results
- Photocopies of QC test results where originals are expected
- Alterations or missing signatures on QC test results

Bribery

Bribery occurs when a contractor misrepresents the cost of performing work by compensating a government official for permitting contract overcharges to increase contractor profit. Watch for:

- Other government inspectors at the job site noticing a pattern of preferential contractor treatment
- Government official having a lifestyle exceeding his or her salary
- Contract change orders lacking sufficient justification
- Oversight officials socializing with, or having business relationships with, contractors or their families

Kickbacks

In kickback schemes, a contractor or subcontractor misrepresents the cost of performing work by secretly paying a fee for being awarded the contract and therefore inflating the job cost to the government. Watch for:

- Unexplained or unreasonable limitations on the number of potential subcontractors contracted for bid or offer
- Continuing awards to subcontractors with poor performance records
- Nonaward of subcontract to lowest bidder
- "No-value-added" technical specifications that dictate contract awards to particular companies

Conflicts of Interest

In fraud involving conflict of interest, a contracting or oversight official misrepresents that he or she is impartial in business decisions when he or she has an undisclosed financial interest in a contractor or consultant who inflates the job cost to the government. Watch for:

- Unexplained or unusual favoritism shown to a particular contractor or consultant
- Government official disclosing confidential bid information to a contractor or assisting the contractor in preparing the bid
- Employee having discussions about employment with a current or prospective contractor or consultant
- Close socialization with and acceptance of inappropriate gifts, travel, or entertainment from a contractor
- Vendor or consultant address being incomplete or matching employee's address
- Government official leasing or renting equipment to a contractor for performing contract work

False Statements and Claims

False statements or claims made "knowingly and willfully" constitute fraud. Knowledge is defined as (1) actual knowledge of falsity, (2) deliberate ignorance of truth or falsity, or (3) reckless disregard of truth or falsity. Watch for:

- Discrepancies between reported facts and observed data and supporting documentation
- Discrepancies between reported facts and test and inspection results
- Refusal or inability to provide supporting documentation
- Inadequate or apparently altered supporting documentation

USDOT

As part of a surveillance operation, an OIG special agent installs an overt camera to help substantiate allegations received via the OIG Hotline. Agents sometimes also use covertly installed cameras to obtain evidence of crimes.

Methods for Reporting Fraud

Report suspicions and allegations of fraud, waste, abuse, or mismanagement to OIG by using one of the following methods:

- Online complaint form: www.oig.dot.gov/hotlineform.jsp
- Telephone: 800–424–9071
- Fax: 540–373–2090
- E-mail: hotline@oig.dot.gov
- Mail: USDOT Inspector General, P.O. Box 708, Fredericksburg, VA 22404–0708

Note: The OIG Hotline is obligated to expeditiously forward all safety-related complaints to USDOT's safety regulatory agencies for action, as appropriate.

- Repeated "errors" that benefit the contractor
- Unreasonable claims or statements compared to prior performance or industry standards
- High rate of rejections, returns, or failures
- Site inspection reports indicating less progress than reported
- Complaints from users

Reporting Concerns About Fraud, Waste, Abuse, or Mismanagement

OIG maintains a hotline (see "Methods for Reporting Fraud" above) to report allegations of fraud, waste, abuse, or mismanagement in USDOT programs or operations. Allegations may be reported by USDOT employees, contractors, or the public. The OIG Hotline is available 24 hours a day, 7 days a week. Issues that should be reported include the following:

- Contract, procurement, and grant fraud
- Environment, health, and safety violations
- Computer crimes
- Product substitution and suspect/counterfeit parts
- Bribery, kickbacks, and gratuities
- False statements and false claims
- Conflicts of interest and ethics violations
- Travel fraud, theft, and/or abuse of government property
- Other violations of Federal laws and regulations

A Final Word

Not all businesses are on a mission to defraud Federal, State, or local governments or the American people. In fact, most businesses are composed of responsible and conscientious professionals who want to do a good job and provide superior products and services. However, the Latin warning *caveat emptor*, which means "Let the buyer beware," applies.

Agency transportation professionals at all levels of government are responsible and accountable for the stewardship and oversight of taxpayer money entrusted to them. Proactively recognizing the signs of potential fraud at each stage of a construction project and taking action, as appropriate, will go a long way in helping to detect and stop fraud.

American taxpayers rely on professionals like us—project managers, contracting professionals, engineers, inspectors, auditors, and compliance officers—to serve as their eyes and ears, and the success of the transportation system and the trust of the American people rely on our success. In the words of Abraham Lincoln, the 16th President of the United States, "If once you forfeit the confidence of your fellow citizens, you can never regain their respect and esteem."

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Leap, Not Creep

by Kathleen A. Bergeron

Delivery and deployment of vanguard technologies promise to lead the way to faster, safer, better highway construction.

In June 1956, President Dwight D. Eisenhower signed the law that brought about the interstate system, one of the largest manmade structures in history. In 2006, the highway community and Americans everywhere celebrated the golden anniversary of this staggering engineering achievement. But many parts of this system of concrete, asphalt, and steel are now a half century old and beginning to show their age.

In August 2005, President George W. Bush signed into law the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). Among a number of other actions, the new law established a pilot program, Highways for LIFE (HfL), to promote innovations and new technologies for building highways faster, safer, of better quality, and in a way that minimizes congestion—in short, to breathe new life into the interstate system and other parts of the National Highway System.

Now, the Federal Highway Administration (FHWA) is advancing the HfL program, highlighting and deploying vanguard technologies to cut through the unfamiliarity, inertia, and other factors delaying adoption of leading-edge practices. FHWA established dedicated teams with dedicated funding to market innovations to State and local transportation stakeholders. The way the Nation's

(Above) An early prefabricated bridge project was the George P. Coleman Bridge, which carries Route 17 over the York River in Yorktown, VA. Here, barges float the last truss span into place. Prefabricated bridge elements are one of many vanguard technologies FHWA is promoting to State and local highway agencies. *Photo: George Clendenin, Virginia Department of Transportation.*

highways are built and maintained could evolve significantly.

Need Is There, But Not the Money

From the day President Eisenhower signed the Federal-Aid Highway Act of 1956, many of the pavements on the interstates were built for 20- to 25-year lifespans. The designs of the day anticipated conditions that were much less demanding than today's reality. Trucks are carrying heavier loads, and the sheer volume of traffic using the system is several times greater than anticipated. As a result, the system needs a makeover.

However, two cold facts stare that need in the face. First, funding for a nationwide construction effort is not there. Bringing the transportation system (including highways) up to par would take some $50 billion in *additional* funding, according to a 2003 estimate by the American Public Works Association. Not only is that amount not available, but projections anticipate less, not more, funding in the future, based on current financing systems. The traditional approach of taxing gasoline on a per-gallon basis at the pump is less effective today than it used to be. In the past, when vehicles averaged 4.3 kilometers per liter (10 miles per gallon), a motorist could drive 161 kilometers (100 miles) on 38 liters (10 gallons) of gasoline. At a tax rate of 5 cents per gallon, that trip would generate 50 cents in taxes. Today, with vehicles getting 12.8 kilometers per liter (30 miles per gallon), that same 161-kilometer (100-mile) trip would generate only 17 cents. Vehicles powered by alternative fuels such as electricity are cutting that amount even more. Further, with gasoline prices near $3 per gallon, legislators are wary of proposing increases in fuel taxes, which have been the core of highway funding. That means just maintaining current spending levels will be a challenge.

Second, such a massive construction effort would have an enormous impact on the National Highway System, including countless work zones delaying commuters, freight haulers, and other travelers. Further, the potential for injuries to both workers and highway users would increase with the proliferation of new work zones. And the public already is showing signs of work zone fatigue. FHWA's most recent national driver survey revealed that the public's feelings about new highways have changed since the early days of the interstate program. Back in the 1950s and 1960s, when the interstate system was young, people clamored to have a section of the system built near their communities. The promise of being able to drive coast to coast without a stoplight was a strong draw.

Today, with highways experiencing problems with available capacity, the public equates new construction anywhere on the system with increased congestion, not less. According to *Moving Ahead: The American Public Speaks on Roadways and Transportation in Communities*, a 2001 report on findings from three national surveys performed by FHWA the year before, "A small but growing segment of the traveling public is dissatisfied with major highways. Both travel delays, which are due to traffic congestion and roadwork, and pavement conditions may contribute to this growing dissatisfaction…Work zones are especially critical as travelers view road repairs as a major reason for traffic delays."

The highway community is aware of motorists' perceptions. The logic follows that a way of building highways and bridges needs to be developed so that the impact on drivers is minimized, such as building them faster, in off hours, or away from the traveling public.

Another approach is to build highways to last longer and thus extend the interlude between one construction fix and the next. Safety is an ongoing concern for the public and the highway community; therefore, each construction project should incorporate the latest safety innovations as a matter of practice. Simply replicating a bridge or section of highway built decades ago might not be the best solution given

AAA Foundation for Traffic Safety

Bridges such as this one can be built in off hours or away from the roadway to reduce drivers' growing frustration with work zones and congestion.

Lesson From the Past

Highway agencies have seen the benefits of innovations from their earliest days. In a 1999 article in *The New Yorker* magazine, Malcolm Gladwell, author of the book *The Tipping Point: How Little Things Can Make a Big Difference*, described the importance of the King Road Drag, a device that, at the turn of the last century, was used to smooth the ruts out of muddy rural roads. Smooth roadways provided access for the United States Postal Service®, which in turn brought the Sears, Roebuck and Co.™ catalog to people who had been isolated from much that the commercial world had to offer, from washing machines to the latest styles in clothing.

Thus, a small device for road grading created dramatic socioeconomic change in rural America. Wrote Gladwell: "Here was the dawn of the modern consumer economy…The [catalog], as economists have argued, represented a radical transformation in the marketing and distribution of consumer goods. But, of course, that transformation would not have been possible unless you had parcel post, and you couldn't have had parcel post unless you had rural free delivery, and you could not have had rural free delivery without good roads, and you would not have had good roads without D. Ward King [inventor of the drag]."

current conditions. As in the past, cost is still a consideration. So the highway community needs a solution that incorporates all of these: roads built faster, safer, of better quality, and in a way that minimizes congestion—and at lower cost. All require one thing: innovation.

Barriers to Implementation

Today, highway research on technological advances is big business. The Federal Government itself spends a half billion dollars each year on highway research. These expenditures include work conducted at FHWA's Turner-Fairbank Highway Research Center (TFHRC), research by consultants and contractors, and scanning tours to other countries to identify innovations that might be used in the United States.

Hundreds of devices—from D. Ward King's King Road Drag, a device to smooth the ruts out of muddy rural roads, to the latest laser-guided paving machines—have been developed and put into use over the past century. But how long does it take for an innovation to move from the laboratory to state of the art to state of the practice? Experience shows the journey can take not months or years, but decades.

A good example is FHWA's experience implementing Superpave™ technology, which produces ideal asphalt pavements using "recipes" individualized for the particular climate requirements of an area. The effort to implement Superpave began in 1992; 12 years later, the 50th State adopted the approach, finally completing implementation.

The implementation process can take a long time for a number of reasons. One might be the familiar refrain: "That's the way it's always been done." Processes become locked into standard operating procedures until someone realizes there is a better way and breaks the mold. Reasons vary as to why the highway community historically has not been quick to adopt innovations. One is limited staffing and funding for technology transfer and for delivering information and training on innovations and technologies to potential users.

Several years ago, a contractor responsible for delivering hot-mix asphalt to a highway site wondered how he could reduce the delivery time. Then one night, while watching television, he saw a commercial for a pizza company that promised delivery in 30 minutes. The next morning, he called the company to find out how it made deliveries so fast. If the drivers could deliver

Tim Breen for FHWA

Work zones like this one on a city street are a leading cause of traffic congestion on streets and highways, and are a target of FHWA's new initiative, HfL's vanguard technologies.

pizzas within 30 minutes, he should be able to learn something from the restaurant chain about how to schedule drivers and plan routes. Specifically, the contractor learned where to get better maps and then hired college students to pencil in street numbers on the maps to speed delivery. The lesson here is that sometimes new and better approaches can come from someone with a totally different perspective.

The process of putting innovations into use costs money. Marketers know that persuading consumers to change their buying habits and try an innovative product is an extensive, costly process. So it is with the highway community. Suppose that a new design concept for a specific bridge is needed. At least two people need to be provided with knowledge: the State department of transportation (DOT) construction program manager, who will possibly need a cost-benefit analysis for selecting the new design; and a bridge engineer, who will want to see the concept in operation, on a real bridge built with the technique. Both will need training, the former in contracting for quality specifications for the new design and the latter on implementing the design onsite. There will be conferences, one-on-one discussions, and success stories in trade publications. Communications tools such as brochures, videos, and Web sites illustrating the benefits of the process could be helpful. All of that costs time and money.

Corporate Marketing Practices

One might well ask: Given the billions of dollars spent on highway research, how much money is dedicated specifically to getting innovations into everyday use by the various highway agencies, construction contractors, and consultants as they build and maintain America's highway infrastructure?

Major corporations likewise spend enormous sums on research and development (R&D) to come up with innovative products and services. But they also spend large sums persuading customers to buy those products and services, with a typical marketing budget being between 5 and 12 percent of gross revenues or corporate income. In many cases, those funds are expended through market research, product branding, and other targeted channels, including one-on-one sales, distribution and supply channels, or mass marketing techniques such as advertising or direct mail.

The four people shown conferring here are members of a road safety audit (RSA) team. RSAs are an innovative approach to improving safety that FHWA is successfully marketing to State DOTs.

Just how high those costs can run is exemplified in the annual competition for attention via commercials on Super Bowl Sunday. The 2007 game set a new record at $2.6 million in advertising purchase costs for every time an advertisement aired for 30 seconds. The reason Super Bowl advertising costs are so high is that they promise one of the largest and most diverse audiences in the world.

Obviously, a large percentage of the budgets for making automobiles, breakfast cereals, laundry detergents, and other common goods is spent on marketing the product. But does that hold true in more research-intensive areas?

Perhaps the industry most noted for its R&D activities is computer technology and related hardware and software. Microsoft® might be the ultimate example in that industry. In its annual report for 2003, Microsoft noted that it spent $4.66 billion on R&D, but significantly more—$6.52 billion—on sales and marketing.

Clearly, corporate leaders understand that it makes little sense to spend billions of dollars developing a product if the buying public is not going to be made aware of it, adopt it, and use it. But the question remains: How much is spent on deploying highway innovations? The answer is: We don't know. Historically, deployment has not received the same recognition as R&D. That is where HfL comes into play.

Highways for LIFE

The HfL program came about after extensive market research by FHWA and passage of SAFETEA-LU. But what *really* got it started was publication of a special issue of PUBLIC ROADS magazine in 2002.

Then-Deputy Secretary of Transportation Michael P. Jackson saw the July/August 2002 issue of PUBLIC ROADS, which was dedicated to innovations in the use of concrete. The cover showed construction workers installing prefabricated concrete pavement slabs on the Tappan Zee Bridge toll plaza in Westchester County, NY, much as brick layers or tile workers might place flooring in a building or patio. Inside the issue were other innovations, from prefabricated bridges to self-consolidating concrete.

Jackson called the FHWA administrator and set up a meeting with engineering staff at TFHRC. The meeting was to be a simple 30-minute presentation, but it lasted 2 hours. At the end, Jackson told the group that he was impressed and that he saw the need to move

The Key to LIFE: Innovation

According to FHWA, the HfL program got its name from its purpose: "to advance **L**onger-lasting highway infrastructure using **I**nnovations to accomplish the **F**ast construction of **E**fficient and safe highways and bridges." Innovation is a broad term that applies to all of the following: technologies, materials, tools, equipment, procedures and processes, specifications, methodologies, and practices used in the financing, design, or construction of highways.

A recent success story from Florida captures many of those elements. In 2006, the Florida Department of Transportation (FDOT) used prefabricated bridge elements and self-propelled modular transporters (SPMTs) to cut months off construction of the new Graves Avenue bridge in Volusia County. SPMTs are multiaxle, computer-controlled vehicles that can move in any horizontal direction while maintaining payload geometry and equal axle loads. In Florida, the SPMTs lifted the entire span of the old Graves Avenue bridge and moved it to the I–4 roadside—in just 22 minutes.

FDOT workers here use an SPMT to replace the span of the Graves Avenue bridge. FHWA will help promote such vanguard technologies through additional demonstrations.

Two new concrete bridge spans then were built alongside I–4. After they were complete, they were installed over the highway using the SPMTs, reducing the need for road closures and disruptions to traffic. The first 43-meter (143-foot) span was installed over the westbound lanes of I–4 on June 4, with the second span installed over the eastbound lanes on June 10. The project marked the first time the SPMT technique was used in the United States to replace a bridge over an interstate highway.

"This accelerated construction technique allowed us to build the bridge's substructure and superstructure at the same time," says Amy Scales, resident engineer for FDOT's District 5. "We saved about 4 months over the course of this bridge project, greatly reducing the impact to drivers."

Instead of the weeks or months of lane closures and rolling roadblocks involved in traditional bridge building, FDOT detoured I–4 traffic for only 2 weekend nights and used roadblocks overnight on 2 nonconsecutive nights. The new bridge opened to traffic on August 7, 2006.

FDOT and FHWA hosted a delegation of about 100 transportation officials from across the United States and Canada at a June 9–11 conference in nearby DeLand, FL. Participants learned about the use of SPMTs for bridge construction and watched as the final span of the Graves Avenue bridge was installed.

Although initial costs of such projects can be higher, this can be offset by the reduced construction time and subsequent savings on personnel and traffic maintenance costs, as well as reductions in user costs. FDOT estimates that using the SPMTs cost an additional $560,000, but the shorter construction schedule resulted in $3 million in user savings.

"The project went well, and we would use SPMTs again," says Scales. "The technology is not for every project, but depending on the roadway, it can be worth it to speed up construction and get drivers back on the road sooner."

innovations to implementation quickly as key to obtaining the highway system the Nation needed. He instructed the attendees to craft a plan for promoting such innovations. "Be bold and audacious in your thinking," he said.

The group looked at several approaches but wanted to solicit input from others in the highway community. In addition to numerous telephone calls, the group obtained input from representatives of State DOTs, trade associations, construction contractors, manufacturers, consulting engineers, and the driving public. Several sessions were attended by the U.S. Secretary of Transportation and the administrators of FHWA and the Federal Motor Carrier Safety Administration. Even in those early discussions, support was overwhelming for concepts that later would appear in HfL.

The HfL program, for example, includes provisions for studying how innovations currently are deployed and for finding ways of implementing them faster nationwide. Or, as FHWA Administrator J. Richard Capka calls it, moving to an approach that deploys innovations at the pace of a "leap, not creep." Faster implementation includes such steps as creating teams and plans for deploying specific technologies and then carrying those plans out; providing funding for State DOT projects that employ innovations; and working with private industry to develop nonhighway innovations for highway application.

Vanguard Technologies

When HfL leaders proposed faster deployment of highway innovations, they created three prototype teams to deploy vanguard technologies. The term "vanguard" was used because it represents the leading edge of a new approach. The specific technologies and practices the teams are promoting are prefabricated bridge elements and systems,

road safety audits (RSAs), and techniques related to "making work zones work better."

Prefabricated bridge elements are manufactured away from or adjacent to the work zone and transferred to the construction site for installation. The prefabricated elements offer a variety of benefits, including faster implementation or construction cycles, decreased traffic disruption, improved work zone safety, greater durability, and, sometimes, lower construction costs. With RSAs, independent, multidisciplinary teams examine existing or future roadway sections to identify safety issues and opportunities for improvement. The concept of making work zones work better encompasses a suite of approaches that improve traffic flow and safety.

These innovations are dramatic changes in how highways are built, but the key for the HfL program is the *process* for *deploying* the technologies. HfL's purpose is not to develop new technologies; instead, it encourages adoption of high-payoff innovations that are available already but used infrequently.

What makes the vanguard approach different is that it is more aggressive than past deployment efforts. Rather than simply making a technology available, the teams develop marketing plans, create communications tools, and conduct activities such as one-on-one meetings, workshops, and product demonstrations for potential users. In addition, a guidebook on how to create a marketing plan for innovations was created and will be available through the "Highways for LIFE" Web site at www.fhwa.dot.gov/hfl.

Team members make deployment a job priority rather than a back-burner task they work on when time allows. They have funding for key elements such as training courses, manuals, and peer-to-peer programs.

Because of the high visibility of the teams in their respective disciplines, opportunities to partner with other groups have emerged. For example, the Technology Implementation Group within the American Association of State Highway and Transportation Officials is working with FHWA's RSA team, creating a synergy that promises even greater acceleration of deployment.

How successful has this approach been? The RSA effort, as an example, has generated results in dozens of States from Hawaii to New Hampshire in less than 3 years. The Arizona Department of Transportation, considered early on to be an "opportunity State," now has become the first State DOT to name a full-time RSA coordinator. The audit concept now is championed by local government agencies, law enforcement agencies, and a State attorney general's office. Other stakeholders, including the State Farm Insurance® company and American Automobile Association, are partnering with States and local communities to improve safety.

Likewise, prefabricated bridge elements and systems are being used across the country, with more States becoming involved all the time. Several product demonstrations have brought States' chief bridge engineers to construction sites to see how effective the technology can be, and many declare the approach to be something they definitely want to pursue. The work zone improvement effort is building a network of supporters as well, including a peer-to-peer program.

Now, another vanguard technology is being added. The new entry is prefabricated pavement slabs, the same technology featured on the cover of the issue of PUBLIC ROADS magazine that started the HfL effort. This effort will be used as a training guide for others within FHWA, at State DOTs, and elsewhere in the highway community to learn the approach, with the first three technologies added as examples.

Ultimately, the goal of the HfL program is to dramatically improve the driving experience for Americans. Through rapid deployment of innovations, those improvements can be achieved sooner rather than later.

Future motorists may leave traffic congestion behind them if the vanguard technologies successfully spur adoption of other transportation innovations.

Kathleen A. Bergeron is a marketing specialist with FHWA in Washington, DC, and works primarily on the HfL program. Prior to joining FHWA, she managed communications and marketing programs for consulting engineering firms and transportation agencies at the State and local levels. She has a bachelor's degree in journalism from the University of Texas at Austin and a master's degree in transportation management from San José State University.

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Mobility Services For All

by Yehuda Gross and Gwo-Wei Torng

ITS technologies are improving the quality of transportation for individuals in human service programs.

(Above) A driver assists human service transportation clients with boarding a vehicle. *Photo: © Courtesy of TriMet, Portland, OR.*

For most people, going to work, stores, doctors, church, or social functions means getting into a car. But for some it might not be that easy. They might be unable to provide their own transportation, relying instead on others to take them where they need to go, such as medical care, work, or job training. These individuals face many challenges when trying to get a ride.

"With the rapid expansion of the population of older adults, people with disabilities, and advocacy for independent living, the importance of providing quality and cost-effective transportation for those participating in human service programs is becoming a high priority," says Dr. Alan Abeson, former director of Easter Seals Project ACTION. "Nearly every human service program recognizes that transportation is fundamental to living in communities."

Examples of Federal human service programs that provide funding for transportation services include Medicaid, Head Start, and the Temporary Assistance for Needy Families Program. Today there are 62 Federal programs that fund services for people lacking transportation. According to a 2003 U.S. Government Accountability Office report, *Transportation-Disadvantaged Populations*, 29 of those programs collectively spent $2.4 billion in 2001 to provide transportation assistance to the targeted populations. Medicaid, a Federal program for medical assistance to low-income individuals and families, spent nearly $1 billion on transportation in 2001.

Although many programs were initiated and funds spent on human service transportation, the creation of more programs did not necessarily guarantee that it would be much easier for people who need assistance to get around. The 62 Federal programs are under the jurisdiction of 9 different Federal departments, often administered and operated independently.

As stated in the Federal Interagency Coordinating Council on Access and Mobility (CCAM) 2005 *Report to the President: Human Service Transportation Coordination*, "It is no secret that the emergence of so many separate transportation options tied to specific programs, or available only to specific population subgroups, has created a complex, often duplicative, web of transportation services in our communities."

To address growing concerns over rising costs and to improve service, President George W. Bush issued Executive Order 13330—Human Service Transportation

Coordination—in February 2004. The order requires all relevant Federal agencies to work together to enhance transportation access, minimize duplication of services, and facilitate the most appropriate, cost-effective human service transportation. The goal is to enhance accessibility and mobility for the transportation disadvantaged, especially individuals with low incomes, people with disabilities, and older Americans.

Several past and current U.S. Department of Transportation (USDOT) initiatives are addressing transportation services for disadvantaged populations. In particular, an interagency endeavor is promoting intelligent transportation systems (ITS) to help coordinate human service transportation systems.

A Transit Cooperative Research Program report, *Economic Benefits of Coordinating Human Service Transportation and Transit Services,* published by the Transportation Research Board in 2003, estimated the potential aggregated economic benefits of coordinating human service transportation in the United States to be about $700 million annually.

Two Innovative Approaches

Building on the strength of the Executive order, USDOT is leading two concurrent initiatives related to the enhancement of human service transportation: United We Ride (UWR) and Mobility Services for All Americans (MSAA). The Federal Transit Administration (FTA) manages the UWR initiative on behalf of CCAM and comprehensively focuses on all issues related to coordination of human service transportation.

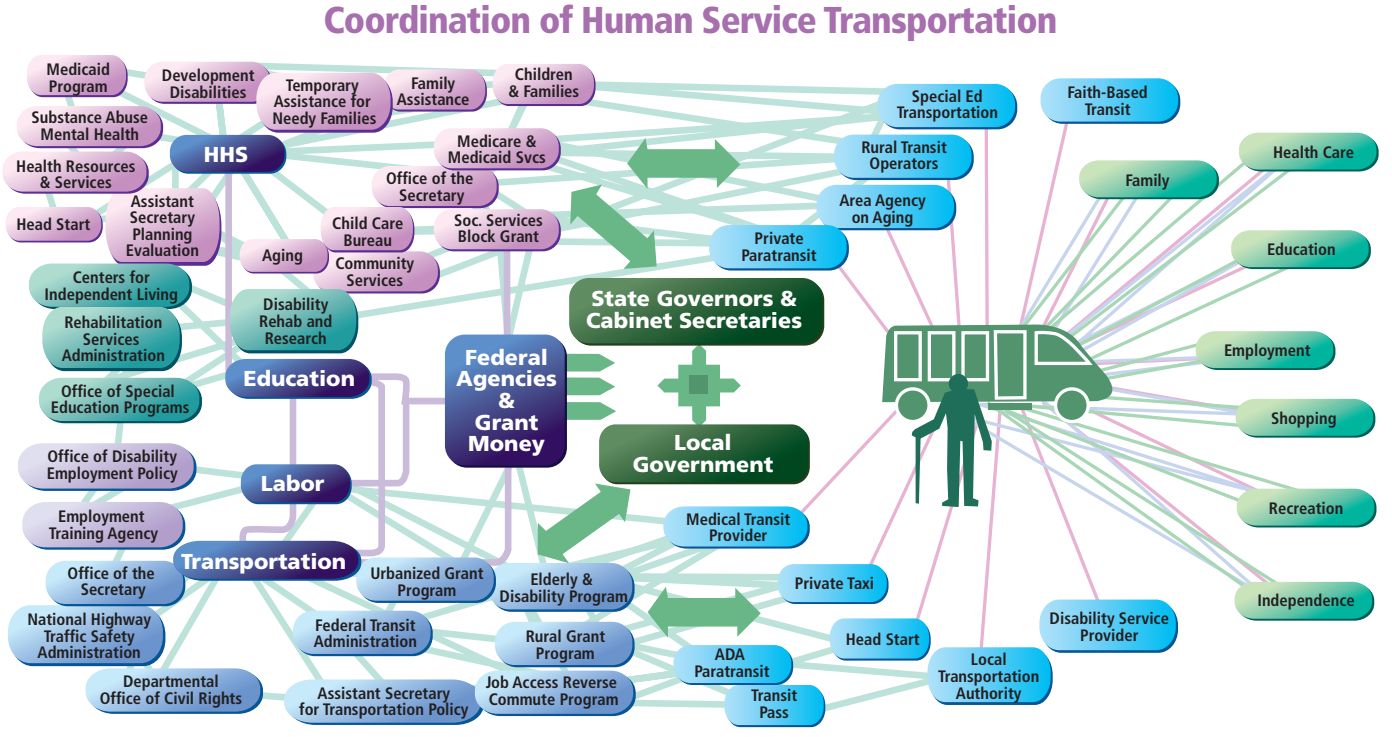
USDOT's ITS Joint Program Office (JPO) launched the MSAA initiative in 2004 to bring all communities together in a coordinated effort to apply technological solutions to the barriers of accessibility and mobility for the transportation disadvantaged. MSAA carried out research to integrate knowledge and information from the transportation and human services communities and to solicit direct input from stakeholders through a series of public listening sessions, expert panel meetings, and focus group discussions. The report on the research is titled *Mobility Services for All Americans* and was published in 2005.

The UWR and MSAA initiatives complement each other and have collaborated closely to build on one another's progress and success. Generally speaking, UWR provides the "what"—including definition of a wide range of issues, challenges, and obstacles, and, in certain cases, potential strategies. In contrast, MSAA provides the "how"—enabling technologies that empower stakeholders to overcome some of the identified issues and obstacles. Stakeholders sometimes describe MSAA as the moving wheels on the UWR coordination wagon. The programs are in the design phase at this point and therefore have no quantitative successes to report as yet.

The ITS Role in Human Service Transportation

Prior to the MSAA initiative, the ITS JPO conducted a series of activities as building blocks aimed at improving delivery of services to the transportation disadvantaged:

- Transportation coordination operational tests. This phased program allocates more than $3 million to 13 operational tests for coordination, technology deployment, and innovative practices of human service transportation. Many of these tests focus on improving operational efficiencies from the transportation providers' perspective.
- *ITS Applications for Coordinating and Improving Human Services Transportation: A Cross-Cutting Study* (FHWA-JPO-05-056). The Oak Ridge National Laboratory led this Federal Highway Administration (FHWA) and FTA study to investigate the use of ITS technologies for coordinating human service transportation operations. The project produced a final report documenting study findings plus two pamphlets for public outreach.



This diagram illustrates the challenges resulting from uncoordinated human service transportation. The complexity of the diagram suggests the various Federal, State, and local programs that relate to human service transportation and the need for much simplified ways for disadvantaged end users to figure out their mobility options. *Source: USDOT.*

The pamphlets promoted awareness of ITS applications and benefits among transportation service providers and the public.

- *ITS Transit Case Studies: Making a Case for Coordination of Community Transportation Services Using ITS*. This report provides a detailed view of the experiences of three organizations as they planned, implemented, and operated ITS technologies to meet the mobility needs of the communities they serve and to improve coordination. The organizations are the Suburban Mobility Authority for Regional Transportation in Michigan, Reach Your Destination Easily in Nebraska, and www.NDinfo.org in North Dakota. The groups represent distinctively different settings: urban/suburban, small urban, and rural/frontier users and service providers.
- Linking Technology with Mobility for Seniors and People with Disabilities. The American Public Transportation Association hosted this workshop in San Francisco in July 2004. The workshop supported information sharing and provided an international perspective on delivery of human service transportation.
- USDOT and the U.S. Department of Health and Human Services (HHS) regional coordination workshops. USDOT hosted workshops in the 10 FTA regions from March 2003 through December 2004. The workshops solicited input from the States' perspectives and assisted them in developing action plans to coordinate their activities.

Bob Boundy, Oak Ridge National Laboratory

In Flint, MI, a Mass Transportation Authority operator is helping a passenger in a wheelchair board a paratransit vehicle using the lift.

Benefits of Applying ITS to Human Service Transportation

Some organizations across the country have experienced the benefits of various ITS applications in advancing human service transportation. Based on limited field observations and input from stakeholders, ITS technologies might offer the following benefits:

- Increased staff productivity
- Integrated point of access for traveler support
- Improved fleet scheduling, dispatching, and routing
- Streamlined reporting, billing, and financial transactions
- Simplified fare payment, collection, and processing
- Enhanced traveler information and travel management capability with accessibility features

Proper use of ITS applications can improve delivery of human service transportation by boosting service productivity, facilitating service coordination, and enhancing system accessibility. Three categories of applications relate to delivery of

human service transportation. These applications include those that:

- Overcome the barriers to accessibility and expand opportunities to use conventional transportation services
- Improve the ease of use and accessibility of demand-responsive transportation services
- Enable coordinated operations between agencies and modes of integrated community transportation services

Barriers to Applying ITS to Human Service Transportation

The MSAA 2005 report, *Mobility Services for All Americans Foundation Research Final Report,* identified 23 major barriers that have led to unmet mobility needs (gaps) facing certain populations. The report grouped the barriers into five categories: service availability, service information and knowledge, service accessibility, service reliability and safety, and service flexibility. For each barrier, the report identified potential ITS solutions that are mostly user oriented, such as automated trip planning and reservation systems, and multimedia and multilingual real-time traveler information through simplified points of access.

Most ITS technologies applicable to overcoming barriers to human service transportation are proven, and many have been used extensively in conventional fixed-route public transportation systems. But any given ITS technology can have substantially different applications and focuses when applied to human service transportation. For example, Automatic Vehicle Location Systems and Computer Aided Dispatch systems for conventional fixed-route systems focus on monitoring service performance and responding to incidents, while those for demand-responsive systems must schedule and route paratransit vehicles (flexible vans and small buses that do not follow fixed schedules and routes), maintain individual customer information, monitor the system's performance, and respond to incidents such as missed pickups.

Despite the availability of proven ITS technologies, their deployment and readiness for human service transportation remains sporadic. According to USDOT's 2005 report *Advanced Public Transportation Systems Deployment in the United States—Year 2004 Update,* of more than 500 transit agencies surveyed, nearly 70 percent had low deployment of ITS technologies to coordinate human service transportation. A mere 29 percent reported a medium level of ITS deployment, and only 1.6 percent had a high level.

No substantial difference exists in deployment levels in metropolitan and nonmetropolitan areas.

By way of comparison, a relatively higher percentage of transit agencies reportedly use ITS for other applications, such as ridership supportive technologies. (See "Technologies for Coordination of Human Service Transportation" and "Technologies Supporting Ridership" below.)

In addition to fundamental institutional and regulatory barriers, the MSAA report found that a lack of relevant empirical evidence on ITS lessons learned, returns on investment at the individual system levels, limited financial resources, and lack of technical expertise on enabling technologies were cited as the most common challenges facing local stakeholders in promoting ITS for human service transportation.

Overcoming the Barriers

USDOT will focus on these barriers as it provides leadership to promote ITS applications and measure their respective cost-effectiveness under various service scenarios and operational environments. Based on the findings and recommendations of the MSAA report and CCAM's *Report to the President: Human Service Transportation Coordination*, also published in 2005, the UWR/MSAA initiatives

Deployment of ITS Technologies by Transit Agencies

Level of Deployment of ITS Technologies	ITS Technologies for Human Service Transportation			ITS Technologies Supporting Ridership Applications		
	78 Large Metro Areas	Other Areas	All Areas	78 Large Metro Areas	Other Areas	All Areas
High	2.1%	1.2%	1.6%	25.4%	6.1%	13.2%
Medium	32.3%	26.9%	28.9%	48.7%	43.7%	45.5%
Low	65.6%	71.9%	69.6%	25.9%	50.2%	41.3%
TOTAL	**100%**	**100%**	**100%***	**100%**	**100%**	**100%**

Source: Advanced Public Transportation Systems Deployment in the United States—Year 2004 Update.
**Rounded to nearest percentage.*

Technologies for Coordination of Human Service Transportation

- Multimodal/multicarrier advanced traveler information systems (ATIS) with other transit systems
- Multimodal/multicarrier ATIS with traffic information
- Coordinated billing with social service agencies
- Coordinated travel requests with multiple agencies
- Technology to coordinate rail, bus, and demand-responsive services

Technologies Supporting Ridership

- Electronic fare payment data used in route and service planning
- Electronic fare payment interoperability with other transit agencies
- Real-time vehicle location detection and monitoring
- Automatic counting of onboard passengers
- ATIS

One Vision of Enhanced Human Service Transportation

In this example of an ITS-enhanced coordinated human service transportation system, the center of the system represents a single point of access for all users. Users include those who wish to obtain information or request services, transportation service providers that coordinate and share information and resources, and funding and legislative entities that strive to establish accountable and quality transportation services to needy individuals and families. ITS plays an enabling role to turn the vision into a reality by connecting the various components as an integrated whole. Ultimately, the integrated system can facilitate not only operational coordination, but also cost sharing on capital acquisitions such as vehicle purchases and infrastructure building.
Source: USDOT.

jointly released an open competition request for proposals in April 2006. The purpose was to select project sites to explore the technical and institutional feasibility of creating an ITS-enhanced human service transportation system that would include enhanced coordination and accessibility features.

The demonstration adopted a two-phased approach: system planning and design (phase 1) and system deployment (phase 2). USDOT selected eight project sites for phase 1 (lead agency name and type of agency in parentheses):

- Aiken, SC (Lower Savannah Council of Governments/ metropolitan planning organization [MPO])
- Atlanta, GA (Atlanta Regional Commission/MPO)
- Camden County, NJ (Camden County Workforce Investment Board/nonprofit organization for local workforce development)
- Fitchburg, MA (Montachusett Regional Transit Authority/transit agency)
- Kent, OH (Portage Area Regional Transportation Authority/transit agency)
- Louisville, KY (Transit Authority of River City/transit agency)
- Orlando, FL (Central Florida Regional Transportation Authority/transit agency)
- Paducah, KY (Paducah Area Transit System/transit agency)

The selections represent a variety of operational environments from large urban to rural areas, various lead agency types from transit agencies to local and regional government entities, and different levels of ITS deployment. To measure and assess the institutional and technical feasibility of the system, the UWR/MSAA joint demonstration uses an approach that involves two parallel, yet autonomous, evaluations: an institutional process evaluation and a system impacts evaluation. USDOT officials expect that the findings and products that result from the two evaluations will constitute the key knowledge base for directly responding to stakeholders' need for lessons learned and expected returns on investment for various ITS applications.

Near the end of the period of performance for phase 1, USDOT intends to proceed with system deployment (phase 2) by selecting two or more local communities. Only those agencies participating in phase 1 will be eligible to apply for phase 2.

Key products of the UWR/MSAA joint demonstration are replicable and scalable models of ITS-enhanced human service transportation systems that promote mobility, accessibility, and coordination of services for the transportation disadvantaged and the public. The models also should achieve more efficient use of Federal transportation funding. The model systems will address three areas: (1) creating simple points of access for all, (2) embracing a comprehensive

set of transportation services, and (3) utilizing ITS technologies to enhance efficiency and accessibility.

Keys to Success

Based on lessons learned from previous projects and field observations, the following three factors should be considered in developing a successful system for human service transportation.

No one size fits all. A successful model will differ from place to place and from system to system, depending on factors such as the type of area (urban or rural) and local, political, and institutional settings. For example, encouraging stakeholder support through a series of small and informal face-to-face meetings might be an effective approach in small and rural areas, but it could pose issues in larger, more urbanized areas. This is one reason why USDOT is taking the lead to demonstrate multiple scalable and replicable models of human service transportation systems, so communities see the relevance and understand how they can benefit.

Incremental deployment with logical sequence. Communities should attempt to broaden the level of stakeholder participation and establish a common vision for what the local human service transportation system should be like. Broader participation helps shape the system to embrace local users' needs and consider comprehensive service scenarios and requirements. Even if implementing the components of the final design of the system for deployment all at once is beyond the community's immediate financial capability, the design will provide a crucial roadmap for incremental and logical growth over time through expansion and replication.

Outreach and education. According to the MSAA 2005 report mentioned earlier, although lack of technical assistance and expertise continues to affect many human service agencies' ability to manage and deploy ITS projects and systems, especially in rural areas, policy and other institutional issues remain as major barriers. The collaboration between the UWR and MSAA initiatives provides a platform for a more comprehensive approach to coordination and overcoming barriers, including regulatory and institutional issues.

"USDOT is committed to providing needed tools, guidance, and training to assist communities in enhancing local human service transportation systems," says Shelley Row, director of USDOT's ITS JPO.

Next Steps

Most ITS applications relevant to human service transportation are proven and well-documented technologies with widespread deployment. However, field deployment is in the form of fixed-route applications and is limited in scope to a single agency. According to the MSAA 2005 report, actual use of ITS solutions to facilitate interagency coordination, both from the operator and customer perspectives, remains sporadic. Even when used for human service transportation, existing ITS applications are largely related to fleet management and operations for efficiency gains, and less to customer-oriented functions such as automated reservations and trip planning through simplified points of access—a high priority expressed by stakeholders.

"We expect that the results from this UWR/MSAA joint venture will facilitate sustained enthusiasm and commitment from both the transportation and human service communities and across all levels of government—Federal, State, and local—to redefine the future of human service transportation," says Row. "Human service transportation could benefit from an overall system approach that not only serves transportation-disadvantaged populations in particular, but also benefits the public as a viable travel mode of choice."

This woman with the Cape Cod Regional Transit Authority in Massachusetts is pointing to a mobile data computer, an ITS application that enhances real-time communication between drivers and dispatchers. *Photo: Bob Boundy, Oak Ridge National Laboratory.*

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QuickZone
Modeling In the Zone

With the revised Federal Work Zone Safety and Mobility Rule now in effect, this modeling tool can help DOTs comply.

by Deborah Curtis

With road repair projects on the rise across the Nation, reducing congestion caused by work zones and improving mobility is more important than ever. About one-quarter of nonrecurring motorist delay is attributable to work zones, which also are cited as second only to poor traffic flow as a source of traveler dissatisfaction, according to research by the Federal Highway Administration (FHWA).

The FHWA study, *Moving Ahead: The American Public Speaks on Roadways and Transportation in Communities* (FHWA-OP-01-017), reveals that highway users tend to view roadway repairs and associated work zones as one of the major causes of traffic delays. The report states that one of the key steps to increase user satisfaction with highways is to reduce work zone delays. Accurately predicting such delays and planning effective construction phasing and detour routes can help reduce driver frustration.

Although no single analysis tool is ideal for all work zones, the software program QuickZone is one of many solutions in a highway agency's toolbox. Released by FHWA in 2002, QuickZone can help State departments of transportation (DOTs) and metropolitan planning organizations estimate the impact of work zone activities on traffic flow. Since 2002, State and local transportation agencies and construction contractors have used the inexpensive software program to estimate costs, traffic delays, and backups due to work zones and to compare the effects of mitigation strategies. An enhanced QuickZone 2.0 debuted in 2005. Now the program is poised to be even more beneficial as State and local agencies move to comply with the revised Work Zone Safety and Mobility Rule, which took effect in October 2007. (See "Revised Work Zone Rule" on this page.)

Work Zones and Congestion

The growing congestion on U.S. highways is well documented. According to *The 2007 Urban Mobility Report* by the Texas Transportation Institute (TTI), "Congestion caused urban Americans to travel 4.2 billion hours more and to purchase an extra 2.9 billion gallons of fuel for a congestion cost of $78 billion" in 2005.

Unlike congestion caused by routine heavy traffic during daily peak travel periods, nonrecurring events generally result in unexpected travel delays. According to FHWA, work zones account for about 482 million vehicle hours of delay—24 percent of nonrecurring congestion and 12 percent of total congestion.

Work zones have adverse impacts on traveler and worker safety. In 2005 nearly 2.7 million people were injured and 43,443 people died on the Nation's roads. In 2006 there were 1,010 work zone fatalities, and each year, more than 40,000 people are injured in work zone-related crashes.

There are broader implications as well. Work zone impacts can extend beyond the physical location of the construction itself to affect safety and mobility miles away.

The trend toward longer and longer periods of peak congestion complicates the picture. TTI's *The 2007 Urban Mobility Report* indicates that annual delay for the peak-period traveler increased from 14 hours in 1982 to 38 hours in 2005 (48 hours in large cities). Ever higher traffic volumes on many highways make it difficult to perform work in or near travel lanes during much of the day because of the impacts posed to workers and the traveling public. As a result, the window to perform roadwork without severely affecting traffic is shrinking; today, about one-third of work zones are active primarily at night.

Revised Work Zone Rule

Anticipating and aggressively mitigating congestion caused by work zones can help relieve the problem. To help meet this goal, FHWA published the revised Work Zone Safety and Mobility Rule in September 2004. All State and local governments that receive Federal-aid funding were required to comply with the rule no later than October 12, 2007.

"The rule has been updated and revised to encourage agencies to address the mobility impacts as well as safety impacts created

by working on the roadways," explains Ken Wood, a traffic operations engineer at FHWA's Resource Center in Olympia Fields, IL. "The changes to the regulation will encourage broader consideration of the safety and mobility impacts of work zones across project development, and the implementation of strategies that help manage these impacts during project delivery."

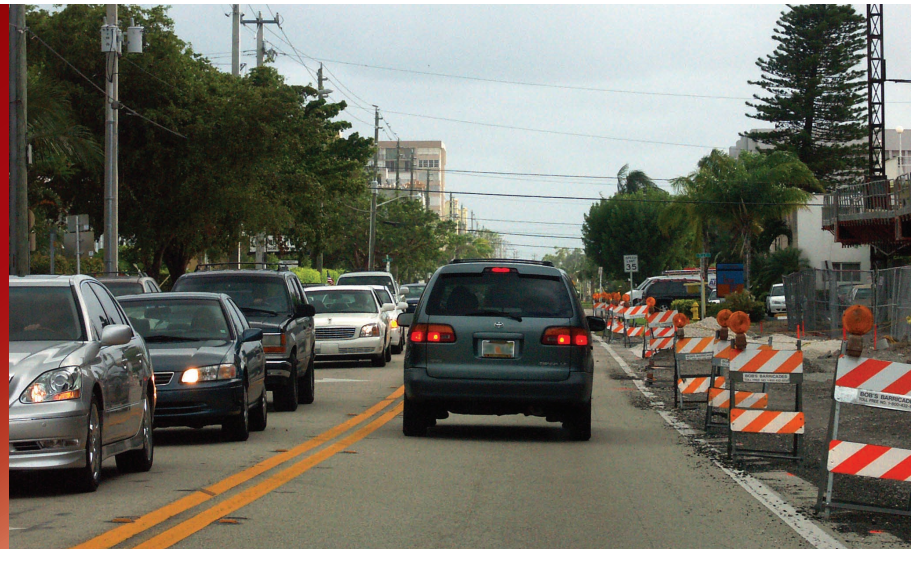
The rule has three primary components and goals. First, it calls for each State and local DOT to implement an overall policy on work zone safety and mobility to institutionalize the consideration and management of work zone impacts. Second, the rule requires establishment of agency-level processes to support policy implementation, including procedures for assessing the impacts of work zones, analyzing data, conducting training, and reviewing processes. Third, the rule calls for establishing project-level procedures to assess and manage the impacts of individual projects.

For a DOT, establishing an overall policy is the first step toward institutionalizing the planning, design, and operational strategies that reduce congestion and crashes due to work zones. Because of the high rates of retirement and turnover within DOTs and the increasing use of consultants, formalizing processes and practices will help ensure a consistent way of doing business across projects. Formalized processes also will lead to greater consistency and uniformity for highway users traveling through work zones.

Recognizing that not all road projects cause the same level of impact, the updated rule establishes a category for "significant" projects. A significant project is one that by itself or in combination with other nearby projects is anticipated to cause sustained impacts that are greater than considered tolerable according to State policy and/or engineering judgment. All projects on the interstate system within the boundaries of a designated Transportation Management Area are deemed significant if they occupy a location for more than 3 days with either intermittent or continuous lane closures.

(Above) QuickZone 2.0 has new features to improve modeling of work zone impacts on traffic flow and delays at major intersections such as this one. *Photo: AAA Foundation for Traffic Safety.*

(Right) The traffic queues at work zones like this are considered "nonrecurring" congestion, which accounts for about one-quarter of all congestion. *Photo: AAA Foundation for Traffic Safety.*



AAA Foundation for Traffic Safety

During the day, road construction workers, such as the men shown here, are becoming a rarer sight. Ever-growing traffic volumes are pushing their work into offpeak hours, especially at night.

The Need for QuickZone

Designation of significant projects triggers the need for further procedures for assessing work zone impacts, which is where analysis tools such as QuickZone come into play. QuickZone can help States and localities meet this need if they have not yet developed their own approaches or do not have the resources for the complexity, time, and expense involved in microsimulation analyses.

"As the compliance date drew near, transportation agencies considered several work zone analysis tools to assist in assessing the work zone mobility impacts," says Daniel Grate, a traffic operations engineer at FHWA's Resource Center in Atlanta, GA. "QuickZone is a tool of interest for many. It is considered one of the viable tools available to assist in assessing work zone impacts during all phases of the project development process, including planning, design, construction, maintenance, and operations."

FHWA's Turner-Fairbank Highway Research Center in McLean, VA, first developed QuickZone following the 1998 release of FHWA's study, *Meeting the Customer's Needs for Mobility and Safety During Construction and Maintenance Operations*. The report stated that the delay costs incurred by road users from work zones typically are not considered when construction zones are planned. The report's authors recommended developing an analytic tool, such as an easy-to-use software program, that would estimate and quantify work zone delays and resulting user costs.

Very few State and local highway officials or construction contractors could determine the true cost of a road construction or improvement project, according to the study, even after the project was completed. In the overwhelming majority of cases, officials and contractors calculated only "hard costs," such as labor and materials. But every road project also incurs "soft costs"—the extra minutes or even hours spent by motorists and their passengers in negotiating the delays caused by work zones. This type of traveler delay is significant, but its cost is rarely calculated.

Meanwhile, travelers must operate with only a vague idea of how long delays will last. Thus, a tool to quantify delays and estimate user costs would benefit everyone affected by work zones, including highway officials, workers, and motorists.

The QuickZone software is a Microsoft® Excel®-based application using Visual Basic® for Applications. Any computer with Excel 97 or a later release can use it. The only other requirement is a Windows®-based operating system with minimal memory and processing speed. QuickZone is an open-source application, which means that users may access the software's source code and customize it to suit their specific needs. QuickZone initially cost $195, including basic user support. QuickZone 2.0 runs approximately

Relieving Work Zone Congestion in the National Parks

QuickZone is proving useful not just in urban areas and highway corridors, but even in national parks. In Utah, the National Park Service used the software to plan a major rehabilitation of the main road through Zion National Park.

A primary concern was the potential problem for visitors entering the park through the town of Springdale during the construction work. Traffic queues often occurred at this visitors' entrance even under normal conditions.

Staff from FHWA's Central Federal Lands Highway Division (CFLHD) used QuickZone to estimate the number of vehicles that would queue up because of the road work during the peak tourist period of June–October. The analysis indicated that queues reaching into Springdale likely would occur unless changes were made to the proposed traffic control plan. Project engineers then reevaluated the construction phasing and came up with a better traffic plan.

CFLHD officials also used QuickZone to plan reconstruction of a 30-kilometer (18.6-mile) section of the Beartooth Highway, just outside Yellowstone National Park in Montana and Wyoming. This section had not been rebuilt since the original road construction in 1936. QuickZone helped evaluate a series of four planned work zones requiring flaggers, to provide an estimate of the cumulative delay that a motorist likely would encounter from the work zones and to improve coordination of lane closures.

$250 but is free to those who purchased the original program.

Typical QuickZone users are State and local highway officials and others involved in planning highway construction. However, consultants also might use QuickZone to analyze project alternatives.

Sketch Planning Using QuickZone

QuickZone calculates the traffic delays and average and maximum queue lengths that could result from lane restrictions in both urban and suburban work zones. The software also facilitates tradeoff analyses between costs of construction and delays; evaluates how modifying the schedule, such as changing the time of day or season for various construction phases, might affect traffic delays; predicts queues and delays associated with mitigation strategies to reduce work zone impacts; and facilitates calculating incentives and disincentives for construction contractors to reduce user delay.

QuickZone is designed to calculate the difference between a roadway network's capacity and the actual number of vehicles using the network. The excess volume is expressed as a queue. The software uses standard queuing theory and volume-capacity ratios to generate its estimates.

A similar virtue is that the program is deterministic rather than stochastic. That is, QuickZone runs one direct calculation rather than a series of calculations using a random variable approach and then averaging those outputs. Thus, QuickZone produces the same results every time it is run, with no random variation to the outputs. Also, deterministic models are quicker to execute as they do not require the outputs of multiple runs to be averaged to derive the results. On the other hand, because drivers are not predictable, averaging using probabilistic models has virtues that a deterministic model does not.

Several mitigation strategies are built into QuickZone, including diversion to a detour route; techniques to manage demand, such as time shifting and trip cancellations; mode shifts to transit; and traveler information services using intelligent transportation systems. The program also facilitates evaluating construction alternatives such as full road closures.

Leading up to a QuickZone analysis, the user needs to gather four critical data components:

- Data on the roadway facility under construction and adjacent alternative routes in the travel corridor
- Data on the work zone strategy and phasing plan, including anticipated capacity reductions due to the work zone
- Data on travel demand, including travel patterns in the corridor prior to construction
- Data on planned strategies to mitigate congestion during each construction phase, including estimates of capacity changes

Using these data, QuickZone compares expected travel demand with the proposed capacity hour by hour through the life of a project to estimate delays and queues on the facility. By performing this hourly calculation for each phase of a project, the software takes into account anticipated travel demand throughout the day as well as seasonal variations (such as summer versus winter travel).

Unlike microsimulations, QuickZone requires orders of magnitude less input data, so the results are not nearly as detailed. While microsimulations can generate individual vehicle trajectories on a second-by-second basis, QuickZone gives overall network delay and length of queue. The software's level of detail is completely appropriate for less complex work zones, such as simple lane closures on high- or low-volume freeways and flagger operations on two-way, one-lane rural roadways. QuickZone is robust enough to handle many types of work zones, but for highly complex projects like interstate-to-interstate interchange projects, traffic managers should opt for a more detailed model.

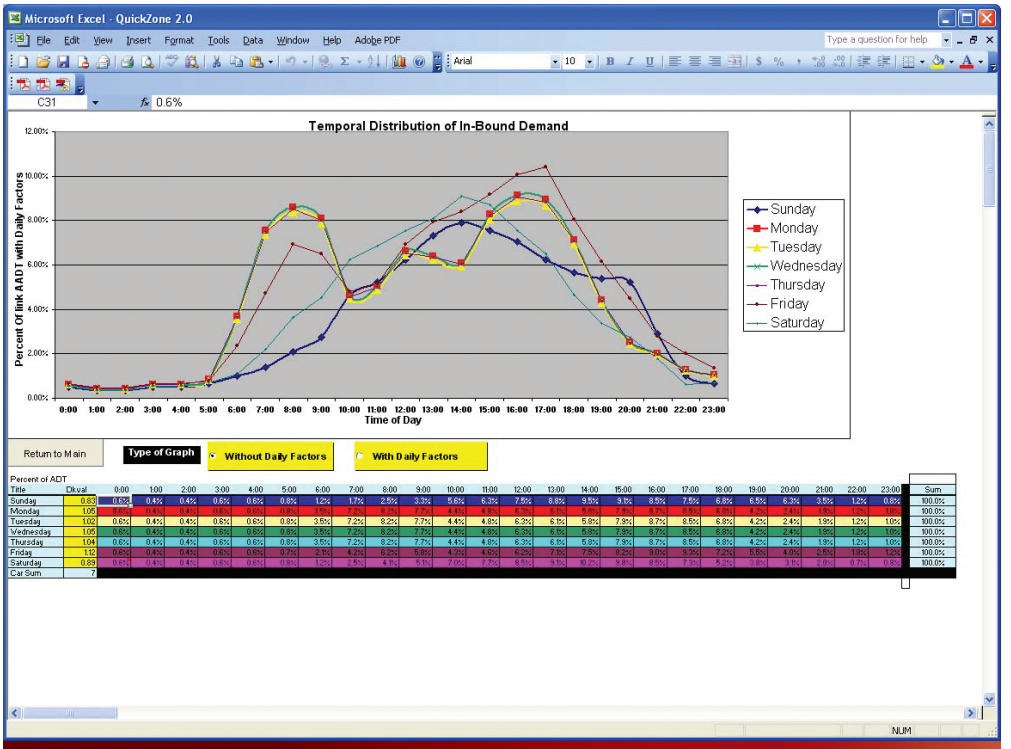
Ensuring the safety and mobility of the traveling public passing through work zones, as this minivan is doing, is one of the goals of the revised work zone rule. *Photo: Tim Breen for FHWA.*

Another goal is the safety of construction workers, such as this man cutting through pavement at a residential intersection. *Photo: Tim Breen for FHWA.*

Advantages of QuickZone

A benefit of QuickZone is that States and localities usually can input data they already have in hand, such as average annual daily traffic. Minor additions might be necessary, but nothing like the quantity of data needed for other more cost-prohibitive microsimulation models.

Inputting data for a typical work zone network should take less than 1 hour, depending on the complexity of the project or network. Once the data are entered, QuickZone can produce results—in graphic, tabular, or spreadsheet format—in less than 1 minute. The program will display the amount of delay in vehicle-hours as well as the maximum length of the anticipated queue.



In this screen capture from QuickZone 2.0, the inbound traffic demand on a road is plotted on a line graph by hour and by day of the week. The same information appears in a table, also by hour and day, just below the graph.

Highway officials, planners, and contractors then can analyze the numbers to determine whether the delay is reasonable and acceptable—or "tolerable," in the words of the new work zone rule. If so, they can proceed as planned. If not, QuickZone offers suggestions for reducing the delay, such as informing the news media and the public about the planned work zone so drivers can find alternate routes, activating variable message signs to inform motorists of the scheduled dates and times of the work, or retiming traffic signals on detour routes so motorists will not have to stop at multiple red lights.

FHWA researchers performed validation testing in Florida, Ohio, Tennessee, Virginia, and Wisconsin and found that QuickZone estimates are accurate within plus or minus 10 percent.

Highway agency personnel can use the program to perform analyses at every stage of construction from planning and design to construction and operation. Traffic engineers can evaluate various work zone alignments to determine the impacts associated with full closure of one or multiple lanes for varying lengths of time. During construction, QuickZone can help highway officials and contractors decide whether day or nighttime work will cause the least overall delay.

Because QuickZone is customizable through an agreement between the user and the vendor on technical support issues, programmers can

QuickZone 2.0 is enhanced with the ability to account for projects with multiple work zones where different kinds of work are performed. Here, workers rebuild a concrete pad for a bus stop as part of a broader renovation of Florida Avenue in Washington, DC. *Photo: Tim Breen for FHWA.*

easily use it for other purposes. For example, with the necessary data elements, a highway agency could predict delays in locations prone to a high number of crashes or plan alternative emergency evacuation routes.

New Features Introduced In QuickZone 2.0

QuickZone 2.0 reflects lessons learned from applications of the earlier software and incorporates the following new features:

- Improved two-way, one-lane operations modeling, including flagger operations
- Improved ability to model more complex projects, including projects with multiple work zones and different work occurring in each work zone at various times
- Enhanced detour modeling, including tracking of increased travel time on long detour routes

The program's updated output statistics enable users to target problem work zones.

Version 2.0 also includes a wider variety of performance measures that users can track, graph, and analyze, including length of total mainline queue, total mainline delay in vehicle hours, total costs per passenger car delay, total travel time in minutes, and detour delay costs. Users can compare the results to preconstruction conditions to assess progress.

Successful State Applications

Numerous States are successfully using the new QuickZone. For example, the Mississippi Department of Transportation is funding a Mississippi State University study of traffic flow in rural highway work zones, with special emphasis on speed. "QuickZone 2.0 has been [customized for Mississippi] to estimate rural work zone delays, which may not be that significant compared to work zone delays in major metropolitan areas," says Li Zhang, assistant professor of civil and environmental engineering at the university. "The improved models are calibrated using data collected from Mississippi."

The Maryland State Highway Administration's (SHA) experience with the initial QuickZone software captures the benefits of the program. SHA used QuickZone to analyze evening road closures for its ongoing replacement of the Woodrow Wilson Bridge outside Washington, DC. During one phase of the project, nighttime road closures were planned from midnight until 4 a.m. When the road work began, it became clear that 4 hours were not enough when coupled with the required setup and takedown times.

Project engineers used QuickZone to analyze multiple scenarios for extending the duration of the lane closure and the number of lanes closed. The analysis showed there would be little difference in the impact on drivers if the closures began at 9 p.m. and the opening time was extended to 5 a.m. The contractor made these changes to the schedule, reducing this phase of the project from an estimated 6 months to 2 months.

Based on past success, Maryland plans to use QuickZone 2.0 on several developing transportation projects, according to Jawad Paracha, assistant chief in the Traffic Development & Support Division of SHA's Office of Traffic & Safety. "The Federal Work Zone Safety and Mobility Rule requires us to analyze work zone traffic control alternatives and consider systemwide impacts in developing Transportation Management Plans," he says. "Depending on the complexity of a project, Maryland plans to use a tiered approach: starting with Maryland's Lane Closure Analysis Program for simple cases, QuickZone 2.0 for simple cases with network impacts, and then simulation tools such as CORSIM, VISSIM, and SimTraffic for relatively complex scenarios requiring detailed analysis."

In sum, QuickZone 2.0 continues to provide a more realistic and complete view of total construction costs, but now is especially timely and effective in helping DOTs comply with the work zone rule that recently came into force.

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For more information, contact Deborah Curtis at 202-493-3267 or deborah.curtis@fhwa.dot.gov. QuickZone 2.0 is available for purchase from the McTrans™ Center, 800-226-1013, 352-392-0378, mctrans.ce.ufl.edu; or PC-TRANS, 785-864-2599, www.kutc.ku.edu/cgiwrap/kutc/pctrans/index.php. Past purchasers of the original QuickZone should use the same contact information to obtain their free upgrade to QuickZone 2.0.

QuickZone Partners

States assisted FHWA in the initial validation process for QuickZone and have continued to help FHWA refine it. In fact, many of the upgrades that FHWA did for version 2.0 were a direct result of information and feedback received from partner States. FHWA first established a partnership with the Maryland State Highway Administration, then further modified QuickZone as a result of collaboration with other State and local transportation agencies. Through the QuickZone Partnership Program, FHWA produced and shared new versions of software with partners who then shared feedback, and some even developed customized versions. The partnership, no longer formally active, originally included seven member States: Maryland, North Carolina, Ohio, Pennsylvania, Utah, Washington, and Wisconsin.

Several States have developed innovative ways to use the software. Maryland customized QuickZone with its own capacity estimation model to derive traffic delay estimates for different types of work zones, among other information. (Due to geographic differences in how drivers respond to work zone delays, however, FHWA decided not to add Maryland's feature to QuickZone 2.0.)

Several States wanted to enhance QuickZone so they could import data directly from traffic counters. In Ohio, software developers were interested in altering the program to accept traffic counts and arrival times automatically from data collection sites throughout the State. The anticipated benefits were time saved by faster data entry and greater accuracy compared to manual data entry.

The Wisconsin Department of Transportation attached a geographic information system application to its version of QuickZone. Users now are able to click on a map to find an intersection or other exact location and input the necessary network data. This feature helps plan detour routes and determine travel speeds and distances between locations.

The *Corporate Master Plan* Shapes R&T Practice

by Debra Elston and Ariam Asmerom

FHWA provides a progress report on implementation of this leadership and management framework for delivery of a multimillion-dollar research and technology program.

Prefabricated Bridge Elements and Systems (PFBES) were used on this I–95 project in Richmond, VA, to complete a bridge deck replacement. PFBES, an FHWA-supported priority, market-ready technology, allowed construction to proceed with only nighttime lane closures, saving the Virginia Department of Transportation (VDOT) an estimated 12 to 14 months of construction time. *Photo: VDOT.*

In 2003, the Federal Highway Administration (FHWA) adopted the *Corporate Master Plan* (CMP) *for Research and Deployment of Technology & Innovation* (FHWA-RD-03-077), accepting the challenge to raise the bar on research and technology (R&T). The CMP is a strategic management framework for improving the quality, timeliness, and cost efficiency of FHWA's R&T program. The plan is intended to set the course for future management and delivery of highway-related products that include processes, procedures, management, design, contracting, and funding; new materials and machinery; software; and other knowledge-based products.

The movement to substantively review and evaluate FHWA's R&T program grew from FHWA's 2002 restructuring assessment. It also was given impetus by recommendations found in the Transportation Research Board (TRB) Research and Technology Coordinating Committee (RTCC) Special Report 261, *The Federal Role in Highway Research and Technology* (Special Report 261), and the U.S. Government Accountability Office (GAO) report 02-573 to Congress in May 2002, *Highway Research: Systematic Selection and Evaluation Processes Needed for Research Program* (GAO report).

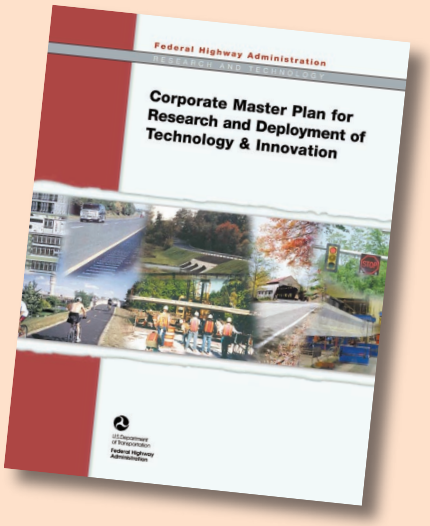
FHWA conducted its restructuring assessment to review the agency's

roles and responsibilities in the changing transportation environment. Of particular interest was how FHWA headquarters functions might complement a restructured field organization after eliminating all of its nine regional offices and establishing a Resource Center in four locations. The restructuring assessment focused on the need to continue to improve FHWA's successful lead role in R&T and identified the following opportunities for improvement:

- Strengthen the definition of priorities
- Designate a champion for technology deployment
- Clarify the deployment process
- Increase corporate ownership, coordination, and commitment for delivering technology and innovation

Stakeholder views are critical to FHWA's evaluation and improvement of its research program. Such input was provided through Special Report 261. The purpose of this report was to examine the Federal role in the national highway R&T effort and to determine whether the focus and activities of the Federal program were appropriate for the overall highway system, stakeholder needs, and the roles and activities of other national highway R&T programs. Special Report 261 states that "the Federal role in highway R&T is vital to highway innovation." However, FHWA's R&T program "is missing an opportunity to address this critical Federal responsibility." To address this concern, RTCC recommended that the FHWA R&T program:

- Focus on fundamental, long-term research aimed at achieving breakthroughs in understanding transportation-related phenomena
- Undertake research to address "significant highway gaps" and emerging issues with national implications
- Be more responsive to major stakeholders and balance stakeholder problem identification with expert external technical review
- Include external stakeholders and technical experts on merit review and evaluation panels
- Promote innovation by surveying worldwide research and practices to identify promising technologies
- Subject the University Transportation Center's (UTC) program to the same guidelines as the FHWA R&T program
- Support Future Strategic Highway Research Program findings and recommendations



Shown here is the cover of the *Corporate Master Plan for Research and Deployment of Technology & Innovation*.

The GAO report reinforced several recommendations from the restructuring assessment and Special Report 261. Specifically, the GAO report recommended that FHWA adopt a systematic approach for obtaining input from external stakeholders and also "develop a systematic process for evaluating significant ongoing and completed research that incorporates peer review or other best practices in use at Federal agencies that conduct research."

Adopting the CMP in 2003 was the first step toward improving the FHWA R&T program, and implementation of the CMP began shortly thereafter. Four years later, in 2007, evidence suggests that the guiding principles and commitments established in the CMP are being used in the R&T program. Today, research at FHWA is not only aimed at doing the right things but doing the right things *well*.

"We have looked for and continue to search for opportunities to change the way we do business, to do a better job of providing service, and to better manage our programs," says Associate Administrator Dennis Judycki, head of FHWA's Office of Research, Development, and Technology and director of FHWA's Turner-Fairbank Highway Research Center (TFHRC). "Collectively, the FHWA R&T leadership team has been instrumental in making that happen, even as during this period FHWA addressed the challenge of a lack of flexibility in resources. The agency commitments in the *Corporate Master Plan* have guided our actions in raising the level of expectations and performance for the R&T program."

Built on Seven Guiding Principles

FHWA's mission is "to improve mobility on the Nation's highways through national leadership, innovation, and program delivery." The CMP defines FHWA's corporate strategy for investing in and conducting research that supports the agency's mission.

The CMP was developed with input from stakeholders representing local, State, and Federal transportation officials. This input revealed that in research programs the three keys for effective program management are (1) involving stakeholders throughout the R&T process, (2) using merit reviews of the research at key stages of its development, and (3) evaluating research and deployment on an ongoing basis. The CMP's seven guiding principles embody these elements and lay the foundation for a new and improved R&T program. (See "Guiding Principles of the *Corporate Master Plan*" on page 32.)

A number of activities such as lab assessments now are incorporated as state of the practice in R&T program management. One-time events, such as an open house for university researchers, also are commonplace and contribute to application of the guiding principles.

From a corporate perspective, a fundamental issue is how to know when FHWA's R&T program has achieved the desired results and raised the quality of R&T. The CMP workgroup identified several likely indicators as measures of success, and FHWA uses those indicators to gauge the program's achievements: (1) improved stakeholder trust and confidence, (2) better data availability as input to R&T investment decisions, (3) increased deployment and implementation of technologies and innovations, and (4) broader communication of the R&T vision and program.

A Life Cycle Approach—Guiding Principle 1

Research is the cornerstone for meeting FHWA's objectives of

Guiding Principles of the *Corporate Master Plan*

Guiding Principle 1: The FHWA R&T process, from research through implementation, is systematic and begins with the end in mind.

Guiding Principle 2: FHWA engages in advanced and applied research deployment activities where an appropriate Federal role exists.

Guiding Principle 3: Stakeholders are engaged throughout the R&T process.

Guiding Principle 4: The R&T process is grounded in FHWA's mission and goals, and guided by multiyear plans.

Guiding Principle 5: The R&T budget allocation is based on and driven by multiyear plans and priorities.

Guiding Principle 6: FHWA measures the performance of R&T at the agency, program, and project levels.

Guiding Principle 7: FHWA effectively communicates about R&T programs and projects.

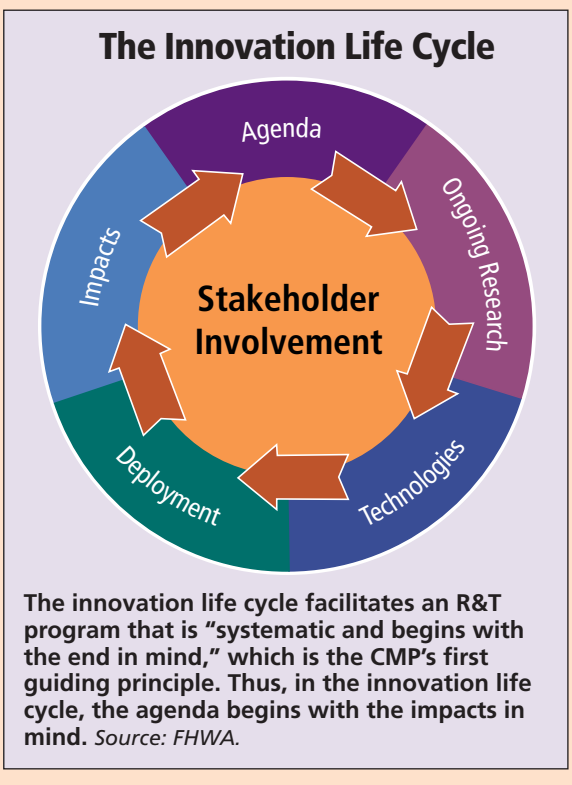
The workgroup that developed the CMP identified a number of specific commitments under each guiding principle for targeting the R&T program effectively. For example, the following six commitments offer practical internal processes and measures to carry forward the third guiding principle:

- Expand the disciplines and diversity of stakeholders engaged in the R&T process.
- Engage stakeholders in FHWA R&T policy decisions.
- Engage stakeholders in FHWA R&T agenda setting and multiyear plan development.
- Include stakeholders in merit reviews during various phases of the R&T process.
- Incorporate stakeholders in research project-, program-, and agency-level evaluations and reviews.
- Involve stakeholders in deployment and implementation of technologies and innovations.

improving safety, reducing traffic congestion, improving efficiency in freight movement, increasing infrastructure capacity, and protecting the environment. To advance the body of knowledge produced by researchers, the critical next steps are technology development and deployment. It is critical to the R&T program's success that research addresses real-world needs by putting ideas into action.

The stages of research and technology development, from setting the research agenda to assessing the impacts of new technologies, exemplify an integrated system that reflects the continuous and cyclical nature of R&T. In particular, a reliable method for assessing impacts provides feedback for measuring overall effectiveness. Impact assessment not only quantifies improvements but also enables a research or program manager to set priorities and revise program agendas to reflect changing needs.

This integrated system is referred to as the innovation life cycle. The life cycle approach has created the framework for a systematic R&T program—as prescribed in the CMP's guiding principle 1—while proving to be an effective communications tool. Each stage of the R&T process can be tracked and measured, with reference to the elements described in the life cycle. Consequently, the overarching first guiding principle is addressed systematically as guiding principles 2 through 7 are implemented.



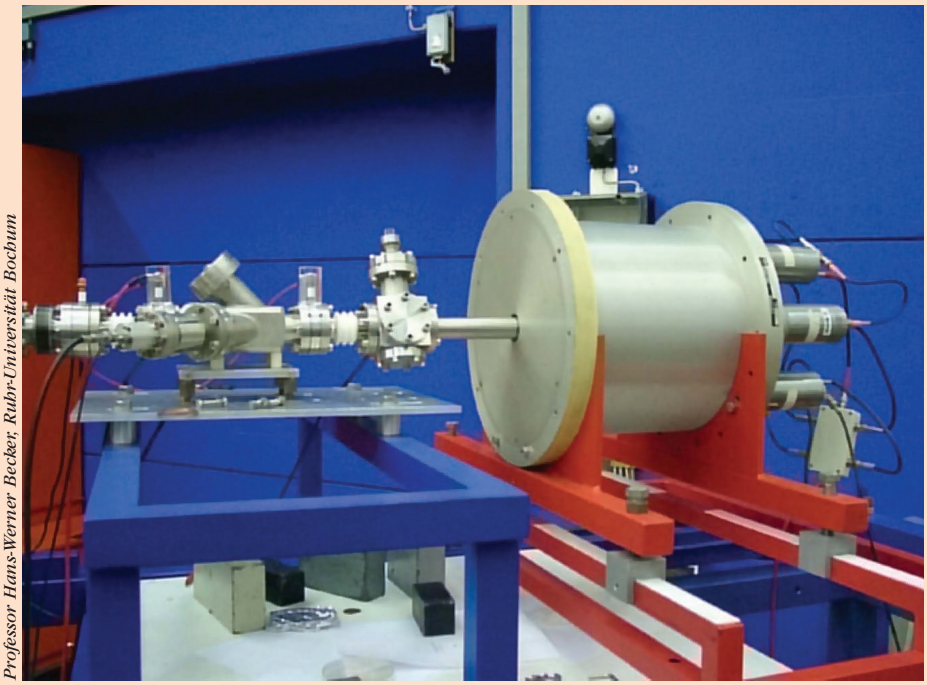
The innovation life cycle facilitates an R&T program that is "systematic and begins with the end in mind," which is the CMP's first guiding principle. Thus, in the innovation life cycle, the agenda begins with the impacts in mind. *Source: FHWA.*

A Balanced Portfolio—Guiding Principle 2

The second guiding principle refers to identifying an appropriate Federal role in carrying out a balanced portfolio of applied and advanced research, as well as deployment of innovations. This principle has played a significant role in establishing a new Exploratory Advanced Research Program as authorized under the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). Prior to creation of this program, FHWA primarily invested in incremental, low-risk research. The current level of investment in advanced research is close to $10 million annually throughout the 5-year life of SAFETEA-LU.

Development of the Exploratory Advanced Research Program led many at FHWA to ask about the appropriate Federal role for engaging in research and deployment. In March 2006 the R&T leadership team participated in a daylong retreat to explore this question. Participants reached a consensus that FHWA would play a limited role in higher risk advanced research. Instead, the agency would focus on transitioning breakthrough technologies into useful applications. The conduct of advanced research through contracts or other means would be limited in scope, in line with existing institutional capabilities.

Christine Johnson, director of Field Services (West) and member of the R&T leadership team, offers her views on the complementary roles of applied and advanced research: "FHWA is a mission-oriented agency that aims to serve our primary constituents in the highway sector. While the majority of our research program is in problem-focused applied research, we certainly recognize the potential for more dramatic benefits as we take on higher risk research. Our commitment is to maintain an appropriate balance of the two while being careful not to compromise our mission focus."



Professor Hans-Werner Becker, Ruhr-Universität Bochum

Shown here is a gamma-ray detector, which researchers can use to measure hydrogen in cement samples on the nanoscale. Located in the Tandem Dynamitron facility at the Ruhr-Universität Bochum in Germany, this equipment is central to an advanced research effort to understand the setting and curing of concrete. This project, which is co-funded with the National Science Foundation, involves a partnership between FHWA and university researchers from the United States and Germany, as well as a major manufacturer of cement chemicals.

Stakeholders at the Table—Guiding Principle 3

Joint outcomes maximize value. In the R&T world, joint ventures and leveraging of resources are especially desirable, whether a partnership pools resources or simply provides an opportunity to solicit input from stakeholders. Guiding principle 3 calls for engaging partners and stakeholders throughout the R&T process. Stakeholders range from expert advisers to research partners, technology evaluators, and technology users.

Since adopting the CMP, FHWA has led a collective effort to raise the level of stakeholder involvement in the R&T program. Likewise, at the project level, input from users typically is solicited during the contract phase of a new research activity through the implementation of the research outcomes.

A broader level of influence is likely to lead to more collaborative efforts and a more coordinated national highway research program. The R&T research team has made a number of recent efforts to grow stakeholder involvement and solicit input in program administration. For example, the team has given particular attention to increasing opportunities for collaboration with the UTCs. At TRB's annual meeting in 2006, FHWA hosted an open house for university representatives to meet one on one with research program managers.

Building on that event's success, FHWA managers decided to host topic-specific workshops to give university researchers the opportunity to discuss topics in their fields of interest. FHWA held three workshops in 2006–2007 and is planning additional workshops.

"It is clear to me that FHWA has worked hard at outreach to [UTCs]," says Dr. Daniel Turner, professor of civil engineering, director of the UTC at the University of Alabama, and past president of the Council of University Transportation Centers. "Examples include special interactions with professors at TRB, hosting three topical FHWA-UTC workshops, and providing high-level managers to attend and make presentations at meetings of the Council of University Transportation Centers. The result has been a significant increase in UTCs'—and professors'—understanding of FHWA research goals and needs."

FHWA also developed the Exploratory Advanced Research Program with a high level of stakeholder input. In 2005, more than 100 participants took part in three forums to provide input to the advanced research agenda. Input from the forums was used to define priority research areas that were highlighted subsequently in project solicitations. In addition, outside experts played a critical role in evaluating research proposals submitted in response to two rounds of solicitations in 2007.

Another example of a strengthened commitment to involving stakeholders in the process, at the program and policy levels, includes the stakeholder-driven development of an environmental research program authorized by the Surface Transportation Environment and

Delivering the R&T Program

FHWA's organizational structure supports delivery of the R&T program. Generally speaking, the R&T program is decentralized and reaches across all facets of the agency. The CMP was not intended as a radical departure from this culture.

Instead, the CMP facilitated creation of an oversight committee to ensure a systematic, corporate approach in program budget and delivery, and to articulate a shared vision of the program. This committee, the FHWA Research and Technology Leadership Team, consists of FHWA leaders who have direct responsibility for the agency's research, technology, innovation, and education programs.

In addition, an external advisory board, the TRB RTCC, provides input and serves as a sounding board in key matters of R&T program administration. The RTCC membership is drawn from top officials at State departments of transportation, university and private research organizations, suppliers, contractors and consultants, local government officials, professional associations, and highway users. On the deployment end, formation of Resource Center technical service teams strategically located across the country has helped improve implementation of new technologies and innovations.

The FHWA Research & Technology Leadership Team directs agencywide business and decisions relating to R&T, including the annual R&T budget delivery. Members (L-R): King Gee, Associate Administrator, Office of Infrastructure; Dennis Judycki, Associate Administrator, Office of Research, Development, and Technology; Mary Phillips, Associate Administrator, Office of Policy and Governmental Affairs; Jeff Paniati, Associate Administrator, Office of Operations; Joyce Curtis, Resource Center Director; Gloria Shepherd, Associate Administrator, Office of Planning, Environment & Realty; and Joseph Toole, Associate Administrator, Office of Professional and Corporate Development. Members not shown: Jeffrey Lindley, Associate Administrator, Office of Safety; Christine Johnson, Director of Field Services (West); Debra Elston, Acting Director, Office of Corporate Research, Technology, and Innovation Management; and J. Richard Capka, FHWA Administrator.

Planning Cooperative Research Program. At the broader agency level, TRB's RTCC is a primary adviser for the R&T program, bringing top-level officials to the table to help guide FHWA's multimillion-dollar program.

Mission-Driven Roadmaps—Guiding Principle 4

Multiyear program plans, also referred to as "roadmaps," have become an FHWA R&T management tool with multiple purposes. Program offices use the plans to manage research and other programs. The plans support budget decisions and enable decision-makers to view key strategies and milestones against timelines. The roadmaps also help to translate abstract concepts into concrete goals and strategies that link to FHWA goals. The roadmaps identify technology and innovation deliverables, describe stakeholder interests, and specify the resources needed to ensure that projects and programs are advanced in a timely fashion and on budget. Multiyear plans also have been used to communicate the R&T program and agenda within the highway research community.

Ensuring that FHWA's R&T pursuits are genuinely in line with the agency's mission is a CMP commitment under guiding principle 4. Establishing this coherence, however, is challenging, particularly with higher risk research where the outcome is not generally known and therefore is difficult to tie to specific goals. As the level of certainty increases, from research to a resulting technology or innovation, the relationship between goals and outcomes becomes more defined.

At this stage in delivery of the CMP, FHWA has established a clear connection between its priority list of market-ready technologies and its deployment goals. Beginning in 2004, two such lists were released, each with more than 20 market-ready technologies. Single-page factsheets are available for each technology or innovation, providing general information, stating a corresponding deployment goal, establishing project champions, and identifying contact information for technical assistance.

SAFETEA-LU and Budget Delivery—Guiding Principle 5

As Albert von Szent-Györgyi, 1937 Nobel Prize winner, once said, "Research is four things: brains with which to think, eyes with which to see, machines with which to measure, and, fourth, money."

The current transportation authorization bill, SAFETEA-LU, exerted a significant negative impact on the level of flexible spending for R&T. The available budget in the legislation included an increase in designations and earmarks, with all the R&T funding allotted to specific

Results of the 2007 Exploratory Advanced Research Broad Agency Announcement

More than 380 applicants responded to a request for exploratory advanced research proposals in January 2007. Eight of the eleven research projects selected are listed below, in no particular order, and three are still pending contract award.

1. "Intelligent Multi-Sensor Measurements to Enhance Vehicle Navigation and Safety Systems," Auburn University GPS and Vehicle Dynamics Laboratory
2. "Intersection Control for Autonomous Vehicles," The University of Texas at Austin
3. "Next Generation of Smart Traffic Signals," ATLAS Center, University of Arizona
4. "Development and Evaluation of Selected Mobility Applications for VII," California PATH Program, Institute of Transportation Studies, University of California, Berkeley
5. "Development and Demonstration of Systems-based Monitoring Approaches for Improved Infrastructure Management under Uncertainty," Civil and Environmental Engineering, University of Central Florida
6. "Development of Soil Stiffness Measuring Device for Pad Foot Roller Compactor," Division of Engineering, Colorado School of Mines
7. "Increased Understanding of Driver Visibility Requirements," Science Applications International Corporation
8. "Layered Object Recognition for Pedestrian Collision Sensing," Sarnoff Corporation

projects and programs. This kind of allotment left no flexibility for FHWA to carry out its R&T roadmaps.

Despite the legislative climate, FHWA has maintained its stewardship role under guiding principle 5 through continuous assessment and cooperation with the highway research community. Internally, the R&T leadership team has used the roadmaps to guide budget deliberations. However, limited flexibility has constrained FHWA's prioritization process and its ability to respond to all identified needs. Instead, the agency's leadership has realigned its approach and emphasized the importance of leveraging needs with the resources made available to others. The effectiveness of this approach will be measured by FHWA's success in forging partnerships where mutual interests exist.

FHWA's Eight Strategic Goals

1. *Safety:* Enhance public health and safety by working toward eliminating transportation-related deaths and injuries
2. *Reduced Congestion:* Reduce congestion and other impediments to using the Nation's transportation system
3. *System Enhancement and Preservation:* Preserve, improve, and expand the Nation's highway transportation system
4. *Global Connectivity:* Facilitate an international transportation system that promotes economic growth and development
5. *Environment:* Promote transportation solutions that enhance communities and protect the natural and built environment
6. *Security and Emergency Management:* Balance transportation security requirements with the safety, mobility, and economic needs of the Nation and be prepared to respond to emergencies that affect the viability of the transportation sector
7. *Program Delivery and Stewardship:* Continuously improve the delivery of Federal highway programs by adding value to the Nation's transportation system and ensuring integrity in the public investment
8. *Organizational Excellence:* Advance FHWA's ability to manage for results and innovation

Measuring Success—Guiding Principle 6

Guiding principle 6 lays out commitments to measure performance on all fronts—at the agency, program, and project levels. At the agency level, performance in delivering R&T is measured by success in achieving performance goals. Success at the program level is measured by doing the right things, such as identifying priority research areas. Project-level performance measurements determine whether the agency is doing things right, such as following standard research protocols.

The standard for R&T performance measurement at the agency level has been in place for several years. As with all FHWA programs, R&T contributes directly to the agency's mission and principal role as "Innovators for a Better Future." FHWA performs this role by focusing on eight strategic goals, each with corresponding performance objectives.

Annual performance plans affirm these eight goals, define agencywide priorities, and establish measures and interim performance targets. The goals and objectives in FHWA's plan are aligned strategically with the U.S. Department of Transportation's strategic and performance plans. Each year, FHWA publishes a performance report to demonstrate progress in achieving the stated goals.

R&T performance at the agency level also is measured by annually tracking deployment of priority market-ready technologies. FHWA measures technology deployment by using a five-phase system—goals and strategies, promotion activities, delivery activities, deployment, and benefits and results—described in full at www.fhwa.dot.gov/crt/lifecycle/deploytrack.cfm.

At TFHRC, one form of program-level review is accomplished through a laboratory assessment designed to enhance research performance and quality. An independent evaluation by technical experts ensures that research performed at TFHRC meets established standards. The lab assessments also determine the potential value of research activities and whether they have achieved stated objectives, that is, "Are we doing the right things?"

In other program areas, periodic self-assessments are conducted to measure progress in meeting CMP commitments. This approach to performance measurement helps raise the level of individual accountability for the program's collective successes. Used consistently, this approach is a key ingredient in meeting the objectives of guiding principle 6.

To answer the question "Are we doing the right things *well*?" TFHRC established a project-level tracking system. Results are published annually in a Research Project Status Summary Report, available online. (See www.tfhrc.gov/about/06084/index.htm and www.tfhrc.gov/about/07049/index.htm.)

Perhaps the greatest satisfaction in research comes from the realization of years of development and analysis into a commercially viable product, overcoming the proverbial "valley of death" between research and product deployment. Although research conducted at FHWA typically results in new standards or new methodologies that enable stakeholders to carry out the Federal-aid highway program, there are occasions where innovations have been developed into marketable products. Recently retired FHWA scientist Richard A. Livingston cites the recent commercialization of a nondestructive testing method for suspension bridge cables as one example. An FHWA-sponsored research contract led to the discovery that magnetostrictive sensing can be used to locate defects on a bridge structure. This solution addresses concerns with the current technology—a testing process that is difficult and time consuming. The summer 2007 collapse of an interstate bridge in Minneapolis, MN, was a grim reminder of the critical need for more efficient testing methods.

NCDOT

This cable median barrier on a North Carolina highway stopped this semi-trailer truck, preventing a potentially deadly cross-median crash. Cable median barriers have been heavily marketed by FHWA and are now deployed in almost every State.

Communicate, Communicate, Communicate—Guiding Principle 7

When all is said and done, and done well, the extent to which positive outcomes are shared is the greatest measure of success. The final guiding principle of the CMP pertains to effective communication of R&T program activities. R&T messages are delivered using a number of communication channels and media outlets. Newsletters, brochures, briefing papers, and other publications are circulated routinely to ever-growing distribution lists covering a wide stakeholder network.

The R&T program also relies on participation and presentations at domestic and international conferences, encouraging personal contacts and networks to communicate information. FHWA currently is engaged in developing communication strategies to deliver targeted messages that address stakeholder needs.

In this era of Web sites, FHWA strives to avoid the pitfalls of information overload and deeply embedded information that is difficult to find. The agency recently undertook a major effort to consolidate R&T news and reports in a one-stop shop, the "Corporate Research and Technology" Web site (www.fhwa.dot.gov/crt). With links to major FHWA program Web sites, the corporate site also includes cross-cutting reference materials and agency initiatives.

The Road Ahead: Challenges And Opportunities

Challenges remain in the push to sustain a stakeholder-driven Federal R&T program. One challenge is the need to establish creative partnerships that will leverage designated or earmarked research funding effectively to various private and public entities. On the other hand, newly legislated programs, such as the Exploratory Advanced Research Program and Long-Term Bridge Performance Program, must be exploited fully and strategically to address the critical needs of the transportation system.

Monique R. Evans, administrator for the Office of Research & Development at the Ohio Department of Transportation and vice chair of the American Association of State Highway and Transportation Officials' Research Advisory Committee Region 3, faces similar challenges and opportunities at the State level. "Maximizing the benefits of transportation research requires the use of multiple yet limited resources to address a variety of needs," says Evans. "The challenge is to coordinate this effort in a way that capitalizes on the strengths of all participants, leverages the available resources for optimum gain, and results in noticeable improvements to [the Nation's] transportation system. The creation of [the] *Corporate Master Plan* led to visible improvements in the level of outreach to FHWA's State partners, and I think this has fostered a greater sense of cooperation."

FHWA Associate Administrator Judycki adds, "As with all things, organizational improvement comes with its share of challenges and opportunities, and FHWA's R&T program is no exception. The *Corporate Master Plan* has been effective in its purpose and will continue to guide the R&T program for many years to come."

Debra Elston is acting director of FHWA's Office of Corporate Research, Technology, and Innovation Management, and has played a key role in implementing the CMP. She has helped meet the challenges of stepping up outreach efforts, strengthening research partnerships, promoting market-ready technologies, and facilitating a coordinated and balanced R&T program. Elston has been with FHWA for 17 of her 25 years in the transportation field.

Ariam Asmerom, P.E., is a transportation specialist and coordinator of FHWA's advanced research initiative in the Office of Corporate Research, Technology, and Innovation Management. She has 16 years of experience in transportation planning and engineering, working in both the public and private sectors, and joined FHWA in 2001. Asmerom holds a bachelor's degree in civil engineering from the University of Virginia.

For more information about CMP implementation, contact Debra Elston at 202-493-3181 or debra.elston@fhwa.dot.gov.

Along the Road

Along the Road is the place to look for information about current and upcoming activities, developments, trends, and items of general interest to the highway community. This information comes from U.S. Department of Transportation (USDOT) sources unless otherwise indicated. Your suggestions and input are welcome. Let's meet along the road.

Management and Administration

USDOT Names Six Interstate Routes as Corridors of the Future

On September 10, 2007, USDOT announced six interstate routes as the first participants in the Corridors of the Future Program (CFP)—a new Federal initiative to develop multi-State corridors to help reduce congestion. The announcement follows a year-long competition to select a handful of interstate corridors. The 38 public and private sector applicants submitted proposals for innovative national and regional approaches to reduce congestion and improve the efficiency of freight delivery in line with the program's goals.

Florida Department of Transportation

Highways such as I–10 in Pensacola, FL, shown here, will receive funding from USDOT's CFP to help reduce congestion and improve the efficiency of freight delivery.

The six participating routes will receive the following funding to implement their development plans: $21.8 million for I–95 from Florida to the Canadian border; $5 million for I–70 in Illinois, Indiana, Missouri, and Ohio; $15 million for I–15 in Arizona, California, Nevada, and Utah; $15 million for I–5 in California, Oregon, and Washington; $8.6 million for I–10 from California to Florida; and $800,000 for I–69 from Texas to Michigan. The selected corridors carry 22.7 percent of the Nation's daily interstate travel.

The selected proposals demonstrate the potential to use public and private resources to reduce traffic congestion within the corridors and across the country. The concepts include building new roads and adding lanes to existing roads, building truck-only lanes and bypasses, and integrating real-time traffic technology such as lane management that can match available capacity on roads to changing traffic demands.

By spring 2008, USDOT and the States will finalize formal agreements detailing the commitments of the Federal, State, and local governments involved. These agreements will outline the anticipated role of the private sector and the ways that the partners will handle the financing, planning, design, construction, and maintenance of the corridors.

FRA Awards $1 Million to Prevent Collisions At Highway-Rail Grades

The Federal Railroad Administration (FRA) recently increased efforts to reduce collisions between trains and motor vehicles at grade crossings and discourage illegal trespassing on railroad tracks. In July 2007, FRA Deputy Administrator Clifford C. Eby awarded a $1 million grant to Operation Lifesaver, Inc.®, a national nonprofit railroad safety education organization. Operation Lifesaver also will provide $338,332 in matching funds.

"Understanding the dangers on, along, and near railroad tracks is the best way to help people avoid needless risks," said Deputy Administrator Eby. He added that approximately 96 percent of rail-related deaths in America are the result of grade crossing collisions and trespassing on railroad property.

The FRA grant will support Operation Lifesaver's education and training programs across the United States. Specifically, the Federal funding will aid Operation Lifesaver's assistance programs to State organizations, helping them manage railroad safety awareness programs. In addition, the funds will support training—such as regional workshops developed for Operation Lifesaver's 3,000 volunteer trainers and presenters—communications programs, and publications, including development and distribution of public service announcements.

The 2007 grant augments comprehensive efforts under the Secretary of Transportation's 2004 Action Plan, Highway-Rail Crossing Safety and Trespass Prevention, and USDOT's 2005 National Rail Safety Action Plan. Both plans provide a roadmap for guiding Federal, State, local, industry, and other efforts to combat highway-rail grade collisions.

Policy and Legislation

New USDOT Rule Gives States Construction Flexibility

States now have more flexibility for building roads and bridges faster under a new USDOT rule that allows design work and environmental reviews to occur concurrently. The final rule, issued in August 2007, amends Federal Highway Administration regulations to allow States to use various innovative contracting methods, ranging from basic design-build contracts to long-term concession agreements, while simultaneously pursuing Federal environmental approvals. By eliminating a required dollar amount for projects, the rule also increases the opportunity for smaller projects to use design-build contracts.

The rule allows certain design work to begin while the National Environmental Policy Act of 1969 (NEPA)

process is underway, but still ensures consideration of a full range of alternatives. Using this process, States are able to expedite the contract award process and start preliminary design work while ensuring the objectivity of the NEPA decisionmaking process. USDOT officials add that a faster process will save taxpayers time and money. Overall, design-build projects prove to be successful contracting tools, reducing average project delivery time by 14 percent.

The rule, which was open for public comment before publication, is available at www.fhwa.dot.gov/programadmin/contracts/fedreg071408.cfm.

Public Information and Information Exchange

Wisconsin Announces Funds for Local Highway Improvements

In September 2007, Wisconsin Governor Jim Doyle announced the distribution of $29.5 million in Federal funds to improve county highways throughout Wisconsin's approximately 161,000-kilometer (100,000-mile) local highway system. Administered by the Wisconsin Department of Transportation (WisDOT) through the Federal Surface Transportation Program-Rural (STP-R), the money will fund 72 projects along local highways across the State.

"Investing in infrastructure ensures we have safe roads for our travelers and helps businesses get their products where they're needed," Governor Doyle said. "Improving roads is one way we can strengthen communities, grow our businesses, and create jobs for our citizens."

Although STP-R traditionally operates on a 3-year cycle, a fourth year has been added to the new program cycle (2009–2012) to better balance the project letting schedule, encourage program stability, and add approved projects to the system sooner in case additional Federal funding becomes available in future years. All projects are 80 percent federally funded and require a 20 percent local funding share.

For a list of STP-R funded projects, visit the WisDOT Web site at www.dot.wisconsin.gov/localgov/highways/approved.htm.

WisDOT

Massachusetts Design Guide Honored

The Massachusetts Highway Department (MassHighway) recently received its seventh award for the 2006 *Massachusetts Highway Department Project Development & Design Guide*. The Institute of Transportation Engineers (ITE) recognized the guide, which serves as a national model, with its 2007 "Transportation Achievement Award." The ITE award highlights significant and outstanding transportation achievements by government agencies, legislative bodies, consulting firms, industry, and other private sector organizations.

Released in January 2006, the MassHighway guide was the product of 2.5 years of work by a 28-member task force composed of representatives from municipalities, regional planning agencies, professional organizations, advocacy groups, and State agencies. The guide employs a more flexible process for constructing road and bridge projects through a context sensitive, environmentally responsive, and multimodal approach.

A copy of the guide is available on the MassHighway Web site at www.mhd.state.ma.us.

MassHighway

Training Update

NATIONAL HIGHWAY INSTITUTE

by Brittany Boughter

A Comprehensive Study of Incident Management

Traffic incidents account for approximately 25 percent of nonrecurring congestion on the Nation's highway system. Further, traffic-related incidents are a leading cause of line-of-duty deaths for law enforcement and fire-rescue responders, with nearly 400 responders struck and killed on highways each year.

To combat these statistics, the U.S. Department of Transportation promotes a quick, safe, and multiagency response to traffic incidents to minimize the effects on first responders and drivers. The Federal Highway Administration's (FHWA) approach is multifaceted, recognizing that transportation practitioners use a variety of resources for activities ranging from responding to roadway emergencies to managing planned special events.

"Incident management is not a stovepipe, stand-alone effort with its own dedicated resources to be used exclusively for traffic incident response," says David Helman, traffic incident management program manager in the FHWA Office of Operations. "It should be seen in a much broader context—as a response to all incidents—mainstreamed in operational procedures of public safety and transportation agencies."

For these reasons, the National Highway Institute (NHI) offers a suite of complementary incident management courses: Managing Traffic Incident and Roadway Emergencies (FHWA-NHI-133048A), Managing Travel for Planned Special Events (FHWA-NHI-133099), and Using the Incident Command System (ICS) at Highway Incidents (FHWA-NHI-133101). Participants who complete all three courses receive certificates of accomplishment recognizing that they have learned, built, and refined their skills in incident management. The courses target personnel from State departments of transportation, county and local governments, the private sector, and FHWA who are responsible for responding to unplanned traffic incidents or planning special events.

Patrick Hasson, FHWA

NHI's courses in incident management provide participants with the knowledge and resources to respond to roadway emergencies such as the one shown here.

Traffic Incident Management

The 2-day course Managing Traffic Incident and Roadway Emergencies addresses institutional and technical aspects of resolving traffic incidents and roadway emergencies safely and efficiently. The course focuses on practices that promote interagency and interdisciplinary understanding and cooperation.

Upon completing the course, participants will be able to apply the elements for developing a formalized multiagency program, compare and contrast techniques and identify technological solutions for onsite incident management, and construct a list of next steps to improve multiagency responses.

Special Events

The 2-day course Managing Travel for Planned Special Events guides practitioners through all phases of managing travel for planned events, using an event scenario selected by the host and developed by course participants. Participants from localities preparing for an event identify and apply pertinent planning steps, operations activities, and associated considerations in developing an action plan for special events.

Upon completing the course, participants will understand key phases and goals for managing travel during events; describe the purpose, value, and key components of an action plan for managing travel during events; identify key factors that influence how an event might affect the surface transportation system; and explain how postevent activities can improve traffic management plans.

ICS for Highway Incidents

The 2-day course Using the Incident Command System at Highway Incidents presents an overview of ICS, its structure, and how it expands and contracts to meet the demands of an incident while maintaining a manageable span of control for people managing resources onscene. Upon completing the course, participants will be able to identify needed resources, develop an appropriate ICS structure, and create an incident action plan.

A Coordinated Solution

Led by expert instructors with real-world experience, the courses provide a comprehensive look at all aspects of planning, organizing, and managing traffic.

"Careful planning will not achieve the desired results if communication is not occurring," says Laurel Radow, evacuations and planned special events program manager in FHWA's Office of Operations. "Unlike other traffic incident management courses, these NHI courses bring together all involved in the management of an incident. The training stresses a coordinated process involving diverse communities. The NHI approach helps participants obtain effective interagency and interdisciplinary understanding and cooperation to detect and remove incidents, and restore traffic capacity as safely and quickly as possible."

To schedule a session or request a certificate of accomplishment, contact the NHI Training Coordinator at 703-235-0534 or nhitraining@dot.gov. For more information on incident management, contact David Helman at 202-366-8042 or david.helman@dot.gov, or Laurel Radow at 202-366-2855 or laurel.radow@dot.gov, or visit http://ops.fhwa.dot.gov/incidentmgmt/index.htm.

Brittany Boughter is a contributing editor for PUBLIC ROADS.

Internet Watch

by Brittany Boughter

Sites to Help Travelers Avoid Congestion

For those who set out to travel on roads and highways only to encounter construction or weather delays, the frustration associated with sitting in traffic is all too familiar. According to the Texas Transportation Institute's *The 2007 Urban Mobility Report*, the cost of congestion for urban Americans—including wasted travel time and extra expenditures for gasoline—is $78 billion. However, as technology improves, the Federal Highway Administration (FHWA) has found new ways to save the public time and money by providing useful congestion information for motorists before they leave the house.

FHWA's "National Traffic and Road Closure Information" Web site (www.fhwa.dot.gov/trafficinfo/index.htm) is a clearinghouse for up-to-date information on congestion conditions nationwide. The homepage features a map of the United States, enabling site visitors to click on links to State-specific departments of transportation, regional transit options, 511® traveler information, real-time travel maps, weather forecasts, and reports on construction delays. The tailored information enables drivers to plan ahead to avoid detours, congestion, and dangerous weather conditions. The outcome means less time and money spent on travel.

In addition to the State links, the site also features a "What's New?" section (www.fhwa.dot.gov/trafficinfo/whatsnew.htm) where visitors can view recently updated traffic and road closure information by State. FHWA regularly updates this section, with 10 State Web sites added in October 2007 alone. The newest information includes links to highway condition maps in Wyoming; beat-the-traffic information in Memphis, TN; and real-time traffic information for Tucson, AZ.

Up to Date in Minnesota

Following the devastating Interstate 35W (I-35W) bridge collapse over the Mississippi River in Minneapolis, MN, on August 1, 2007, the Minnesota Department of Transportation (Mn/DOT) created the "Interstate 35W Bridge Collapse" Web site (www.dot.state.mn.us/i35wbridge). In the aftermath of the collapse, the Mn/DOT site played a critical role in communicating up-to-the-minute information on traffic conditions on I-35W. After the site opened on the night of the collapse, FHWA quickly followed suit and added the Mn/DOT Web site to the "What's New?" section of its "National Traffic and Road Closure Information" Web site. This decision broadened the availability of information to a wider audience of concerned travelers.

"During the hours after the collapse, the site provided information about detours and alternate routes for the I-35W bridge," says Kay Korsgaard, Web coordinator for Mn/DOT. "Most major online news media linked to maps we posted on our site." Among other things, the page provided direct links to Minnesota's real-time Regional Transportation Management Center (www.dot.state.mn.us/tmc/index.html) information pages and traffic and road conditions at www.511mn.org.

"Mn/DOT decided early on to use the site to help get information directly to the public," continues Korsgaard. "Our goal was to be as transparent as possible in communicating news about the collapsed bridge and about the statewide bridge inspections that followed."

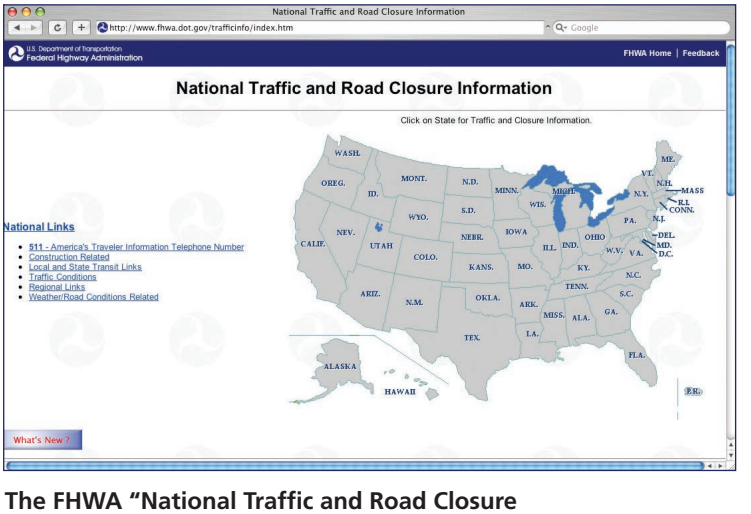
In the time since the bridge collapse, the site expanded to include inspection reports, video footage of the collapse, facts about the bridge, and plans for the new bridge. "The site even served as a virtual open house to supplement our more traditional outreach efforts for communicating plans about the new bridge," says Korsgaard. "Our online comment form generated more than 1,000 comments about Mn/DOT's plans for the new bridge."

Saving Time, Saving Money

FHWA's "National Traffic and Road Closure Information" Web site and Mn/DOT's "Interstate 35W Bridge Collapse" Web site give drivers the advantage of knowing road conditions before they step outside. Visitors to either site can access timely information that can reduce travel times drastically. With information on subjects from avoiding construction delays and congested roads to preparing for weather conditions and highway detours, these two sites might help reduce travel costs and, ultimately, congestion.

For more information, visit FHWA's "National Traffic and Road Closure Information" Web site at www.fhwa.dot.gov/trafficinfo/index.htm. For more information on Mn/DOT's "Interstate 35W Bridge Collapse" Web site, visit www.dot.state.mn.us/i35wbridge or contact Kay Korsgaard at 651-366-4267 or kay.korsgaard@dot.state.mn.us.

Brittany Boughter is a contributing editor for PUBLIC ROADS.



The FHWA "National Traffic and Road Closure Information" Web site.

Communication Product Updates

Compiled by Zac Ellis of FHWA's Office of Research and Technology Services

Below are brief descriptions of products recently developed by the Federal Highway Administration's (FHWA) Office of Research, Development, and Technology. All of the reports are or soon will be available from the National Technical Information Service (NTIS). In some cases, limited copies of the communications products are available from FHWA's Research and Technology (R&T) Product Distribution Center.

When ordering from NTIS, include the NTIS publication number (PB number) and the publication title. You also may visit the NTIS Web site at www.ntis.gov to order publications online. Call NTIS for current prices. For customers outside the United States, Canada, and Mexico, the cost is usually double the listed price. Address requests to:

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5285 Port Royal Road
Springfield, VA 22161
Telephone: 703–605–6000
Toll-free number: 800–553–NTIS (6847)

Address requests for items available from the R&T Product Distribution Center to:

R&T Product Distribution Center, HRTS-03
Federal Highway Administration
9701 Philadelphia Court, Unit Q
Lanham, MD 20706
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Fax: 301–577–1421

For more information on R&T publications from FHWA, visit FHWA's Web site at www.fhwa.dot.gov, the Turner-Fairbank Highway Research Center's Web site at www.tfhrc.gov, the National Transportation Library's Web site at http://ntl.bts.gov, or the OneDOT information network at http://dotlibrary.dot.gov.

Compilation and Evaluation of Results From High-Performance Concrete Bridge Projects, Volume I: Final Report
Publication No. FHWA-HRT-05-056

In 1993 FHWA initiated a national program to implement the use of high-performance concrete (HPC) in bridges. The program included construction of demonstration bridges in each FHWA region and dissemination of the technology and results at showcase workshops. Initially, 19 bridges in 14 States were included in the program. Since then, other States have begun using HPC in various bridge elements.

The bridges are located in different climatic regions of the United States and used different types of superstructures. They demonstrated practical applications and provided opportunities to learn more about the placement and behavior of HPC. In addition, the bridges' instrumentation enabled regions to monitor short- and long-term performances and measure concrete material properties.

Appendixes for this volume appear in *Compilation and Evaluation of Results From High-Performance Concrete Bridge Projects, Volume II: Appendixes* (FHWA-HRT-05-057).

Limited copies are available from FHWA's R&T Product Distribution Center. The document also is available from NTIS under order number PB2007-105581.

Compilation and Evaluation of Results From High-Performance Concrete Bridge Projects, Volume II: Appendixes
Publication No. FHWA-HRT-05-057

This report details the four parts of FHWA's national HPC program. The first part of the program collected and compiled information from each joint State-FHWA HPC bridge project and other HPC bridge projects. The compilation is available on a CD-ROM and includes information on the benefits of HPC, costs, structural design, specified concrete properties, concrete mix proportions, measured properties, associated research projects, sources of data, and specifications.

The second part of the program reviewed the American Association of State Highway and Transportation Officials' (AASHTO) *Standard Specifications for Transportation Materials and Methods of Sampling and Testing*, *Standard Specifications for Highway Bridges*, *Load and Resistance Factor Design (LRFD) Bridge Design Specifications*, and *LRFD Bridge Construction Specifications* for provisions that directly affect the use of HPC.

The third part of the program developed proposed revisions to the AASHTO specifications where sufficient research results existed to support the revisions. The report includes proposed revisions to 15 material specifications, 14 test methods, 30 articles of the standard design specifications, 17 articles of the LRFD design specifications, and 16 articles of the LRFD construction specifications. In addition, a new materials specification for combined aggregates, a new test method for slump flow, and a revision to the FHWA definition of HPC are proposed.

The fourth part of the project developed specific recommendations for research to support needed changes in the specifications. The report also recommends six research problem statements related to concrete materials and four related to structural design.

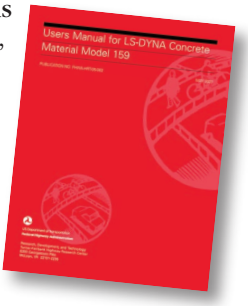
The final report associated with these appendixes is *Compilation and Evaluation of Results From High-Performance Concrete Bridge Projects, Volume I: Final Report* (FHWA-HRT-05-056).

Limited copies are available from FHWA's R&T Product Distribution Center. The document also is available from NTIS under order number PB2007-105582.

Users Manual for LS-DYNA Concrete Material Model 159
Publication No. FHWA-HRT-05-062

This is the first of two manuals that document an elasto-plastic damage model with rate effects developed for

concrete and implemented into LS-DYNA, a finite element code. This manual explores the theory of the concrete material model, describes the required input format, and includes sample problems for use as a learning tool. In addition, the manual provides a default material property input option for normal strength concrete. Originally developed for roadside safety applications such as concrete bridge rails and portable barriers impacted by vehicles, the model also applies to other dynamic applications. The companion report to this manual is titled *Evaluation of LS-DYNA Concrete Material Model 159* (FHWA-HRT-05-063).



Limited copies are available from FHWA's R&T Product Distribution Center. The document also is available from NTIS under order number PB2007-109573.

Evaluation of LS-DYNA Concrete Material Model 159 Publication No. FHWA-HRT-05-063

This manual documents evaluation of the concrete material model, including selection of the concrete model input parameters. The report details model evaluations through correlations with test data: drop tower impact of 1/3-scale beams (plain and reinforced), bogie vehicle impact of full-scale reinforced beams, pendulum impact of bridge rails, and quasi-static loading of a safety-shaped barrier. The companion report to this manual is titled *Users Manual for LS-DYNA Concrete Material Model 159* (FHWA-HRT-05-062).

This document is available online at www.tfhrc.gov/safety/pubs/05063/05063.pdf. Limited copies are available from FHWA's R&T Product Distribution Center.

Freight Technology Assessment Tool User Guide Publication No. FHWA-HOP-06-110

FHWA works with its partners to evaluate potential technology solutions to improve the reliability, efficiency, and security of the freight transportation system. Technology evaluation is a complex process requiring analysis of many factors, including freight transportation needs, supply chain performance, costs, and benefits. Not surprisingly, the complexity increases as the number of criteria and parties involved rises.

Recognizing the need for evaluation tools to sift through technology options, FHWA developed the Freight Technology Assessment Tool (FTAT) and a supplemental user guide. FTAT aims to give decision-makers the information and tools needed to invest wisely and prioritize future projects. Making good investment choices for the transportation system is critical to enhancing the Nation's economic productivity and global connectivity.

This document is available online at http://ops.fhwa.dot.gov/freight/publications/ftat_user_guide/ftat_user_guide.pdf. For additional information, please contact Transportation Specialist Randy Butler at 202–366–9215 or randy.butler@fhwa.dot.gov.

Freeze-Thaw Resistance of Concrete With Marginal Air Content (TechBrief) Publication No. FHWA-HRT-06-118

Freeze-thaw resistance is a key durability factor for concrete pavements. Recommendations for the air void system parameters are normally 6 ± 1 percent total air and a spacing factor of ≤ 0.20 millimeter (0.008 inch); however, recent laboratory studies proved that some concretes without these commonly accepted thresholds offer good freeze-thaw resistance.

This study evaluated the freeze-thaw resistance of several marginal air void mixes with two types of air-entraining admixtures, a Vinsol® resin and a synthetic admixture. To conduct the study, researchers used rapid cycles of freezing and thawing in plain water, with no deicing salts.

For the specific materials and concrete mixture proportions used in this project, the marginal air mixes (concretes with fresh air contents of 3.5 percent or higher) presented an adequate freeze-thaw performance with a Vinsol resin-based, air-entraining admixture. The synthetic admixture used in this study did not perform as well as the Vinsol resin admixture.

This document is available online at www.fhwa.dot.gov/pavement/concrete/pubs/06118. Limited copies are available from FHWA's R&T Product Distribution Center.

Pedestrian and Bicyclist Intersection Safety Indices: Final Report Publication No. FHWA-HRT-06-125

The primary objective of this study was to develop safety indices to enable engineers, planners, and other practitioners to prioritize intersection crosswalks and approaches with respect to pedestrian and bicyclist safety. The study collected data on pedestrian and bicyclist crashes, conflicts, avoidance maneuvers, and subjective ratings of intersection video clips by pedestrian and bicycle experts. Researchers selected 68 intersection crosswalks for the pedestrian analysis from the following cities: San José, CA; Miami-Dade County, FL; and Philadelphia, PA. The bicycle analysis included 67 intersection approaches from Gainesville, FL; Eugene and Portland, OR; and Philadelphia, PA.

The study developed prioritization models based on expert safety ratings and behavioral data. Indicative variables in the pedestrian safety index model included type of intersection control (signal or stop sign), number of through lanes, 85th-percentile vehicle speed, main street traffic volume, and area type. Indicative variables in the bicycle safety models (for through, right-turn, and left-turn bike movements) included the presence of various combinations of bicycle lanes, main and cross street traffic volumes, number of through lanes, presence of onstreet parking, main street speed limit, presence of

a traffic signal, number of turn lanes, and others. A user-friendly guide will help practitioners use the safety indices to identify which crosswalk and intersection approaches have the highest priority for indepth pedestrian and bicyclist safety evaluations and subsequently use other tools to identify and address potential safety problems.

This document is available online at www.tfhrc.gov/safety/pedbike/pubs/06125/index.htm. Limited copies are available from FHWA's R&T Product Distribution Center. The document also is available from NTIS under order number PB2007-109548.

The Use of Lithium to Prevent or Mitigate Alkali-Silica Reaction in Concrete Pavements and Structures
Publication No. FHWA-HRT-06-133

Alkali-silica reaction (ASR) was first identified as a form of concrete deterioration in the late 1930s and early 1940s (T.E. Stanton 1940). Approximately 10 years later, researchers discovered that lithium compounds can control expansion due to ASR. Since then, there has been an increased interest in using lithium technologies to both control ASR in new concrete and retard the reaction in existing ASR-affected structures.

This facts book provides information on lithium's origin, properties, and applications. The report discusses the mechanism of ASR, together with methods of testing to identify potential ASR aggregates, and presents traditional methods for minimizing the risk of damaging ASR. Examples include avoiding reactive aggregates, controlling the levels of alkali in concrete, and using supplementary cementing materials such as fly ash, slag, and silica fume. The final two sections discuss the use of lithium first as an admixture for new concrete construction and second as a treatment for existing concrete structures affected by ASR.

This document is available online at www.fhwa.dot.gov/pavement/concrete/pubs/06133/index.cfm. Limited copies are available from FHWA's R&T Product Distribution Center. The document also is available from NTIS under order number PB2007-109549.

Strengthening Historic Covered Bridges to Carry Modern Traffic (TechBrief)
Publication No. FHWA-HRT-07-041

This document is a technical summary of an unpublished FHWA report, *Strengthening Historic Bridges to Carry Modern Traffic* (FHWA Contract No. DTFH61-00-C-00081), which is only available through NTIS. This TechBrief describes research from 2000–2004 on the use of glass fiber-reinforced polymer composites to strengthen wooden superstructure components of historic covered bridges.

At one time, the United States reportedly had as many as 14,000 covered bridges; fewer than 900 now remain. Under the National Historic Covered Bridge Preservation Program, FHWA provides funds for rehabilitation, restoration, and preservation of covered bridges. If the goal for a particular bridge is to strengthen it sufficiently to support today's vehicular traffic, a major engineering challenge arises. The research described in this TechBrief could help meet that challenge.

The TechBrief is available online at www.tfhrc.gov/structur/pubs/07041/index.htm. The NTIS accession number of the report covered in this TechBrief is PB2007-103714.

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    Martha M. Soneira, Editor-in-Chief
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Conferences/Special Events Calendar

Date	Conference	Sponsors	Location	Contact
April 10–11, 2008	Traffic Data Workshop: Successful Strategies in the Collection of Data for Corridors and Planning	California Department of Transportation	Irvine, CA	Thomas Palmerlee 202-334-2907 tpalmerlee@nas.edu www.natmec.org
May 18–21, 2008	National Roundabout Conference	Transportation Research Board (TRB) of the National Academies	Kansas City, MO	Gene Russell 785-539-9422 geno@ksu.edu http://trb.org/conferences/2008/Roundabout/Call.pdf
June 2–4, 2008	25th Annual International Bridge Conference®	TRB, American Association of State Highway and Transportation Officials, American Composites Manufacturers Association, Precast/Prestressed Concrete Institute, Prestressed Concrete Association of Pennsylvania, and SSPC: The Society for Protective Coatings	Pittsburgh, PA	Stephen Maher 202-334-2955 smaher@nas.edu www.eswp.com/bridge/bridge_overview.htm
June 16–17, 2008	4th National Conference on Surface Transportation Weather	TRB's Task Force on Surface Transportation Weather, Federal Highway Administration (FHWA), and Indiana Department of Transportation (INDOT)	Indianapolis, IN	Rosa Allen 202-334-2935 snow2008@nas.edu www.trb.org/conferences/2008/weather
June 17–19, 2008	7th International Symposium on Snow Removal and Ice Control Technology	TRB's Committee on Winter Maintenance, FHWA, and INDOT	Indianapolis, IN	Rosa Allen 202-334-2935 snow2008@nas.edu http://trb.org/conferences/Snow2008_CallforAbstracts.pdf
July 13–16, 2008	8th National Conference on Access Management	FHWA, TRB, and Maryland State Highway Administration	Baltimore, MD	Vaughn Lewis, Conference Chair 410-545-5674 amconference@sha.state.md.us www.accessmanagement.info
July 22–27, 2008	ASCE International Pipelines Conference 2008: Pipeline Asset Management: Maximizing Performance of Our Pipeline Infrastructure	American Society of Civil Engineers (ASCE)	Atlanta, GA	Dr. Tom Iseley, P.E. 404-386-5667 dtiseley@iupui.edu Ralph Carpenter 205-325-1965 rcarpenter@acipco.com http://content.asce.org/conferences/pipelines2008/index.html
July 27–30, 2008	6th National Seismic Conference on Bridges and Highways	FHWA, TRB, South Carolina Department of Transportation, and MCEER	Charleston, SC	Stephen Maher 202-334-2955 smaher@nas.edu www.scdot.org/events/6NSC

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