Public Roads

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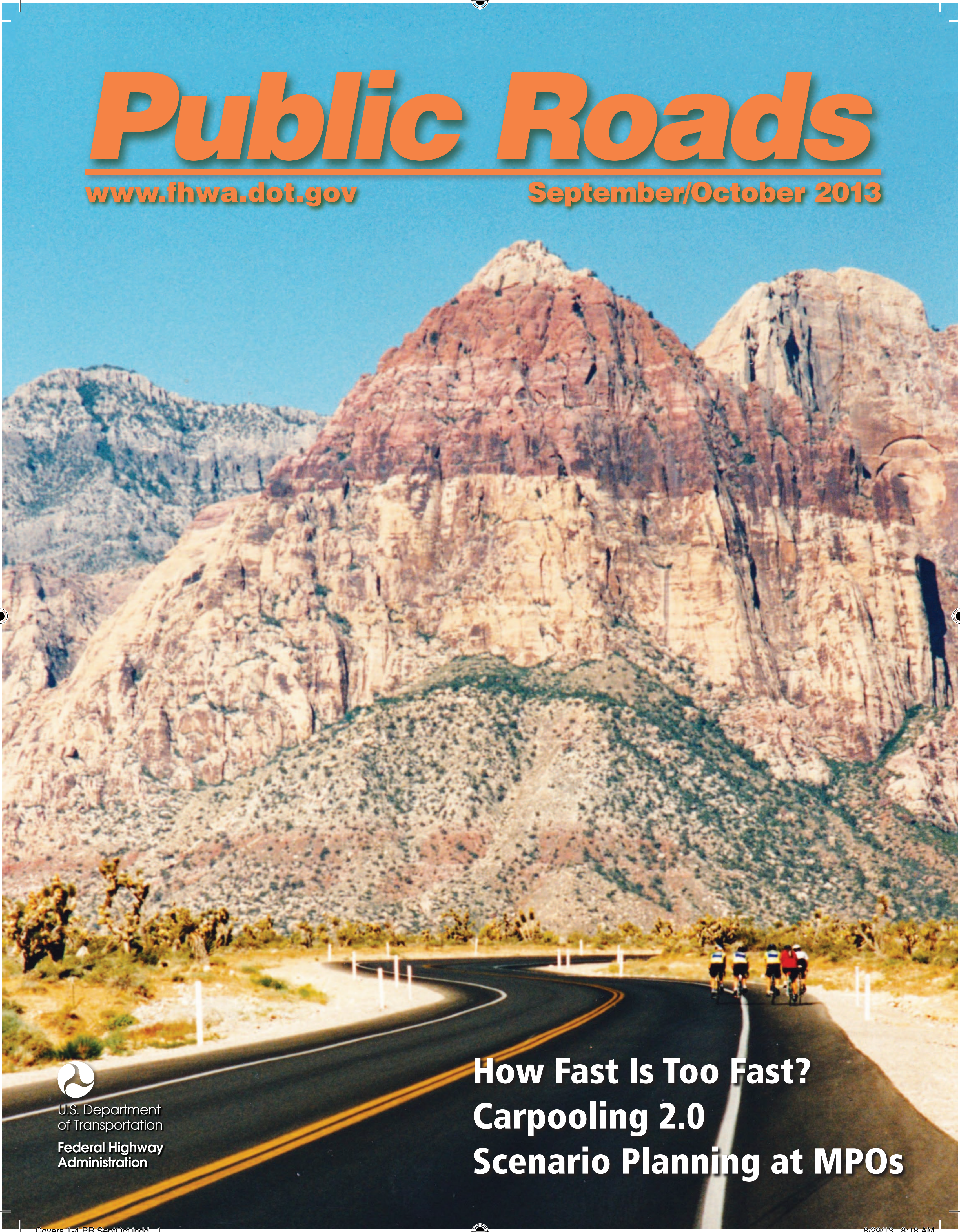

How Fast Is Too Fast?
Carpooling 2.0
Scenario Planning at MPOs

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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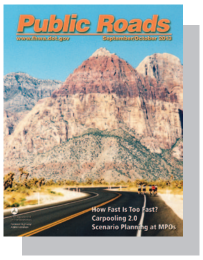

Front cover—These cyclists are pedaling along State Route 159 near Red Rock Canyon, west of Las Vegas, NV. Road geometry, roadside hazards, and pedestrian and bicyclist activity are among the risk factors engineers consider when setting speed limits. The latest release of the Federal Highway Administration's Web-based software, USLIMITS2, takes into account these and other factors in recommending reasonable and safe speed limits. For more information, see "Setting Speed Limits for Safety" on page 8 in this issue of PUBLIC ROADS. *Photo by Davey Warren.*

Back cover—Casual carpoolers queue on Beale Street in downtown San Francisco, CA, for a ride home during the evening commute. Casual carpooling, also known as dynamic ridesharing, has proven to be a flexible, informal commuting option with potential to combat traffic congestion in some metropolitan areas. For more information, see "Fill Those Empty Seats!" on page 15 in this issue of PUBLIC ROADS. *Photo: Mark Burris, Texas A&M University.*

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The editorial office of *Public Roads* is located at the McLean address above.
Phone: 202-493-3398. Fax: 202-493-3475.
Email: paula.magoulas@dot.gov.

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The Secretary of Transportation has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this department.

Guest Editorial

Driving Away Congestion Through Exploratory Research

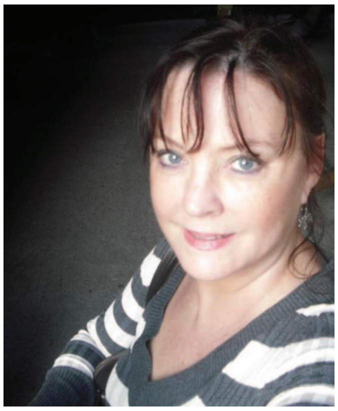
Almost everyone agrees that congestion is detrimental to the Nation's well-being. Congestion contributes to air pollution, inefficient energy usage, and ineffective movement of people, goods, and services. Even as early as 1920, PUBLIC ROADS was reporting that the transportation community had realized the need for research about the movement and operation of vehicles on roadways to enable engineers to build better roads and traffic controls.

Nearly a century later, the transportation system faces different operational challenges. The Federal Highway Administration's Exploratory Advanced Research (EAR) Program, a bridge between basic and applied research, aims to address those challenges. The program conducts high-risk, high-yield research to help identify promising long-term opportunities to improve the transportation system.

In many urban areas, the system capacity has maxed out operationally, and "rush hour" has become "rush hours." Yet carpooling has dropped from 20 percent modal share in 1980 to 11 percent in 2008—despite longer commutes and increased traffic. Researchers with the EAR Program are examining the causes for the decline and how the Nation might be able to tap into the empty seats in private vehicles to help move more people in fewer cars using the existing road system.

In this issue of PUBLIC ROADS, an article titled "Fill Those Empty Seats!" explores how dynamic ridesharing might be one solution. More flexible than traditional carpooling, dynamic ridesharing increases the number of riders per vehicle. The concept is ripe for technology applications, which could enable users to access social networks to find rideshare opportunities, rate the experience, and reimburse drivers for expenses.

In addition, the article discusses a form of ad hoc ridesharing known as slugging, or casual carpooling, in which potential carpoolers meet at a specific place and rides are not prearranged. Driven by the incentive of access to the high-occupancy vehicle (HOV) lanes, casual carpooling, like other forms of ad hoc ridesharing, saves time and money for drivers and riders. Legend has it that casual carpooling started when drivers wanting to use the HOV lanes began stopping at bus stops to offer rides to waiting passengers. Riders received free nonstop travel, and the drivers were able to use the highly coveted, faster HOV lanes—a win-win situation. In three major cities—Houston, TX; San Francisco, CA; and Washington, DC—the phenomenon organically grew into workable com-



muting systems, without any government or for-profit involvement.

An upcoming issue of PUBLIC ROADS will feature an article that discusses several recently completed projects under the EAR Program. The focus is on improving mobility and increasing safety. The article will include information about how the transportation community is exploring cooperative vehicle-highway automation systems, freeway merge assistance, development and evaluation of selected mobility applications, and advanced traffic signal control algorithms.

In addition to addressing mobility challenges, the EAR Program encompasses improvements in planning, building, renewing, and operating safe, congestion-free, and environmentally sound transportation facilities. The program also seeks to leverage advances in science and engineering that could lead to breakthroughs for critical current and emerging transportation issues.

To secure broad scientific participation and extensive coverage of advanced ideas and new technologies, FHWA engages stakeholders throughout the EAR Program's processes. Not only do stakeholders participate in identifying and scoping topics, but also expert panels and peer reviews help ensure the technical quality of sponsored research. Communicating research results through these networks, as well as through published research reports, helps ensure that the transportation community can benefit from the findings.

To become involved in the program, go to www.fhwa.dot.gov/advancedresearch.

Debra S. Elston
Director, Office of Corporate Research, Technology, and Innovation Management
Federal Highway Administration

Roadmap to the Future

by Nastaran Saadatmand, Beth Visintine, and Gonzalo R. Rada

States are working with FHWA to expand the role of pavement management systems in improving pavement design. Read on to find out what all the buzz is about.

Pavement design meets pavement management. Bringing these normally disparate elements together to improve overall performance is the Federal Highway Administration's (FHWA) *Pavement Management Roadmap* (FHWA-HIF-11-011), a far-reaching guide to the Nation's pavement future.

Historically, State transportation agencies have seldom used data on pavement management to improve pavement design because the two disciplines reside at separate divisions in most departments of transportation (DOTs). DOTs' maintenance divisions use data collected on the condition of a roadway, such as whether it is cracking, to make decisions on when to perform repairs. But DOT designers often do not use those data to evaluate whether a pavement is performing as expected or is developing cracks prematurely—and thus they infrequently use the data to refine the designs of future pavements. One of the ideas behind the *Roadmap* is to overcome this separation of pavement design and management, with the ultimate goal of improving pavement performance.

Introduced in 2010, the *Pavement Management Roadmap* is intended to improve the effectiveness of pavement management programs used by transportation agencies to address agency needs at the project, network, and strategic levels. These programs use decision-making tools such as electronic pavement management systems to store data and monitor pavement conditions, measure performance, predict trends, and recommend maintenance projects and pavement preservation treatments. Today, engineers also use the data to calibrate pavement performance models so they can predict pavement distresses more accurately.

"Pavement design and pavement management had been uncoupled, but now there is a new marriage of the two," says Nadarajah Sivaneswaran, senior research civil engineer at FHWA's Turner-Fairbank Highway Research Center in McLean, VA.

Creating the *Roadmap*

FHWA developed the *Roadmap* during three regional workshops held in 2010 in Phoenix, AZ; Dallas, TX; and McLean, VA. Partners in the workshops included representatives from State and local highway agencies, FHWA, Canadian government agencies, metropolitan planning organizations, academia, and private industry.

Workshop participants identified and prioritized 23 short-term research and development needs (spanning 5 years) and 24 long-term needs (5 to 10 years out). Meeting those needs would require $14.6 million in funding.

The project's technical working group, FHWA, and FHWA's development contractor for the project grouped the needs according to four themes:

1. *Use of existing tools and technologies*. An example of a short-term research need under this theme is defining requirements for data quality to improve various business decisions, such as whether to replace rather than repair a pavement segment. A long-term research need is to determine the risk, uncertainty, and variability in pavement management decisions.
2. *Institutional and organizational issues*. A short-term need is to improve the contracting process to accommodate timely selection of pavement treatments. A long-term example is promoting the benefits of pavement management to nontechnical audiences, such as legislators.

Transportation agencies can use data on pavement management to evaluate their construction and design practices, as well as such factors as safety and sustainability, to improve the performance of pavement on roads like this one in Washington State. *Photo: Washington State Department of Transportation.*

3. *The broad role of pavement management*. Here, a short-term need is to address near-term technology issues in data storage and integration. A long-term need is to advance analytical tools for continual calibration of predictions of pavement performance.
4. *New tools, methodologies, and technology*. A short-term example is to develop a fully automated processing tool for identifying pavement distress conditions, such as cracking. A long-term need is to identify strategies for incorporating emerging technologies into pavement management systems.

Here, we will focus on the third theme only, the broad role of pavement management.

The *Roadmap's* Vision

The *Roadmap* presents a 10-year overarching vision for States and FHWA to partner to improve pavement management and the research, development, and technology transfer initiatives needed to help DOTs achieve that future. The vision targets how States can improve pavement management through electronic systems for data collection and how they can use robust, comprehensive, and credible practices in pavement management to investigate new materials and designs, and communicate project options to stakeholders.

The *Roadmap*'s vision takes pavement management beyond reporting and estimating to a new analytical role, where agencies can use pavement management data to evaluate construction and design practices, safety, and sustainability. Ultimately, today's pavement management data can lead to improved pavement design and performance.

As noted in the *Roadmap*, "The availability of quality data has a tremendous impact on an agency's ability to compare different investment options and to make sound business decisions that consider both engineering and economic factors."

Asset Management

Over the past 20 years, in addition to implementing technological innovations in pavement materials and mix designs, DOTs have adjusted the way decisions for allocating resources are made. Increasingly, the emphasis is on management of infrastructure assets. Moreover, asset management offers a coordinated approach over entire life cycles.

Released in 2010, FHWA's *Pavement Management Roadmap* presents a long-term vision for pavement management and the research, development, and technology transfer initiatives needed to achieve that vision.

In following an asset management approach, agencies use data, economic analysis, performance measures, and performance-based goals to make decisions. Specifically, those decisions consider the most effective combination of new construction, which upgrades or replaces infrastructure components, versus the maintenance and renewing of existing assets.

The emphasis on asset management and the importance of quality data have resulted in a growing and changing role for pavement management systems and the output from analyses using those tools. Beginning with States such as Washington in the late 1970s, agencies have used pavement management systems—which today exist as software models—to assess and report pavement conditions, prioritize capital improvements, and estimate funding needs.

Mechanistic-Empirical Models

The new era for pavement design began with the introduction of the *Mechanistic-Empirical Pavement Design Guide* by the National Cooperative Highway Research Program. Adopted by the American Association of State Highway and Transportation Officials (AASHTO) in 2008, the published guide replaced an earlier AASHTO guide for pavement design.

A mechanistic pavement design approach uses mathematical models to calculate the response of pavement to traffic loads. A mechanistic-*empirical* approach uses both mathematical models *and* experimental data to predict pavement performance.

The earlier AASHTO design guide used empirical design models derived from a road test conducted between 1958 and 1960 by the then American Association of State Highway Officials (AASHO). The road test used a limited number of pavement sections at a single test site in Ottawa, IL. Traffic loads and volumes varied but were far below those of today.

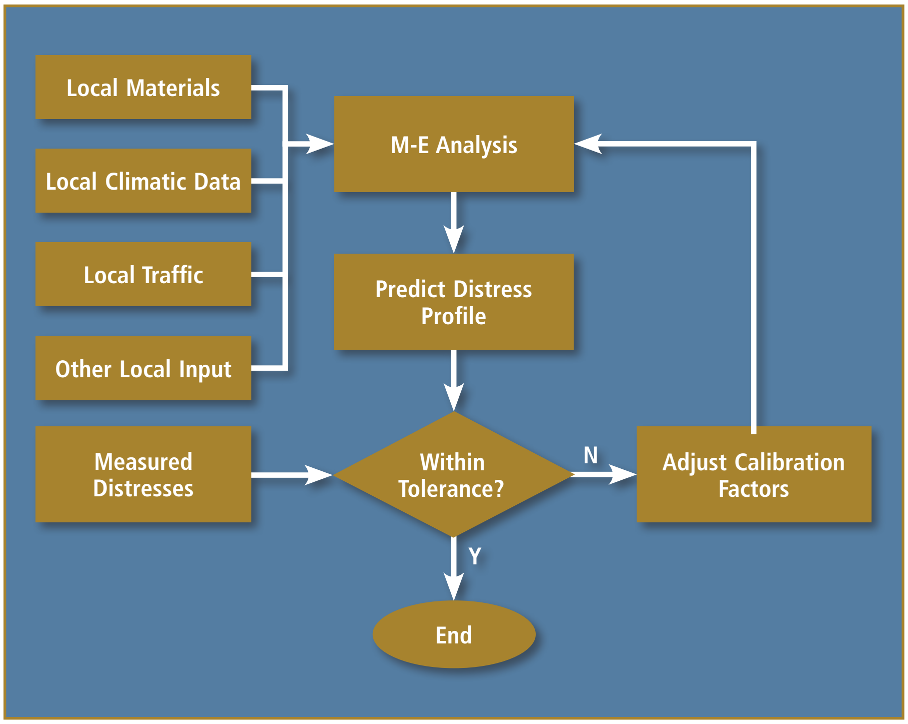
Today's mechanistic-empirical approach more realistically characterizes inservice pavements. The mechanistic-empirical model enables transportation agencies to better predict pavement performance over time and to make more informed decisions when designing pavements.

The *Design Guide* now is accompanied by associated software for pavement design, available as Pavement ME Design™, in the AASHTOWare® line of products. The software is an expanded and improved version of the prototype first released under the title Mechanistic-Empirical Pavement Design Guide, Version 1.1.

"The development of the *Mechanistic-Empirical Pavement Design Guide* brought to the forefront both the need for and the benefits of relinking pavement design and pavement management," says Sivaneswaran.

Broadening the Mechanistic-Empirical Approach

Today, many agencies are transitioning to using the mechanistic-empirical model to predict pavement



Shown here is the process for performing local calibration of the *Mechanistic-Empirical Pavement Design Guide*, as evaluated in North Carolina. *Source: FHWA.*

performance during the design phase. Now, broadening that model via the *Roadmap*'s vision, agencies can feed actual performance data from their pavement management systems back into their mechanistic-empirical design models and thereby update them. Through that process, they can improve their next pavement design by considering maintenance and preservation needs during the pavement's entire life cycle.

"You start adjusting the design based on the pavement performance data," says Sivaneswaran. "It is a continuous process in which performance monitoring is a component of systems for managing pavements but is also the feedback loop for pavement design."

Researchers across the country are taking the first steps in fulfilling the *Roadmap*'s vision, enabling agencies to both expand the role of pavement management and improve pavement design. By incorporating the feedback loop for pavement design, the *Roadmap*'s long-term vision reflects a transformation—a new era—in the way transportation agencies conduct the daily business of planning, building, and maintaining roadways.

The vision of broadening the role of pavement management systems and using pavement management data to improve pavement design is intrinsically linked to the *Mechanistic-Empirical Pavement Design Guide*, as several States are using pavement management data to calibrate the *Design Guide* for local use. The *Roadmap* does not replace the *Design Guide*, but rather it lays out what is needed to be done over the next 10 years to improve current pavement management practices.

Projects underway around the country, whether conducted individually by States or through FHWA sponsorship, are making progress toward achieving this 10-year plan. From improving predictions of pavement performance to making it easier for States to effectively use the data collected by their pavement management systems, these projects collectively are helping to achieve the *Roadmap* goals.

Local Calibration of The *Design Guide*

Meanwhile, DOTs across the country are implementing the *Design Guide* by performing local calibration of the guide's models. The local calibrations analyze input data for such categories as traffic, climate, and materials, and estimate damage accumulation over the service life of various pavements. The *Roadmap*'s vision of broadening the role of pavement management is helping States improve this implementation process.

Although the mechanistic-empirical models are based on data from across the United States, including data from pavement test sections initiated under FHWA's Long-Term Pavement Performance (LTPP) program, calibration that uses local data provides agencies with improved predictions of pavement performance. Many States are finding that data from their pavement management systems serve as important inputs for this calibration.

In 2005, shortly after the introduction of the *Design Guide*, a study sponsored by FHWA examined the use of pavement management data by eight States to calibrate and validate the new guide. To conduct the study, the researchers visited Florida, Kansas, Minnesota, Mississippi, New Mexico, North Carolina, Pennsylvania, and Washington. In addition to ensuring a broad geographical representation, FHWA selected those States due to the strength of their pavement management systems and their commitment to implementing the *Design Guide.*

Based on the site visits, the study presented guidance on using data from pavement management systems to carry out calibration. The study also recommended that each State develop a separate electronic "satellite" database using data on pavement management and design for each project designed and constructed using the *Design Guide.* Data used in the design phases of each State's projects, along with pavement management data, were to be stored in this separate database, which would be compatible with the State's database on its pavement management system.

"The only way to calibrate the *Mechanistic-Empirical Pavement Design Guide* long term nationwide is through using data from pavement management systems," says study researcher W.R. Hudson, senior consultant at AgileAssets, Inc., and professor emeritus at The University of Texas at Austin.

The final report came out in 2006 and noted, "Such a satellite database will provide an opportunity to better coordinate and tie together pavement design and pavement management. The

Halil Ceylan, Iowa State University

An Iowa study is improving the accuracy of predictions on performance of the State's jointed plain concrete pavements. The study also is enabling implementation of the *Mechanistic-Empirical Pavement Design Guide* with proposed local calibration factors. This jointed plain concrete pavement is located on U.S. 20 in Webster County, IA.

original development of pavement management was as a pavement design system and, although pavement management has become generally a planning tool, this is a great opportunity to pull the two back together for future benefits."

A followup to the 2005–2006 study evaluated its recommendations. In the followup, the researchers developed a local calibration database for the *Mechanistic-Empirical Pavement Design Guide* using data from the North Carolina Department of Transportation's (NCDOT) pavement management system. This followup demonstrated that pavement designers could use NCDOT's existing data on flexible and rigid pavement sections to calibrate pavement distress models contained within the *Design Guide*.

The followup report, *Local Calibration of the MEPDG [Mechanistic-Empirical Pavement Design Guide] Using Pavement Management Systems* (HIF-11-026), published by FHWA in 2010, contains an estimated timeline for performing local calibration, ranging from selecting roadway segments to evaluating project and distress data to interpreting results. As noted in the report, one of the major challenges with calibration involves correlating data on pavement conditions collected as part of the LTPP program with data contained in the State's pavement management systems. Depending on the amount of data collected in pavement management systems, highway agencies also might need to add data from their as-built construction records, material-testing databases, or their other databases.

Iowa Improves the Accuracy of Performance Predictions

After the followup FHWA study, States continued research into improved implementation of the *Mechanistic-Empirical Pavement Design Guide* through the use of local calibration factors. An Iowa initiative, for example, is improving the accuracy of predictions of pavement performance for the State's jointed plain concrete pavements.

Taking into consideration both geographical locations and traffic levels, Iowa State University researchers, in consultation with the Iowa DOT, selected representative sites across the State for calibration and validation. The researchers obtained data inputs for the *Mechanistic-Empirical Pavement Design Guide* primarily from the Iowa DOT's Pavement Management Information System and material-testing records.

"The local calibration improved the accuracy of performance predictions for jointed plain concrete pavements," notes researcher Halil Ceylan, associate professor in the department of civil, construction, and environmental engineering at Iowa State University and pavement research engineer at the university's Institute for Transportation. These performance predictions included faulting, transverse cracking, and pavement smoothness as measured by the International Roughness Index. "The locally calibrated performance prediction models for jointed plain concrete pavements identified in this study have been recommended by project researchers for use in Iowa as alternatives to their nationally calibrated counterparts," says Ceylan.

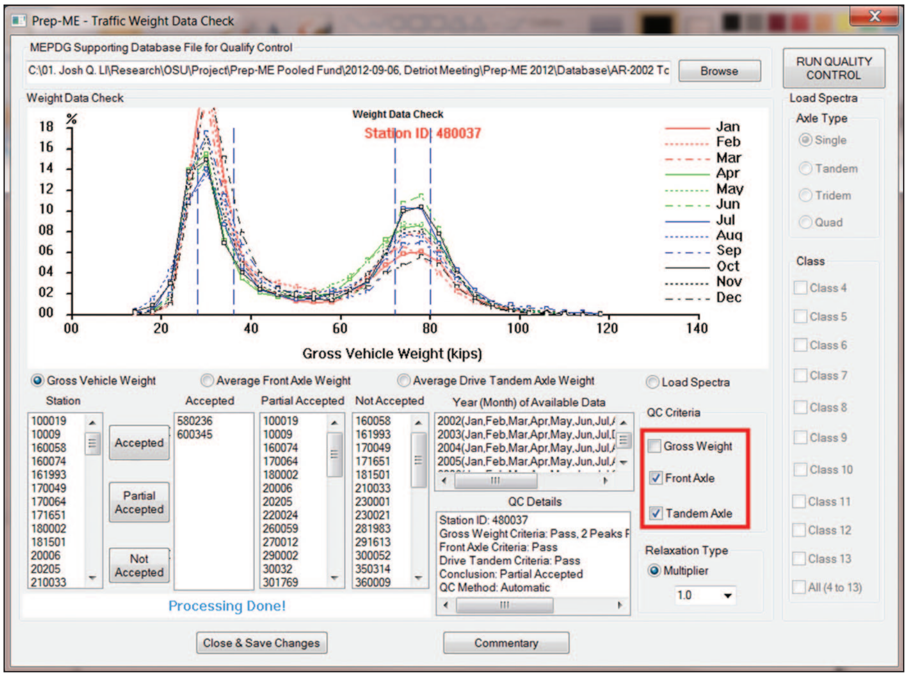
Arkansas Develops New Software

Arkansas also has invested in efforts to implement the *Mechanistic-Empirical Pavement Design Guide* through a series of research projects conducted by the University of Arkansas. Based on the work of several past projects, the university researchers completed a study in 2009 titled "Database Support for the *Mechanistic-Empirical Pavement Design Guide.*"

This project paved the way for the State's development of a software tool known as Prep-ME, which is used to prepare traffic, weather, and materials datasets for direct input to the *Mechanistic-Empirical Pavement Design Guide*.

"The module that processes traffic data quality and other features in Prep-ME caught the eyes of pavement engineers from FHWA and several State highway agencies," says former University of Arkansas professor Kelvin Wang, now professor of civil engineering at Oklahoma State University.

In 2011, FHWA and eight State DOTs launched a pooled fund research study to refine Prep-ME so that it can serve as companion software to the *Mechanistic-Empirical Pavement Design Guide*. The Louisiana Transportation Research Center is the lead agency for the study. The Arkansas and



Shown here is a data screen from Prep-ME, a software tool for preparing traffic, weather, and materials datasets for direct input to the *Mechanistic-Empirical Pavement Design Guide*. A pooled fund research study launched in 2011 is refining Prep-ME so that it can serve as companion software to the *Design Guide*. *Source: Arkansas State Highway and Transportation Department.*

Oklahoma transportation agencies separately are continuing their support of the development of Prep-ME. Testing of a new version with updated capabilities is underway and will run until fall 2014.

Louisiana Calibrates The *Design Guide* For Local Conditions

As the Louisiana Department of Transportation and Development (LA DOTD) transitions to using the *Mechanistic-Empirical Pavement Design Guide*, the agency has evaluated results obtained using the guide's design software and compared them to data on pavement performance from the State's pavement management system and other State data sources. Calibration of the guide's design models against local conditions is particularly important in Louisiana, as the national calibration for the *Design Guide* uses LTPP data, among other data sources. Louisiana has very few LTPP pavement test sites, and none of them were included in the national calibration.

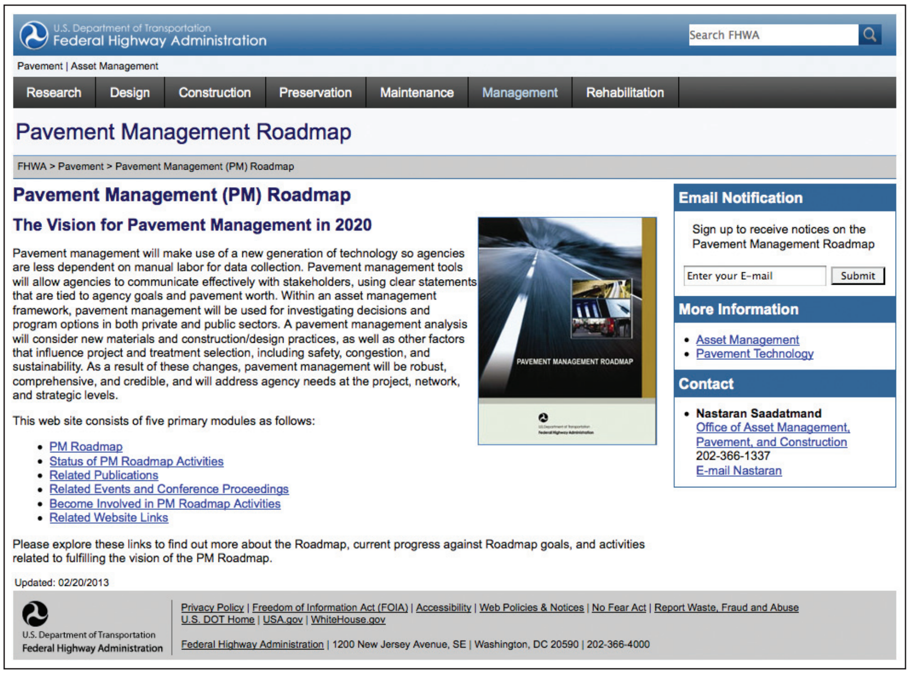
"Louisiana needs the local data and design criteria as it moves forward in implementing the *Mechanistic-Empirical Pavement Design Guide*," says Zhong Wu, program manager for accelerated pavement research at the Louisiana Transportation Research Center and associate professor of research at Louisiana State University. "It is the current reality in Louisiana and probably in various other States that the validation and calibration of the *Design Guide* have to be based on pavement management system data."

A study conducted by the Louisiana Transportation Research Center from 2009 to 2011 evaluated 40 asphalt concrete pavement projects throughout the State. These projects represented five typical types of asphalt pavement structures in Louisiana: asphalt concrete constructed over (1) an asphalt concrete base, (2) a portland cement concrete base that has been "rubblized" or fractured into small pieces, (3) crushed stone, (4) a soil cement base, and (5) stone interlayer pavements. For the selected projects, the researchers obtained original information on pavement structural design and data on network-level pavement management systems from various LA DOTD data sources, including Louisiana's pavement management system and other project-tracking databases.

The Louisiana Transportation Research Center developed design inputs for materials, climate, and traffic based on Louisiana conditions for version 1.1 of the software. For all of the projects, the researchers stored the design inputs in a satellite database known as the Louisiana Mechanistic-Empirical Pavement Design Guide, along with pavement performance data retrieved from the State's pavement management system. By comparing the data, the researchers developed proposed local calibration factors for the various asphalt concrete pavement structures.

A new project to be completed in spring 2014 is expanding the earlier research by evaluating both asphalt and concrete pavements using the pavement mechanistic-empirical design software and comparing the results to data from Louisiana's pavement management system.

A recently completed FHWA research study analyzed pavement management system data from four States, including Washington, to develop guidelines for maximizing the benefits of pavement management. Washington State collects data annually to enhance the performance of pavement on roadways such as this scenic route. *Photo: WSDOT.*



This is the home page of FHWA's "Pavement Management Roadmap."

Integrating Data for Improved Pavement Management

Data integration is the key to achieve the full benefits offered by a comprehensive pavement management system, including improved pavement design and management. Although many highway agencies have most of the data elements required for a fully integrated and comprehensive pavement management system, the data often are scattered in different formats, including both electronic and paper files. Integrating the data would make data mining easier, thereby improving the efficiency and maximizing the benefits of both pavement management and overall asset management.

FHWA recently completed a research project on Procedures for Integrating Pavement Distress and Other Data Elements to Maximize the Benefits of Pavement Management. The project developed guidelines for integrating data and identifying the optimum set of data needed to implement a cost-effective pavement management system and determine the benefits of various pavement treatments.

Researchers analyzed pavement management system data on pavement condition and distress from Colorado, Louisiana, Michigan, and Washington State, as well as data from Minnesota's MnROAD pavement test track and LTPP program databases. The four States included in the study collect and store data for a pavement segment of 0.1 mile (0.16 kilometer) along each road in their entire networks. Washington collects data annually, while the other three States perform the collection every other year. Because MnROAD is a test track, its data collection varies from multiple times per year to an as-needed basis.

Currently in draft form, the project report will detail the required elements for data integration and recommend implementation procedures for States to use. The report also will include algorithms for calculating and comparing the benefits and cost-effectiveness of various pavement treatments.

Guidelines range from collecting data on pavement conditions to preparing data for analysis to selecting pavement treatments and planning maintenance and rehabilitation programs. The guidelines are flexible and can be tailored easily to the needs and objectives of any highway agency, from those that already have developed a pavement management system and want to make the most of their data on pavement performance to those planning to introduce a pavement management system.

The Road Ahead

The *Pavement Management Roadmap* has sparked a new era in pavement management across the country. It is leading to a broader role for pavement management data and a closer link between pavement design and management.

FHWA's Web site for the *Pavement Management Roadmap* features updates on goals and activities, information on projects currently underway in support of the *Roadmap*, and links to related publications and Web sites. Visit today to join pavement management's new era and explore with other members of the highway community how advances in pavement management can build a safer, more durable, and more sustainable highway system for the future.

Nastaran Saadatmand is the program manager for asset management in FHWA's Office of Asset Management in Washington, DC. She has more than 24 years of experience in highway engineering. Saadatmand holds a B.S. in mechanical engineering from the Iran University of Science and Technology in Tehran; an M.S. in civil engineering from the University of New Hampshire; and a professional engineer license from the State of New Hampshire.

Beth Visintine is a project engineer for AMEC Environment & Infrastructure, Inc. She holds a B.S., M.S., and Ph.D. in civil engineering from North Carolina State University.

Gonzalo R. Rada is a principal engineer for AMEC Environment & Infrastructure, Inc. He holds a B.S., M.S., and Ph.D. in civil engineering from the University of Maryland, College Park, and is a registered professional engineer in five States.

For more information, visit the Pavement Management Roadmap *at www.fhwa.dot.gov/pavement/management/roadmap or www.fhwa.dot.gov/asset/hif11011/map00.cfm. Or contact Nastaran Saadatmand at 202-366-1337 or nastaran.saadatmand@dot.gov, Beth Visintine at 301-210-5105 or beth.visintine@amec.com, or Gonzalo R. Rada at 301-210-5105 or gonzalo.rada@amec.com.*

Setting Speed Limits for Safety

Engineering appropriate speed limits now is easier and more consistent, thanks to a powerful software tool called USLIMITS2.

by Davey Warren, Guan Xu, and Raghavan Srinivasan

Speeding—whether driving in excess of the posted speed limit or simply traveling too fast for road conditions—is a factor in an estimated one-third of all fatal crashes, according to the National Highway Traffic Safety Administration. Although agreement is almost universal on the relationship between speed and crash severity (the higher the crash speed, the more serious the resulting injuries and property damage), the relationship between speed and the *probability* of a crash is more complicated. Higher speeds require longer stopping distances and thus possibly result in more crashes. However, crash risk also involves a multitude of other factors, including roadway and environmental conditions as well as driver attitudes and behavioral traits that are independent of speed.

Unlike other driver behaviors that can have a negative impact on safety, such as distracted driving, speed is also associated with positive benefits, including reduced travel times, greater mobility, and increased economic productivity due to lower transport and inventory costs and larger market areas. Thus, speed management involves balancing safety and efficiency in travel.

Posting speed limits is the most widely used method for managing speed, yet they are only effective if set at the maximum reasonable and safe speed. The apparent subjectivity of the process of setting speed limits, however, can lead to inconsistencies in posted speeds within and between jurisdictions. This can also make it difficult to defend decisions on speed zoning when public pressure comes to bear.

In 2012, the Federal Highway Administration's (FHWA) Office of Safety released an updated version of USLIMITS2, a Web-based software program designed to assist State and local agencies in setting appropriate—defined as safe, credible, consistent, and enforceable—speed limits. The following is a refresher on the science behind speed limits and a glimpse at how some States are using this software to improve their processes for setting speed limits.

FHWA's USLIMITS2 Web-based tool for setting appropriate speed limits is applicable to all types of roads, ranging from residential streets like this one in Columbia, MD (left), to rural roadways like this one outside Sedona, AZ (below).

Legal Framework For Speed Limits

As described in the Transportation Research Board's (TRB) *Special Report 254, Managing Speed: Review of Current Practice for Setting and Enforcing Speed Limits*, published in 1998, motorists continually make decisions about appropriate driving speeds by factoring in the amount of risk they are willing to accept. Using the assumption that drivers are motivated by a strong incentive to complete their trips safely, a natural question is why not allow drivers to choose their own travel speeds? However, the report identifies three main reasons for officials to regulate drivers' speeds:

1. Inappropriate speed choices can impose risks and uncompensated costs on other drivers.
2. Motorists often lack sufficient information (for example, capabilities of their vehicles, roadway geometry, or other conditions) to determine an appropriate speed.
3. Motorists' inability to judge the effect of speed on safety and their tendency to underestimate the effect of higher speeds on crash propensity impose unnecessary risks.

States establish their speed limits based on national standards outlined in FHWA's *Manual on Uniform Traffic Control Devices* (MUTCD) and their own legal frameworks. Most States have statutes establishing default speed limits determined by road type and location. For example, State law might limit vehicle speeds to 30 miles per hour (mi/h) (48 kilometers per hour, km/h) in

Brudis & Associates

Specific advisory speeds are used in conjunction with warning signs like this one to indicate appropriate travel speeds at curves and intersections.

urban and residential areas, 55 mi/h (89 km/h) outside urban areas, and 70 mi/h (113 km/h) on freeways. However, States and most local governments also have the authority to change speed limits on the basis of an engineering study in sections of roads where the statutory limits do not fit specific conditions. The speeds posted in these speed zones designate the maximum reasonable and safe speed, based on favorable conditions.

Engineering Speed Limits

The MUTCD is the national standard for all traffic control devices on roads open to public travel. It *requires* that speed limits be posted in increments of 5 mi/h (8 km/h) and that speed limits in speed zones be based on an engineering study and analysis of free flow speeds (speeds that are unimpeded by other vehicles, stop signs, signals, or inclement weather).

The MUTCD *recommends* that agencies set speed limits within 5 mi/h (8 km/h) of the 85^{th} percentile speed of free-flowing traffic. The 85^{th} percentile speed is the speed that 85 percent of drivers travel at or below and is one of the best indicators of a reasonable and safe speed. According to FHWA's report, *Methods and Practices for Setting Speed Limits* (FHWA-SA-12-004), motorists who drive faster contribute disproportionately to the risk of crashes. Setting a speed limit 5 mi/h (8 km/h) higher than the 85^{th} percentile speed will make a few additional drivers legal, but setting it 5 mi/h (8 km/h) lower will make violators out of nearly half of all drivers.

The MUTCD also lists other risk factors that may be considered, including road geometry, the pace speed (the 10 mi/h, or 16 km/h, speed range at which the most vehicles are driving), roadside development, parking practices, pedestrian activity, and crash experience. However, it does not provide specific guidance on how to account for these variables.

In *Methods and Practices for Setting Speed Limits*, prepared in cooperation with the Institute of Transportation Engineers, FHWA reviewed national and international practices and then described the following methods for determining an appropriate speed limit for a given roadway section:

- *Engineering approach*. This approach typically involves a starting point (or base condition) from which engineers first identify a speed limit using the 85^{th} percentile speed or road function, and then adjust it in accordance with other roadway characteristics, such as pedestrian or bicyclist activity, roadside hazards, and the presence or absence of medians.
- *Expert system approach*. Expert systems aim to emulate the human thought process in solving complex problems. In this approach—basically a computerized version of the engineering approach—a computer program uses decision rules developed by traffic engineers, enforcement personnel, and other practitioners to recommend a speed limit.
- *Optimization approach*. Here, the goal is to minimize the societal costs of transportation using models that estimate the effect of speed limits on travel time, vehicle operating costs, crashes, noise, pollution, and other factors. Although this method has some theoretical appeal, it is rarely used in practice because of its complexity.
- *Injury minimization or safe system approach*. In this case, the tolerance of the human body

to injury during a crash is the primary factor in identifying appropriate speeds. This method has become popular in some parts of Europe, especially Sweden and the Netherlands, which have a legal framework that is different from that in the United States. (In the United States, the safe system approach cannot be the sole criterion for setting speed limits because State laws and the MUTCD require that the speed limit also be reasonable.)

Expert Systems for Setting Speed Limits

In 2003, FHWA released the first version of USLIMITS to assist practitioners in setting speed limits that are safe, credible, consistent, and enforceable. When used to determine appropriate speed limits, this Web-based expert approach provided a systematic, consistent method for examining and weighing factors in addition to vehicle operating speeds. ARRB Transport Research, headquartered in Melbourne, Australia, created the original version of USLIMITS by modifying a speed zone expert system developed for the Australian State road authorities. The researchers adapted the system logic developed by Australian experts to reflect practices in the United States, such as posting in 5 mi/h (8 km/h) increments.

Four years later, with funding from the National Cooperative Highway Research Program (NCHRP), a research team headed by the University of North Carolina Highway Safety Research Center produced an updated version with decision rules developed by U.S. experts. A project panel made up of three State department of transportation (DOT) members, an Institute of Transportation Engineers representative, and a county transportation representative oversaw development of USLIMITS2, which was released in 2007. In addition to the project panel, the research team convened a group of experts to identify key factors and decision rules through a series of panel meetings and case studies.

In 2012, the same team updated the user interface and moved the expert system to a server at FHWA. USLIMITS2 now can be accessed at http://safety.fhwa.dot.gov/uslimits.

The software employs a risk-based set of decision rules using roadway, traffic, and crash data input by the user to determine an appropriate speed limit for a specific segment of roadway. USLIMITS2 is applicable to all types of roads, from two-lane rural roads and residential streets to multilane urban freeways. Currently, however, USLIMITS2 is not designed to address speed limits in work zones, school zones, or other areas with variable speed limits.

USLIMITS2 provides recommended speed limits based on site characteristics, which include such variables as access density, pedestrian activity, roadside hazards, operating speed, and crash history. It also provides relevant warnings in a summary report that can suggest actions for addressing areas of concern.

As noted earlier, the 85th percentile speed, the speed that 85 percent of drivers travel at or below, is one of the best indicators of a reasonable and safe speed. The median or 50th percentile speed is used in recommending a speed limit when the crash risk on a particular road is significantly higher than the average for similar roads, or when other risk factors such as significant pedestrian activity are present. The researchers selected the median speed as the determining factor to better balance the speed driven by the majority of motorists with the needs of other road users or the local community.

The following case studies illustrate the application of USLIMITS2 and its data requirements using real-life examples.

Michigan: Racho Road

Complaints and enforcement challenges compelled authorities in the city of Taylor, MI, to select several corridors for reevaluation of existing speed limits. The traffic division of the police department evaluates requests for changes in speed limits in the city. The traffic division worked with a local engineering consultant to conduct an investigation. One of the corridors they selected was a 2-mile (3-kilometer) section of Racho Road that had an existing speed limit of 35 mi/h (56 km/h).

Racho Road is a four-lane divided roadway separated by a grassy median in the northern portion and a center two-way, left-turn lane in the southern segment. The roadway is an urban minor arterial serving low-density residential development and a major commercial shopping

Martin Parker, Wade Trim

Features of the highway environment such as signal spacing, the nature of roadside development, and the presence of medians, as in this road segment, influence vehicle operating speeds. Prevailing speed calculated from a sample of safe drivers can serve as an indicator of the influence of the highway environment and an appropriate limit.

Factors Used in USLIMITS2 Speed Limit Recommendations

Road Type	Site Characteristics
Limited-access freeway	Operating speed: 50^{th} and 85^{th} percentile speed Crash statistics Interchange spacing Annual average daily traffic Transition to a nonfreeway Terrain Presence/absence of adverse alignment
Road section in undeveloped area	Operating speed: 50^{th} and 85^{th} percentile speed Crash statistics Presence/absence of adverse alignment Roadside hazard rating Transition to developed area Number of lanes and presence/type of median
Road section in developed area	Operating speed: 50^{th} and 85^{th} percentile speed Crash statistics Extent of pedestrian/bicyclist activity Presence/usage of onstreet parking Access density: driveways and unsignalized intersections per mile Signals per mile Area type Presence/absence of adverse alignment

center. There are 25 access points and an average of one signal per mile (1.6 km) in the section under study. Although there is a 4-foot (1.2-meter) sidewalk in both directions that is offset 10–25 feet (3–7.6 meters) from the road edge, there is little pedestrian activity. The consultant and the traffic division used the USLIMITS2 tool to assist in the decisionmaking process.

Martin Parker, a senior engineer with Wade Trim, headquartered in Detroit, MI, and a national expert on speed zoning, conducted the study for the city of Taylor. His team used automated speed monitoring equipment and road tube sensors to collect speed data for a 24-hour period at three locations within the corridor. The median speed was 38 mi/h (61 km/h) and the 85^{th} percentile speed was 44 mi/h (71 km/h). The 3-year crash rate for the study section was 340 per 100 million vehicle miles and the injury crash rate was 58 per 100 million vehicle miles.

According to USLIMITS2, the crash rate for the section was above the average for similar roads but below the critical rate of 364 per 100 million vehicle miles. The critical rate is the rate that is statistically higher than the average for similar roads with 95 percent confidence. The injury crash rate was below average.

USLIMITS2 recommended a speed limit of 40 mi/h (64 km/h). The Taylor city council approved the change in speed limit, and the city's department of public works erected new signs.

Parker, who has conducted hundreds of these studies for Federal, State, and local agencies, observes, "Decisionmakers are more likely to accept the engineering study recommendations when they are supported by the expert-based USLIMITS2 system."

Indiana: County Road 500/510 South

Changes in development along County Road (CR) 500/510 South in Tippecanoe County, IN, and complaints about the 55 mi/h (89 km/h) speed limit on a segment of the roadway prompted the county highway department and sheriff's department to reevaluate the existing speed limit. CR 500/510 South is a two-lane roadway with 12-foot (3.7-meter) lanes and 6-foot (1.8-meter) grass shoulders. Roadside hazards such as telephone poles are located 15 feet (4.6 meters) or more from the edge of the road.

The study section is located south of the Lafayette city limits but

Martin Parker, Wade Trim

Engineers used USLIMITS2 to evaluate the speed limit on Racho Road, shown here, an urban arterial in Taylor, MI. The city council approved increasing the speed limit from 35 mi/h (56 km/h) to 40 mi/h (64 km/h) based on a traffic and engineering study.

is on the fringe of urban development. Over the years, the surrounding area gradually has transitioned from a rural undeveloped area to a mix of rural and residential development. The section of the road used in the study had fewer than 30 access points per mile (19 per kilometer), and carried an average of 4,200 vehicles per day. The median speed was 43 mi/h (69 km/h) and the 85th percentile speed was 49 mi/h (79 km/h). Police reported 29 crashes—six of which involved personal injury—over a 3-year period.

Because of CR 500/510 South's varied characteristics, engineers used USLIMITS2 to evaluate the road under both undeveloped and developed scenarios. For the undeveloped scenario, the roadside hazard risk was rated a 3 based on guidance provided by USLIMITS2. The roadside hazard rating is a composite measure of roadside conditions, including shoulder width, side-slope, clear zone distance, and fixed object hazards. USLIMITS2 considers a rating of 3 or less to indicate good roadside conditions and low risk. For the developed scenario, both pedestrian activity and parking were negligible. According to USLIMITS2, the crash rate for the study section of 373 per 100 million vehicle miles was considerably above average for similar roads and above the critical rate. The injury crash rate of 77 per 100 million vehicle miles was near the average for similar roads in urban areas and above the average but below the critical rate for rural areas.

USLIMITS2 recommended a speed limit of 45 mi/h (72 km/h) for both scenarios. The program also recommended that the county undertake a comprehensive crash study to identify engineering or traffic control actions that could mitigate the crash problem. Based on the engineering investigation, the county engineer recommended—and the county council approved—reducing the speed limit to 45 mi/h (72 km/h).

Wisconsin: Statewide Safety Study

In 2009, the Wisconsin Department of Transportation (WisDOT) released new *Statewide Speed Management Guidelines*, which provide step-by-step instructions for investigating and setting safe, enforceable speed limits. The guidelines recommend that all jurisdictions use USLIMITS2 as a starting point for determining appropriate speed limits.

Rebecca Szymkowski, State traffic engineer of operations at WisDOT, notes that both the department and local agencies are required by law to base all speed limit changes on a traffic engineering study. "USLIMITS2 is a tool that should be part of that study," says Szymkowski. "It provides an objective method for considering the many factors involved and can help analysts in developing consistent and rational speed limit recommendations."

WisDOT staff recently completed a statewide study of 34 noninterstate highway corridors identified by their regional offices as having suspected speed issues (for example, poor compliance or speeding-related safety problems). For each corridor, they questioned law enforcement personnel, collected speed data, reviewed crash data, and performed an analysis using USLIMITS2.

They also identified engineering countermeasures for reducing speed. The percentage of crashes that were related to speeding exceeded the statewide average in 13 of the 34 corridors in the study. The large majority of crashes occurred when the roads were wet or slippery because of snow or ice. Only about one-quarter of the study locations had appropriate speed limits.

John Campbell, senior traffic engineer with TADI of Cedarburg, WI, who conducted the study for WisDOT, concluded that "USLIMITS2 is a useful tool that is easy to use."

In a related study, WisDOT compared five corridors across the State with irrational speed limits to similar corridors with rational speed limits. The researchers classified speed limits in each corridor as rational or irrational based on observed travel speeds and results from USLIMITS2. Posted speed limits that differed by more than 5 mi/h (8 km/h) from the limit recommended by USLIMITS2 were defined as irrational.

"Roadways with irrational speed limits tended to have larger differences in travel speeds and higher crash rates," says Campbell. "These results are consistent with other studies that indicate that lower limits do not have much effect on the speed most drivers choose to travel and do not guarantee a safer road."

Beyond the Limits

To minimize the number of speed limit changes, *advisory* speeds are used for spot locations, such as

An engineering study based on roadway, traffic, and crash characteristics on this section of State Highway 33 approaching Saukville, WI, found the 35 mi/h (56 km/h) speed limit to be inappropriate. Researchers suggested countermeasures such as speed feedback signs, increased speed limit, and additional enforcement to increase credibility.

John Campbell, TADI

Jurisdictions can use variable speed limit signs like this one in Delaware to reduce speed limits during adverse weather conditions.

horizontal curves or hidden intersections, where reduced speeds are needed for safe operation. FHWA has developed a handbook of procedures designed to improve consistency in advisory speed signing and, it is hoped, in driver compliance with advisory speeds. The handbook, *Procedures for Setting Advisory Speeds on Curves* (FHWA-SA-11-22), provides guidelines for determining when an advisory speed is needed, engineering study methods for establishing the advisory speed, and strategies for selecting other curve-related traffic control devices.

Variable speed limits based on changing road, traffic, and weather conditions have the potential to improve safety and operations under adverse conditions when crash risks are higher. FHWA recently released *Guidelines for the Use of Variable Speed Limit Systems in Wet Weather* (FHWA-SA-12-022) for conditions such as snow, rain, or ice. The guidelines address the design, installation, operation, maintenance, and enforcement of variable speed limits in wet weather, especially at locations where the operating speed exceeds the design speed and the stopping distance exceeds the available sight distance.

Although speed limits are set to indicate the maximum speed based on favorable conditions, road design is based on a minimum speed that reflects comfort considerations and unfavorable conditions. In 2009, FHWA published an informational guide to help engineers, planners, and elected officials better understand design speed and its potential role in achieving desired operating speeds and setting rational speed limits.

These guidelines and reports are available on the FHWA Office of Safety's Speed Management Safety Web site at http://safety.fhwa.dot.gov/speedmgt.

Last Word

The management of speed through appropriate speed limits is an essential element of highway safety. Speed limits are an act of the State traffic law system and need to be reasonable, safe, and enforceable.

According to Michael Griffith, director of FHWA's Office of Safety Technologies, "The USLIMITS2 Web-based application provides State and local agencies with a tool for determining appropriate speed limits for specific roadway segments. It is easy to use and should be a part of any speed limit review. Engineers should collaborate with law enforcement and other stakeholders before a speed limit change is made. Enforcement is needed to ensure compliance with speed limits."

For situations where the community desires, or a safe system approach suggests, a speed limit lower than that recommended by USLIMITS2, the solution is not to simply lower the speed limit. Studies show that setting speed limits lower than the prevailing speed without changing the road environment will have little effect on speed and might increase crash risk. Instead, agencies should consider alteration of the road layout and other engineering countermeasures to reduce speeds to a level that would support the lower limit. Engineering countermeasures for reducing speeds and improving road safety will be explored further in a future issue of PUBLIC ROADS.

Davey Warren is director of research at Brudis & Associates, Inc. He has more than 37 years of experience in traffic and safety research with a significant component focused on speed management. He received a B.S. in civil engineering from North Carolina State University and an M.S. in transportation from the University of Maryland.

Guan Xu is manager of the Speed Management program in FHWA's Office of Safety and a member of the USDOT Speed Management Team. She leads FHWA's efforts to implement infrastructure actions in the USDOT Speed Management Strategic Initiative. She has more than 25 years of experience in traffic operations and safety. She holds an M.S. in civil engineering from the University of Cincinnati.

Raghavan Srinivasan is a senior transportation research engineer at the University of North Carolina Highway Safety Research Center. He has more than 15 years of research experience in human factors and traffic safety. He has a Ph.D. in civil engineering (transportation) from the University of California, Davis.

For more information, visit http://safety.fhwa.dot.gov/speedmgt or contact Guan Xu at guan.xu@dot.gov.

Fill Those Empty Seats!

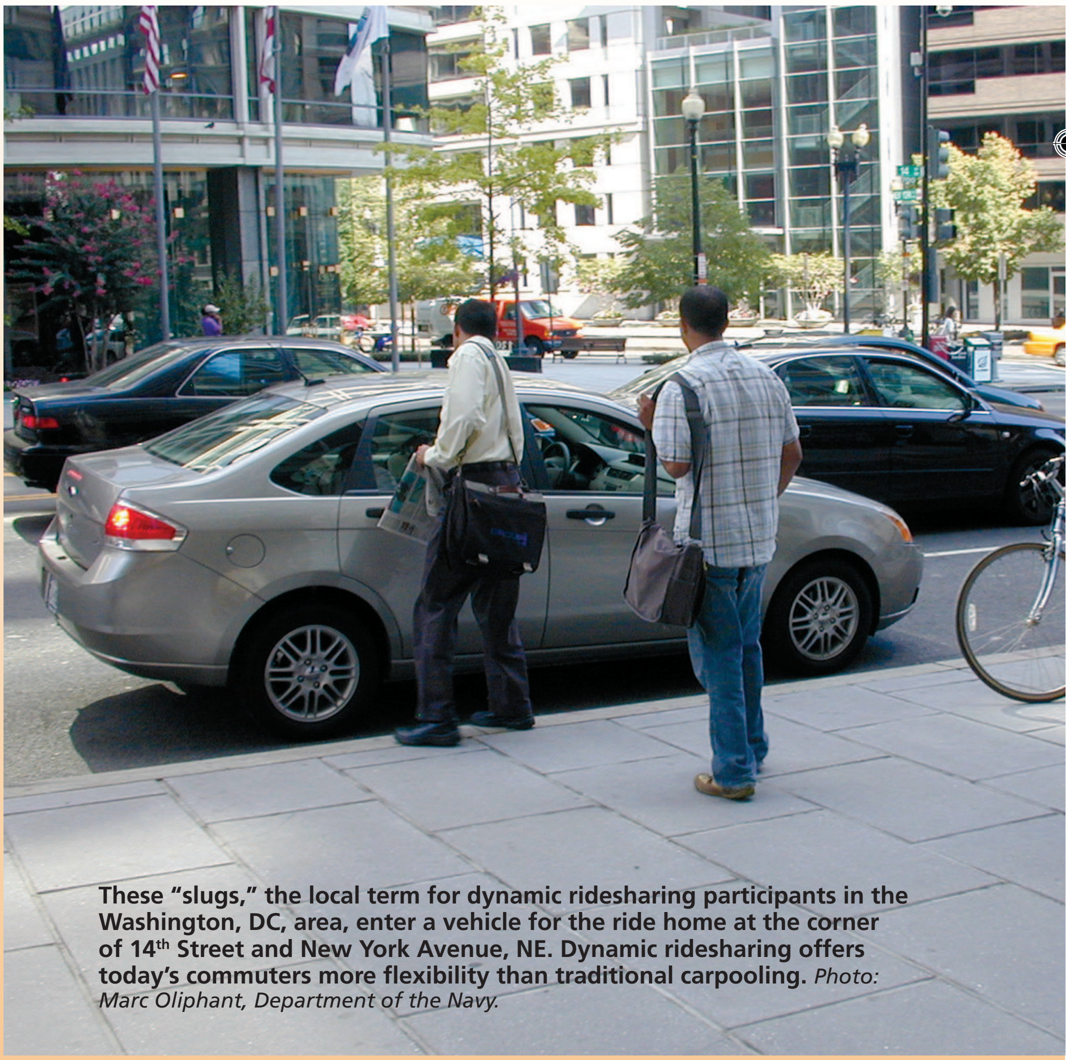
*by Marc Oliphant,
Allen Greenberg, Ron Boenau,
and Jeremy Raw*

Could dynamic ridesharing help combat traffic congestion in your metropolitan area?

Empty seats in private vehicles might be the greatest untapped transportation opportunity in the United States. Average vehicle occupancy across the country is less than two persons per vehicle, while the vast majority of private vehicles have the capacity to carry four or more passengers comfortably.

Low occupancy levels happen despite the fact that many of these car trips occur at about the same time (peak hours) and have similar destinations. The excessive number of vehicles on roadways causes a host of negative externalities such as traffic congestion, greenhouse gas emissions, and lost productivity due to traffic-related delays.

The obvious solution? Find ways to fill those empty seats. Historically, the Federal Government has promoted ridesharing mostly in times of war or economic uncertainty. During World War II, government agencies heavily promoted carpooling as a way to conserve limited resources such as gasoline and rubber for tires. Later, in the 1970s, the Organization of the Petroleum Exporting Countries (OPEC) instituted an embargo that caused a worldwide shortage. The oil crisis precipitated another major push to



These "slugs," the local term for dynamic ridesharing participants in the Washington, DC, area, enter a vehicle for the ride home at the corner of 14th Street and New York Avenue, NE. Dynamic ridesharing offers today's commuters more flexibility than traditional carpooling. *Photo: Marc Oliphant, Department of the Navy.*

promote energy conservation and more efficient means of commuting.

Over the last three decades, however, carpooling has been on the decline. In 1980, it had a mode share of about 20 percent, but by 1990, its share had dropped to about 13 percent. By 2004, it was 10 percent and it has remained steady since then. Contributing causes could include a decrease in the real-term costs of driving and an increase in the percentage of the population with a driver's license. Because more individuals have the means to own an automobile and a license to drive it, the appeal of carpooling has diminished. Flexible work hours, desire for personal convenience, and greater pressure to accomplish multiple things during each trip, requiring multiple stops, are likely contributors as well.

Even so, today's commuters are looking for flexible, affordable commuting options. Some have turned to dynamic ridesharing as an answer.

What Is "Dynamic" About Ridesharing?

Dynamic ridesharing, also known as casual carpooling or slugging, is more flexible and less structured than traditional carpooling. The latter typically involves predetermined arrangements whereby participants agree to travel together, sharing the costs and often taking turns as the driver. Instead, dynamic ridesharing involves informal carpools that form when drivers and passengers meet at designated or at unofficial locations, typically near transit routes that provide parallel service.

"Dynamic ridesharing has the potential to revolutionize carpooling," says Bob Arnold, director of the Office of Transportation Management in the Federal Highway Administration's (FHWA) Office of Operations. "FHWA's investments to pilot dynamic ridesharing—targeted especially to address social factors, quickly facilitate efficient pairings, develop user-friendly technologies, and utilize appropriate incentives and pricing—will help create a viable and desirable transportation choice in the [United States] in the near future."

This type of ridesharing can take many forms. One is commuters meeting at unofficial gathering places along highways with high-occupancy vehicle (HOV) lanes. Another is using smartphone-based apps that facilitate finding rides, sharing expenses, and rating rideshare experiences. The informal nature broadens the appeal of carpooling by reducing the time and commitment required from drivers and riders.

Dynamic vanpooling, like dynamic carpooling, offers the potential to reduce vehicle trips by filling empty seats. According to U.S. Code, for participants to be eligible for tax-free commute subsidies, a vanpool must have the capacity to carry six adults in addition to the driver and have at least 80 percent of its mileage used for commuting purposes.

Dynamic ridesharing has a long history in the United States and is tied closely to the creation of HOV lanes, which came into existence in the 1970s in response to the pressures of energy scarcity. The Henry G. Shirley Memorial Highway (I–395) in northern Virginia was the first HOV-designated corridor in the country. The lanes started with bus-only restrictions in 1969, but then opened to four-passenger carpools (HOV-4) and eventually vehicles with at least three passengers (HOV-3).

HOV lanes provided the incentive for dynamic ridesharing, arguably the first major variation in carpooling since the large-scale adoption of the automobile in the United States. Within a short time of their introduction, HOV lanes had motivated commuters in San Francisco, CA, and Washington, DC, to start forming one-time carpools in the morning and also in the evening. The practice came to be known as "casual carpooling" in San Francisco and "slugging" in Washington.

Drivers wanting to use the HOV lanes began cruising by commuter bus stops looking for carpool partners, offering a direct, free ride to anyone going to the same destination. Riders realized they could get a free, faster (no intervening stops) trip, while drivers enjoyed the time savings benefit of HOV eligibility. The popularity of the practice took off from there. The systems grew organically, with no formal organization or outside entities guiding their development. In some locations, volunteer users set up Web sites to help standardize the norms of the practice, but overall it is a self-governing system.

Dynamic ridesharing thrives on a few factors. First, a congested corridor offering HOV travelers time savings and travel time reliability, or at least toll cost savings, is essential. HOV-3 restrictions make riders and drivers feel more comfortable

Commuters participating in dynamic ridesharing in the Houston metropolitan area can bypass traffic using this limited-access westbound HOV lane on the Northwest Freeway.

As shown here, HOVs and buses traveling on the westbound lanes over the San Francisco-Oakland Bay Bridge use the reserved lanes at the far left and right sides for speedier passage through the tolls. Picking up passengers helps drivers qualify for these restricted lanes. *Photo: Mark Burris, Texas A&M University.*

carpooling with strangers. Having a third person in the vehicle helps offset the awkwardness and personal safety concerns that two strangers may feel when sharing a vehicle. Second, parallel transit services, even if slower and less frequent than desired, also are important as a backup option for riders if they miss the normal dynamic ridesharing hours. Lastly, for dynamic ridesharing to work, it is necessary for large groups of commuters to live in close proximity or have ready access to sizable park-and-ride lots near HOV facility entrances, coupled with densely packed work locations.

Organic Growth

Casual carpooling in San Francisco centers on commuters who use the San Francisco-Oakland Bay Bridge to access downtown. By using the Bay Bridge, commuters reduce what would otherwise be a 35-mile (56-kilometer) trip around the bay to less than 10 miles (16 kilometers).

In addition, cars must pay a toll on all westbound lanes of the Bay Bridge. However, drivers may pay a reduced toll in certain reserved lanes by carrying three or more passengers on the westbound morning commute. Thus, drivers are incentivized to invite more passengers into their cars for the morning trip. Other commuter travel options include the Bay Area Rapid Transit (BART) train and commuter ferries across the San Francisco Bay.

Slugging, as dynamic ridesharing is known in Washington, DC, has as many as 25 different morning origin points in northern Virginia. Arlington and the District of Columbia have about a dozen morning dropoff points, which generally serve as evening origin locations as well.

According to David LeBlanc, author of *Slugging: The Commuting Alternative for Washington, DC*, the term "slugging" may have originated with bus drivers comparing people waiting to join carpools at bus stops to fake coins or "slugs" dropped in the fare box.

The slugging system is centered along the I–95/I–395 corridor, which has 27 miles (43 kilometers) of reversible-direction HOV-3 lanes that extend from Dumfries in Virginia to just shy of the District of Columbia border. Slugging participants, or "slugs," can realize significant time savings by using the HOV instead of the general purpose lanes. In addition, slugs have a number of different backup transportation options, such as Metro trains and OmniRide commuter buses.

In Houston, TX, slugging occurs along two corridors—the Katy Freeway (I–10) and Northwest Freeway (U.S. 290). Similar to Washington, DC, the slug lines in Houston form in areas with ample parking, access to transit, and close proximity to HOV-restricted routes.

In addition, the city has fewer pickup and dropoff points than exist in northern Virginia and fewer pickup points than San Francisco. Slugging volume in Houston, moreover, decreased after completion of a freeway widening project in 2010, along with a policy reduction from HOV-3 to HOV-2 and conversion of HOV to high-occupancy toll (HOT) lanes.

Duplicating Dynamic Ridesharing

Many local governments, academics, and private entrepreneurs have expended substantial resources trying to make dynamic ridesharing work outside the corridors where it has sprung up organically. For example, several west coast cities tried to develop computer matching programs in the 1990s before widespread use of the Internet. But these efforts, which relied on land-line telephones and pagers, were short lived. (See "Lessons from Ridesharing Pilots

This vehicle pulls away after picking up slugs at the Horner Road park-and-ride lot in Woodbridge, VA.

Marc Oliphant, Department of the Navy

in the 1990s" on page 19.) More recent efforts include stand-alone social networking-style Web sites and ridesharing apps for smartphones. In addition, some companies have tried to capitalize on popular existing social media platforms by offering rides among college students at the same university or employees of the same company.

"In the past year, there have been a number of developments in real-time ridesharing and dispatching services," says Susan Shaheen, associate adjunct professor of civil and environmental engineering and codirector of the Transportation Sustainability Research Center at the University of California, Berkeley, and an expert on carpooling and vehicle sharing. "This has been facilitated through smartphone technology and social media, which can be used to match or link riders to drivers within minutes before a trip."

The relative success and low cost of dynamic ridesharing have piqued the interest of researchers at the U.S. Department of Transportation (USDOT), who are studying the phenomenon with the goal of replicating or enhancing it with technology. For example, in 2010, FHWA's Exploratory Advanced Research (EAR) Program sponsored a scan tour of the dynamic ridesharing sites in Houston, San Francisco, and Washington, DC. The scan team also met with transportation planners in the private and public sectors in those cities.

Observations and lessons learned from the scan include the following:

- Dynamic ridesharers are motivated by time and money savings.
- Having a third occupant in the vehicle (HOV-3) makes passengers feel safer.
- Infrastructure plays an important role in helping dynamic ridesharers accumulate time and money savings. Designated commuter parking areas and HOV lanes make carpooling faster and more convenient for commuters.
- Transit and dynamic ridesharing are complementary modes of transportation.
- Technology may help to bring dynamic ridesharing to new locations by moving the physical meeting places used in traditional casual carpooling into the virtual world.

Marc Oliphant, Department of the Navy

In a park-and-ride lot in suburban Houston, this ride seeker is holding up two fingers to inquire whether the driver can take two passengers.

Lessons from Ridesharing Pilots in the 1990s

Bellevue, WA, Smart Traveler

In 1993 the University of Washington and TransManage, the transportation management association in Bellevue, developed the community's Smart Traveler system. Funded by the Federal Transit Administration, the system included a traveler information center that provided dynamic ridesharing support, real-time traffic reports, and transit information. All downtown Bellevue employees were eligible to sign up and access information via telephone.

For ridesharing purposes, the system divided users into groups based on home location. When users offered or requested rides, telephone messages notified participants in the same group. Since the origin and destination of the user was already in the system, it only requested the day and time of the trip. Users also could search for rides with a pager. The pager received hourly transmissions with available rides for the pager holder's group.

The project ran from November 1993 to March 1994. During that time, there were 53 people registered, 509 rides offered, and 148 rides sought, producing 40 potential matches. However, the program did not require users to log a ride, and therefore records indicate only six ride matches. In addition, the system did not actually do the ridematching.

Los Angeles, CA, Smart Traveler

Commuter Transportation Services, a regional ridesharing agency, added an automated matching system, the Los Angeles Smart Traveler, to its ridesharing program to help alleviate traffic after the 1994 Northridge earthquake, which damaged and closed many of the area's roads. The service was limited to the approximately 68,000 people affected by the earthquake and operated only from July to September 1994.

To participate, users called a toll-free number and selected dynamic ridesharing from a menu of options. An auto-text interface enabled them to input and change their travel times and to search for matches based on those times. The system provided ride-match lists over the phone to the users, who then had the option of calling the potential matches or sending a computer-generated message. In order to use the system, individuals had to register first with Commuter Transportation Services. Unregistered callers had to transfer out of the automated system and speak to an operator to register.

An evaluation of the Los Angeles Smart Traveler system from October 1994 to March 1995 showed that an average of 34 people per week used the system. However, because the system did not require participants to report matches, no data exists on the actual number of matches.

Sacramento, CA, On-Demand Ridesharing

The California Department of Transportation tested a dynamic ridesharing program in Sacramento, CA, in 1994 and 1995. The telephone service was operator-based, not automated.

Users answered several questions such as their origin and destination locations, and the purpose of the trip. The operator then would identify trip matches by sorting through a database with origination and destination ZIP codes and prioritizing by the proximity of desired trip times. Three hundred and sixty people (from a database of 5,000 who expressed interest in carpooling) registered as drivers willing to offer on-demand rides. However, the program received only a small number of requests for dynamic ridesharing, and made an even smaller number of potential matches.

Lessons Learned

These early pilot projects taught stakeholders more about what did not work than what did work. A number of challenges were related to inefficient ridematching systems, which failed in part due to less advanced technologies than those available today. Also, in the 1990s, experience with dynamic ridesharing from which program designers could draw was limited.

All the early pilots met with similar outcomes: few requests for rides and even fewer ride matches. The pilots were short lived, which left insufficient time for effective marketing and commuter experimentation. Time and dollar savings—important points for convincing commuters to take alternative forms of transportation—did not exist or were not apparent in these abandoned pilots.

Security was another concern. The projects verified that, without enhanced security measures, people's natural distrust of strangers was often a deterrent. Participants also were reluctant to leave their cars at home if they were uncertain about obtaining a ride for the return trip.

At its core, the opportunity cost of obtaining a match inhibited participation. In all of the projects, ridematching was a time-consuming and burdensome process that required sorting through lists and attempting to make contact with possible drivers, all without a guarantee of a match. However, today's systems and capabilities, and the ubiquity of smartphones, offer the potential of overcoming many of the challenges that contributed to early program failures.

In 2012, the EAR Program also convened focus groups of dynamic ridesharers in the three cities. The focus group participants saw possible benefits to offering rewards of some type to ridesharers who take action to make the system function better. For example, suggestions included adding an option for return trips when not available, rewarding passengers for using more remote parking that is still within walking distance, and arranging for a "last call" backup van or taxicab service or rewarding drivers who pick up later in the HOV time period when riders risk getting stranded. Other ideas include prematching drivers and passengers, particularly for those using meet-up locations where dynamic ridesharing service is not reliable, and incorporating driver certification and ratings, especially for HOV-2 areas, to make passengers feel safer. The report is available at www.fhwa.dot.gov/advancedresearch/pubs/13053/index.cfm.

In addition, USDOT is sponsoring several ongoing efforts to promote ridesharing. The largest effort is through FHWA's Value Pricing Pilot Program (VPPP), which underwrote several projects prior to program funding ending in fiscal year 2013 that combined ridesharing with financial incentives as a nontoll pricing strategy. Other USDOT efforts include initiatives from the department's Small Business Innovation Research Program, Federal Transit Administration (FTA), and FHWA's EAR Program. Details on these efforts follow.

Ridesharing and Financial Incentives

FHWA's VPPP provides funding to support studies and implementation of projects to manage congestion on highways through tolling and other pricing mechanisms. Several ongoing projects combine dynamic ridesharing with pricing.

Santa Barbara, CA. A VPPP project in Santa Barbara, branded SmartRide, is implementing a technology-facilitated dynamic ridesharing project that includes a range of cash incentives to attract both drivers and riders to participate. The system is based on a GPS-enabled smartphone platform provided by a private sector partner, Avego, and is designed

Marc Oliphant, Department of the Navy

Ride seekers queue for the evening ride home at the corner of 5th and M Streets, SE, in Washington, DC.

for commuters who travel on two congested segments of U.S. 101.

The project completed a beta test with 20 participants and the first phase of the pilot was directed toward college students. The pilot test targeted Santa Barbara City College students who live about 11 miles (18 kilometers) from the college in the community of Isla Vista. More than 400 students signed up at www.smartride.org, and more than 85 percent also downloaded the smartphone app and created a profile. Forty-three percent of those who signed up subsequently scheduled rides, and 30 percent posted a picture in their user profiles.

Project organizers report more than 100 users to date completing SmartRide trips and dozens of students regularly using the system. The project, now in its second phase, is focusing on encouraging more use of the app by the existing users and also increasing the number of users. The second phase targets commuters who work in the Santa Barbara area and live more than 30 miles (48 kilometers) away in neighboring Ventura County.

"The SmartRide dynamic rideshare value pricing pilot project has been incredibly insightful, showing us how travel behavior can be changed through the proper balance of mobile application technology and pricing incentives," says Kent Epperson, director of traffic solutions for the Santa Barbara County Association of Governments.

Northern Virginia. To lessen the traffic morass along the I–95/395/495 corridor from Fredericksburg, VA, to Washington, DC, transportation officials are exploring innovative solutions such as dynamic ridesharing. A major impetus for this project is to mitigate traffic impacts associated with the U.S. Department of Defense's base closure and realignment actions in the region. The process of reorganizing military installations involves job relocations and related roadway construction projects that are adding traffic to already jammed highway corridors.

The dynamic ridesharing project in northern Virginia, funded in part through the VPPP, includes a range of cash incentives to attract both drivers and riders. The project, focused on seven employment sites related to base closure and realignment along the I–95/395/495 corridor, aims to recruit 500 drivers and 1,000 riders for a 6-month pilot. As of April 2013, 400 individual users had participated.

Dynamic ridesharing software, coupled with GPS-enabled smartphones, facilitates finding and executing ride matches, tracking and recording journeys, and transferring money automatically. The money transfer is mostly from riders to drivers, although riders receive "credits" to spend before having to contribute their own funds.

The prevalence of slugging in northern Virginia, especially around the Pentagon, has familiarized the public, and particularly local employees of the military, with the benefits of dynamic ridesharing. Despite this familiarity, however, the project team had to overcome substantial challenges unique to operating at secure military facilities, such as site access and barriers to communication with prospective and current participants. The team overcame these challenges by establishing relationships with senior military personnel.

"We have proven that we can make this work with the military," says Mark Gibb, executive director of the Northern Virginia Regional Commission. "The lessons learned about the technology, how to reach critical mass quickly, and ridesharing in general have been building blocks for better execution [of] a full-fledged program militarywide [and] regionwide…in northern Virginia."

Austin, TX. The Texas Department of Transportation and the Central Texas Regional Mobility Authority are partnering to conduct a VPPP project in Austin to evaluate ways to reduce the impact of heavy tollroad traffic on non-tolled roads downstream. The FHWA-funded pilot includes incentives to attract drivers and riders to participate in a 12-month pilot. The project seeks to recruit participants who travel the tolled 183A and Manor Expressway, as well as non-tolled roads in the corridor. Candidate facilities include U.S.183, I–35, and Loop 1/MoPac Expressway. Three major employment centers are likely destination clusters located downstream: the Northwest Technology

A ridesharing member of the military enters a vehicle in the Rosslyn neighborhood of Arlington, VA, for his evening commute. *Photo: Marc Oliphant, Department of the Navy.*

Center, the Arboretum at Great Hills, and downtown Austin, including the University of Texas at Austin.

The project will recruit 500 participants through targeted surveys asking for feedback on the use of toll discounts as an incentive to encourage driving on tolled roads during non-peak hours. The program also will test a real-time ridesharing application accessible through mobile and desktop devices. The program will dynamically match potential rideshare partners and provide toll-road rebates as an incentive.

The Texas A&M Transportation Institute will lead the evaluation. If successful, the project will be the first to both verify and execute high-occupancy toll discounts electronically.

Contra Costa County, CA. The ridesharing project on Contra Costa County's I–80 builds on an existing project that is locally funded to engage employers located near Bay Area Rapid Transit stations in the county. The project extends the coverage of a preexisting pilot to provide discounted tolls—and faster trips—for carpools with three or more participants crossing one or both of the two tolled bridges in the corridor.

This VPPP-funded project aims to curtail the heavy traffic congestion on I–80 by deploying real-time ridesharing in a corridor with a history of casual carpooling. Some employers in the area already engage in ridesharing efforts. In addition, the corridor provides substantial backup transit service, including several Bay Area Rapid Transit stations, bus transfer facilities, and park-and-ride lots.

Partnering with Small Businesses

USDOT's Small Business Innovation Research Program focuses on stimulating technological innovation while partnering with small businesses to meet Federal research and development needs to enhance the transportation system. As part of this program, in April 2011 FHWA awarded a contract (modified in October 2011) to Axiom xCell, Inc., to plan and conduct detailed preliminary design for a dynamic ridesharing system app in partnership with the San Diego Council of Governments and privately owned iCarpool. To enhance travel options and reduce congestion, the city's council is searching for new approaches to verify vehicle occupancy on its I–15 HOT lanes. A dynamic ridesharing system app could provide for a

A Note on Safety

Organized dynamic ridesharing systems can use a number of protocols to help ensure user safety. Most require a credit card number, personal recommendation, or affiliation with a larger group, such as an employer or university. However, operators of these systems need to balance safety provisions with ease of use. For example, unrealistic barriers to entry, such as lengthy background checks, could prevent a dynamic ridesharing program from getting off the ground.

Despite safety provisions, a ridematching service can only provide recommendations. The final decision to share a vehicle rests with the ridesharers.

verified and automated declaration of occupancy. When two individuals are confirmed by the electronic system as sharing a ride, which also is arranged by the system, the app automatically declares occupancy.

As part of the first phase of the project, the company and its partners wrote a concept of operations and a commercialization report. The latter concluded that there is potential for widespread use of a dynamic mobility app, developed perhaps in partnership with automakers, distributed through public agency programs (such as regional ridesharing agencies), and initially deployed with the support of large employer partners. Phase two will include development of a working prototype of the app, verification testing, and pilot testing in the San Diego region.

Integrating with Transit

FTA is addressing dynamic ridesharing through its Integrated Dynamic Transit Operations bundle of applications, an initiative jointly supported by the agency and the USDOT Intelligent Transportation Systems Joint Program Office. One of the applications includes a real-time method for connecting drivers with riders. In April 2013, the initiative brought in the Battelle Memorial Institute to develop a prototype and perform a demonstration of a dynamic ridesharing app that will enable drivers and riders to communicate electronically. The technology also will enable connections to other modes of travel, such as transit, if needed to complete the trip.

The application will use invehicle interfaces and hand-held devices. These innovations make this app differ from the existing technology, which uses mobile phone apps only. Combining existing mobile ridesharing applications with invehicle technology solves a number of problems associated with carpooling. For example, using a hand-held device to communicate ridesharing needs is fine for passengers but could lead to distracted driving for drivers because of the devices' hands-on nature. By integrating ridematching functions into a vehicle's onboard computer, voice-activated technology will enable drivers to find and accept potential ride matches along their routes with less diversion of their concentration from the roadway.

The project will develop requirements, architecture, and software in 2013 and then build and conduct component and field testing by spring 2014. Ultimately, it remains to be seen if an entirely new system, built from the ground up and utilizing new technologies and social networking tools, can yield comparable or even better results than the existing organic dynamic ridesharing systems.

Creating a Virtual Transportation Market

In 2010, FHWA's EAR Program initiated another dynamic ridesharing project, called Engineering Tomorrow's Transportation Market. A multidisciplinary team at the University of Southern California, with participants from the fields of operations research and computer science, are conducting the project, which aims to determine whether the market for dynamic ridesharing can be enlarged and generalized.

Rather than establishing fixed pickup and dropoff locations for ridesharing, the rise of smartphones offers the possibility of a virtual market where drivers and passengers can rapidly negotiate pickups and dropoffs anywhere—for a mutually beneficial price. The EAR project team is modeling and simulating potential demand to determine how the market might work (and what kinds of support it would require), how pricing would happen, and what the impact might be on travel by transit and personal vehicle.

The project is employing a variety of advanced computational

Ron Boenau, FTA

Ride seekers at this park-and-ride in Springfield, VA, are queued up for rides into Washington, DC.

algorithms and techniques to explore how prices could be set fairly and efficiently in such a market, how the market could absorb effects such as trip diversions for pickup or dropoff, and how it might be feasible for a driver to pick up two or more passengers on the same trip. The simulation also explores how fast the real-time market system would have to work, the lead time that a driver or potential passenger might need to participate, the marginal cost for the driver who is picking up passengers, and how competition between drivers might alter the market prices. In addition to simulating and projecting the performance of such a market, the project team also is exploring possible impacts that the market might have at a regional level. The project is set to conclude in late 2013.

Seeding the Revolution

Dynamic ridesharing has the potential to substantially reduce peak-hour congestion by making it easy and beneficial for riders and drivers to fill the empty seats in commuting vehicles. Various USDOT efforts aim to expand existing dynamic ridesharing systems within their current service areas and add service to additional cities and regions. Smartphone-based apps, combined with carefully designed incentives, could help expand and sustain dynamic ridesharing, especially in areas with existing HOV or HOT lanes.

"As more and more Americans adopt smart mobile devices—and as traffic volumes continue to rise—interest in dynamic ridesharing as a safe, convenient, and beneficial travel option is likely to grow," says Arnold.

Polly Trottenberg, Under Secretary of Transportation for Policy, agrees and underscores USDOT's commitment to supporting the practice. "Ridesharing is a key tool to help alleviate congestion on our roads and highways—it's good for communities, the environment, and overall quality of life," she says. "The [U.S.] Department of Transportation will continue to support State and local agencies that are using this simple but effective means to improve mobility."

Mark Burris, Texas A&M University

A ride seeker enters a vehicle at the Northwest Station Park & Ride in Houston.

Marc Oliphant is the regional employee transportation coordinator for the Department of the Navy, Naval District Washington. He studied at Brigham Young University and Virginia Tech and wrote his master's thesis on dynamic ridesharing.

Allen Greenberg is a senior policy analyst with FHWA's Office of Operations. Greenberg manages projects under the VPPP and Urban Partnerships program, focusing on usage-based auto insurance, variable and transparent demand-based parking pricing, and new forms of vehicle-use pricing and services (including carsharing, electric bicycle sharing, and priced dynamic ridesharing). He has a B.S. from Carnegie Mellon University in public policy and management and psychology, and a master's in urban planning from the University of Virginia.

Ron Boenau is a senior transportation systems manager for the connected vehicle program in FTA's Office of Mobility Innovation. Boenau focuses on intelligent transportation systems, automated vehicles, and standards. He has a B.S. from the University of Florida and an M.S. from the University of Maryland. He is an active slug line user in Washington, DC.

Jeremy Raw, P.E., is a travel modeling and analysis specialist in FHWA's Office of Planning. He focuses on research, development, and deployment of improved analytic techniques to support metropolitan and State transportation planning. Raw holds degrees in engineering from Cooper Union and regional planning from the University of North Carolina at Chapel Hill.

For more information, contact Marc Oliphant at 202-685-8049 or marc.oliphant@navy.mil, Allen Greenberg at 202-366-2425 or allen.greenberg@dot.gov, Ron Boenau at 202-366-0195 or ronald.boenau@dot.gov, or Jeremy Raw at 202-366-0986 or jeremy.raw@dot.gov.

Predicting the Future?

by Lew Villotti and W. Kirk Brethauer

A Pennsylvania MPO takes the mystery out of scenario planning and the growth projections used by transportation agencies.

Who can predict the future? Whether designing an improvement to an intersection, identifying potential transit routes, or developing freight corridors, planners need to forecast the future. Although sometimes predictions such as these may resemble more art than science, they really are a bit of both.

Base data can help determine the needed capacity of the intersection, headways (times between bus or train arrivals) for the transit route, or the future need for freight movement in the corridor—all to ensure that the facilities have the ability to serve the public's needs down the road. When looking forward, designers of these facilities need to

Communities in southwestern Pennsylvania used the scenario planning process to develop a vision scenario that prioritizes investments in revitalization and redevelopment of existing infrastructure, including central business districts like this one in Beaver, PA. *Photo: Thomas P. Straw, Southwestern Pennsylvania Commission.*

This aerial photograph shows Southside Works, a redevelopment of a former brownfield site in Pittsburgh, PA. Brownfield redevelopment is one of the key regional policies that came from an MPO's scenario planning for southwestern Pennsylvania.

Mattucci Photography and Graphics, Southwestern Pennsylvania Commission

predict the future number of vehicles, the potential ridership, or the number of freight containers.

How fast will the surrounding area grow? What types of growth will occur? What steps do planners take to estimate future needs? Here is where scenario planning can play an important role.

Scenario Planning

In the early years of developing growth projections, they were almost purely developed using straight-lined trending. That process involves simply carrying the most recent past trends from the current situation to some point in the future, using an annual growth factor. Although accurate in the near term, the overall usefulness of this approach over time was dependent on duration and stagnation. The farther from the origination date, the less accurate the projections became, because the important input variables changed, instead of staying stagnant, and their ability to maintain accuracy degraded.

Modelers compensate for this problem by developing more reactive policy models that allow for policy changes, thereby altering the outcomes computed by the models. In recent years, as the use of policy models gradually became more commonplace and the models became better able to capture changes in policy, the use of scenario planning in regional transportation planning also began to take hold. As the policy models became more sophisticated, they became able to distinguish the outcomes of different future scenarios.

A scenario is essentially a story about the future that helps people understand the forces of change and the collective choices they have. Scenarios show alternative futures by using maps, pictures, and text that illustrate different projections of future conditions that could occur as a result of varying policy choices. By associating diverse policies with different scenarios, a planner can visualize anticipated outcomes of future alternatives so that policymakers and the public can react in the present.

Scenario planning integrates policy models with geographic information systems (GIS) to form a powerful tool. It not only helps decisionmakers evaluate alternate policies but also assists planners in predicting future conditions and growth by connecting policies to future land use patterns. Before adding GIS, policy models could show numbers only. With the geographic element added, the models could depict variant land uses.

As Fred Bowers, a transportation planner with the Federal Highway Administration's (FHWA) Office of Planning, Environment & Real Estate, states, "FHWA considers scenario planning an enhancement to, not a replacement for, the traditional planning process. We are committed to advancing scenario planning through workshops, webinars, and research. We support other Federal, State, and local agencies in their scenario planning efforts, and we will continue to help communities solve problems through scenario planning workshops tailored to meet their needs."

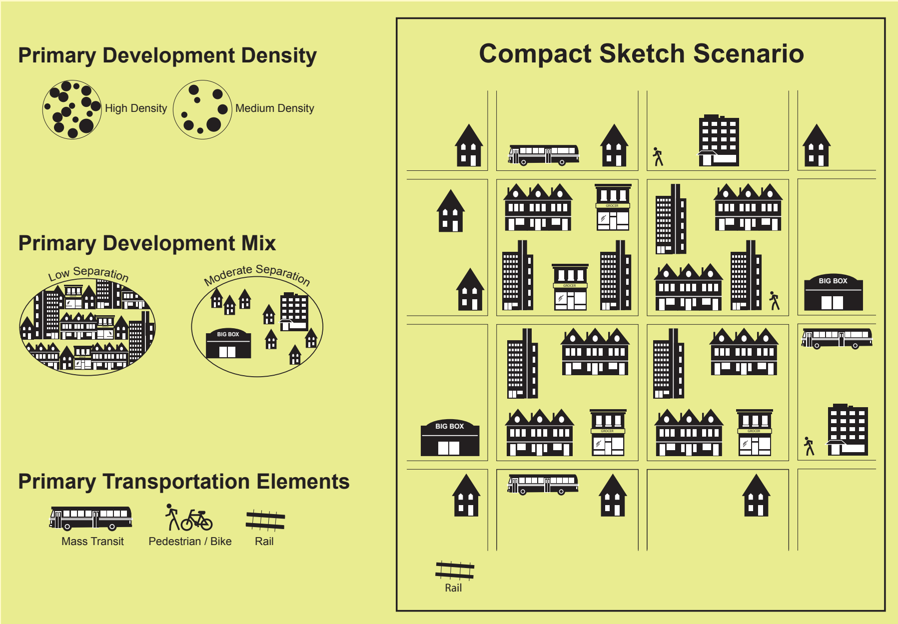
At the forefront of forecasting through the use of scenario planning are metropolitan planning organizations (MPOs).

Who Does It

When the U.S. Congress passed the Federal-Aid Highway Act of 1962, the new law required the formation of an MPO for any urbanized area with a population greater than 50,000. In a metropolitan area with more than 50,000 people, the responsibility for transportation planning lies with the MPO designated for that city.

As the organizations responsible for planning metropolitan transportation, MPOs examine travel patterns in their regions and couple that analysis with a review of demographic and economic conditions to identify transportation issues and needs within their jurisdictions. This long-range planning includes an analysis of alternatives to meet projected future demands, while providing a safe and efficient transportation system to ensure mobility without creating adverse impacts on the environment. For many MPOs, this planning process includes the development of forecasts and growth projections for population, housing, and employment.

Federal- and State-mandated programs use regional and subregional socioeconomic estimates and



This sample sketch scenario for southwestern Pennsylvania depicts the density and mix of development and transportation system elements associated with a compact development scenario. *Source: SPC.*

projections developed by modelers to support long-range transportation plans and shorter range transportation improvement programs. In addition, modelers use the forecasts for other critical aspects of the planning process, such as air quality modeling, land use plans, and environmental justice analyses. Aside from the planning process, MPOs and transportation agencies often use the growth projections in project-specific planning, design, and evaluation; program design and evaluation; and program implementation. Integrating growth projections with scenario planning enhances all of these efforts.

Richard J. Hoch, Ph.D., AICP CEP and assistant professor in the Department of Geography and Regional Planning at Indiana University of Pennsylvania, considers scenario planning to play a critical role in the planning process. "Developing land use plans or environmental impact assessments requires the use of scenario planning," he says. "Scenario planning legitimizes the process in a way that is acceptable to professionals and understood by the public."

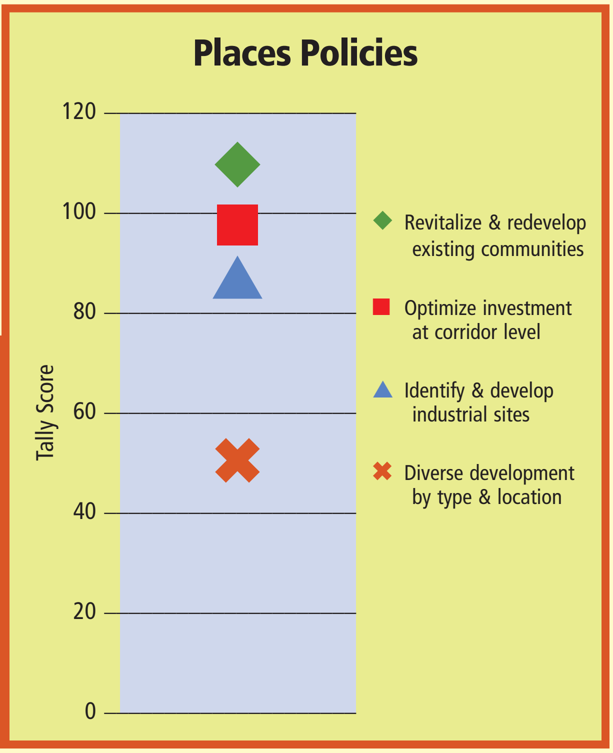
Case Study in Scenario Planning

In the summer of 2007, the MPO for the 10-county metropolitan region surrounding Pittsburgh, PA—the Southwestern Pennsylvania Commission (SPC)—adopted a transportation and development plan that was the culmination of a scenario planning process known as Project Region. Reviewing the history of this process provides an illustration of how scenario planning is done.

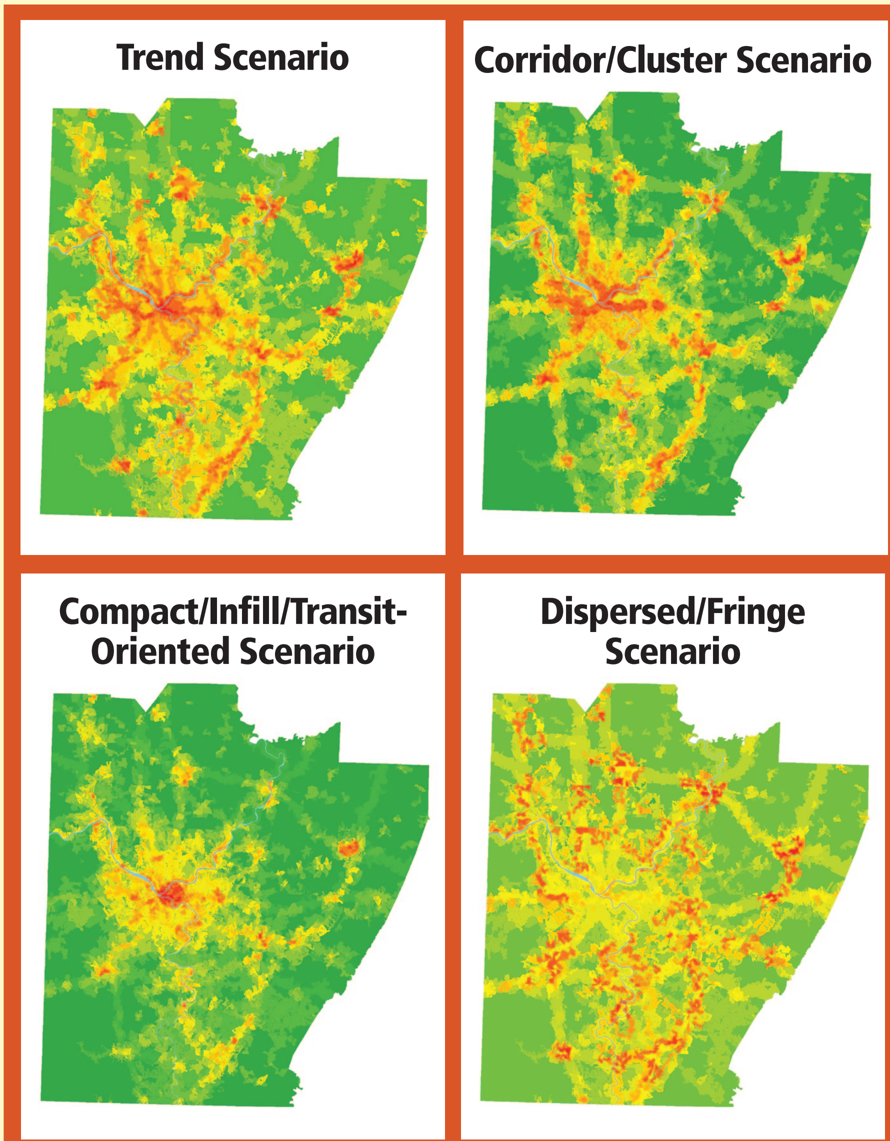
SPC's Project Region involved a set of organized activities to help the 10 counties of southwestern Pennsylvania work together to develop a regional consensus on a growth plan. To achieve this consensus and the most effective strategies for the future, Project Region used analytical tools, community involvement, and scenario development. The SPC members designed the Project Region process to maximize regional assets and infrastructure to achieve balanced, cost-effective growth; capitalize on investments in existing communities; and strengthen quality job creation and regional economic competitiveness.

The SPC members relied on FHWA throughout the planning process. The members started by reviewing past State, regional, and local plans to identify recurring themes and perspectives. They sought to develop a set of core common themes as the basis for initial policy statements. By developing these common themes through information provided in past plans, SPC was able to demonstrate that these policy statements had a direct lineage to past public feedback.

Through this process, the SPC members prepared close to 40 draft policy statements. An example is "Encourage the redevelopment of brownfields." The members further refined these statements and, when appropriate, combined and grouped them as the basis to begin scenario development. Through these statements, SPC sought policies to guide investment that would influence future growth patterns.



In its scenario planning, SPC used value ladders to show the policy statements that the participants in the planning process considered most important or of greatest value to the region. Shown is the value ladder for policy statements on places. *Source: SPC.*



Shown here are GIS spatial representations of the Trend Scenario, Corridor/Cluster Scenario, Compact/Infill/Transit-Oriented Scenario, and Dispersed/Fringe Scenario for the SPC region. *Source: SPC.*

The Next Steps in Scenario Planning

In a 2005 report funded by FHWA and titled *Integrating Land Use Issues into Transportation Planning: Scenario Planning*, Keith Bartholomew, an assistant professor at the University of Utah, summarized several of the common components and variables included in many exercises in transportation and land use scenario planning. Bartholomew's research showed that four of the most common components or variables used in scenario planning are the location, density, and mix of development, and the elements of the transportation system.

Through a series of workshops and larger partner meetings, and through facilitated group discussions, SPC was able to establish the participants' general preferences in terms of common scenario components. Using Bartholomew's concepts as the basic building blocks, SPC developed six sketch scenarios. Instead of running full-blown scenarios, SPC developed simple variant scenarios without having to do model runs. Sketch scenarios enable the modelers to assess rapidly which ones should be run in more depth.

To assist in this discussion, SPC assigned its draft policies to the six sketch scenarios. The SPC facilitators gave participants an opportunity to review all of the draft policy statements and then rank them in order of importance, developing what is called a value ladder. This value ladder is critical to the process, as it helps participants see which policies have "value" and remain consistent, not only in the sketch scenario process but also in the entire scenario planning process.

The facilitators then helped the participants narrow the six sketch scenarios down to four scenarios, either through combination or elimination. The discussion groups labeled the scenarios the Trend Scenario, Corridor/Cluster Scenario, Compact/Infill/Transit-Oriented Scenario, and Dispersed/Fringe Scenario.

The Trend Scenario depicted what the region would look like if existing patterns of investment were to continue.

The Corridor/Cluster Scenario showed what the region would look like if the patterns of investment focused development in and along defined transportation corridors and clustered it around access nodes such as highway interchanges or transit stations.

The Compact/Infill/Transit-Oriented Scenario represented a future where investments would be assigned solely around existing older communities with transit as the primary transportation mode.

The Dispersed/Fringe Scenario adopted investment policies that favored new highway development and investment in infrastructure in low-density areas throughout the region.

Each of the four scenarios maintained a distinct theme such as focusing on corridors, compact development, or dispersed development. The themes are critical in the end because what is being evaluated are the differences between the scenarios.

Each of the four scenarios placed a different emphasis on specific policy statements. For example, if a policy stated that improving transit would be a primary focus of the region, that policy would receive more emphasis in a Compact/Infill/Transit-Oriented Scenario than it would in a Dispersed/Fringe Scenario. The four scenarios depicted not how much the region would grow, but how and where that growth would take place.

At this point scenario planning supplements traditional growth forecasting with important new information. SPC used traditional regional

Thomas P. Straw, SPC

A priority outcome of the scenario planning process was to invest in a transit system that will connect people with resources throughout the entire region. This light-rail stop is in Pittsburgh.

and subregional policy models to develop straight-line population, housing, and employment numbers for each scenario. Then, SPC used an in-house allocation model in combination with the scenario development models to allocate residential and employment growth by traffic analysis zones down to the block level.

Each projection depended on the block's attractiveness measures as associated with the policies of a given scenario. For example, a given block might have a transit station yet have poor highway access. In a scenario based on policies that place a greater emphasis on transit, this block will "attract" more residential and employment growth than a scenario with policies that place a greater emphasis on highway access. The key to effective scenario planning is the ability to show those differences in a meaningful way.

By using scenario planning software, SPC presented approximately 40 variables as performance indicators for each of the chosen scenarios and showed how those variables would differ depending on the scenario. Working with all 40 variables could become confusing, so the facilitators again gave the partners in the planning process the opportunity to choose which variables were most important to them. The participants selected the following six variables:

- Density of development
- Amount of land developed
- Households close to highway interchanges
- Households close to transit stops
- Regional travel as depicted by regional daily vehicle miles traveled
- Cost for basic infrastructure

After choosing these variables, the participants reviewed the four scenarios and discussed the pros and cons of each development pattern for their own local community and for the region as a whole.

To afford the public and policymakers a way to assess these differences easily, SPC used GIS technology and scenario planning software to depict visually how the different scenarios and policy emphases would affect the region and show how and where it would grow.

It is important to emphasize that these scenarios would not predict the specific outcome of a given scenario but would instead highlight the differences resulting from investment policy decisions. The scenario process does not predict the future; rather, it shows the potential differences among alternative futures.

Impacts on Growth Patterns

Each of the scenarios would have different impacts on the region's growth patterns. For example:

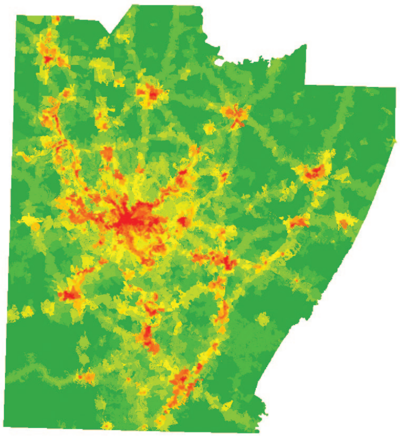
The Dispersed/Fringe Scenario has a lower density development pattern, with development occurring outside the urban cores. The transportation focus is primarily highway-oriented with transit and transit accessibility playing little-to-no role. This scenario would require the expansion of infrastructure, including water and sewer utilities, to previously unserved areas.

The Compact/Infill/Transit-Oriented Scenario has high-density development with a mix of uses and development targeted within or adjacent to core communities.

These housing units represent an example of the kind of newer medium-density residential development being built in the suburbs. A desire to increase the density of newer suburban housing was one of the outcomes of the scenario planning process.

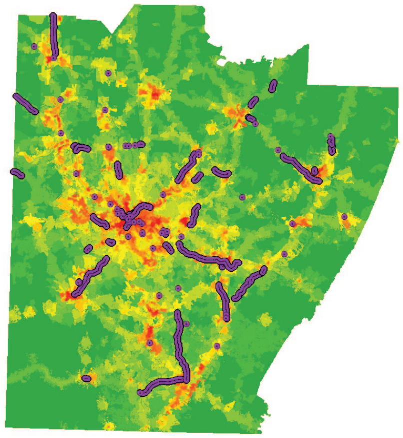
Thomas P. Straw, SPC

Vision Scenario



Source: SPC.

Vision Scenario With Potential Transportation Projects



Source: SPC.

This GIS spatial representation of SPC's vision scenario is the final rendering adopted as part of the region's 2035 Transportation and Development Plan.

Shown here are potential transportation projects overlaid on the vision scenario to evaluate their consistency with the adopted scenario.

This scenario would take advantage of opportunities for infill development, would reinvest in existing business districts, and would rehabilitate brownfields. In rural areas, preservation of open space would be key. This scenario would be more pedestrian oriented and rely strongly on public transportation. Expansion of existing utilities to accommodate new growth would be minimal.

The Corridor/Cluster Scenario features medium- to high-density development in centers, clusters, and transportation corridors with a strong multimodal focus, including highways, transit, railways, and waterways. This scenario has excellent access to the urban core with improved transportation operations. Expansion of water and sewer infrastructure would occur along established corridors.

The Trend Scenario is simply the continuation of existing development patterns and policies.

The SPC next developed scorecards to capture the statistical differences between the performance indicators (the six variables listed above) that were considered important through the public process. Participants in the planning process were able to use the statistical and spatial information to help them consider what the region might look like in the future. Using this information, the participants, partners, and regional policymakers were able to select a vision scenario and growth pattern for the region.

How to Use Scenario Planning

Forecasting a region's growth pattern through scenario planning is just the beginning. As previously mentioned, a scenario is essentially a story about the future that can help people understand the forces of change and the collective choices they have. Once participants and decisionmakers have made the necessary choices, it is important to ensure that future decisions are consistent with that preferred future.

Using the same techniques that were employed in developing the scenario, transportation agencies also can use the scenario planning process to conduct a geospatial and policy analysis for project evaluation and program implementation and development. This helps to ensure that current or future decisions are consistent with the preferred vision for the future. For example, by geographically comparing projects against the vision scenario, transportation planners can evaluate the consistency of a project or series of projects with that vision. Even more important, agencies can develop new programs or initiatives to advance the vision for the region.

For example, SPC's vision scenario looks to give all areas of the region access to transit. The growth pattern associated with the vision scenario seeks to place more households close to transit in an effort to help achieve that outcome. To promote that scenario, the region needed to look at efforts to advance transit-oriented development.

Through public and private initiatives taking place throughout the region, a number of transit-oriented projects are underway with the support of policymakers and the public. These projects, which seek to place residential and commercial development around transit nodes, are consistent with the policies and intent of the region's vision scenario and therefore are able to attract the needed funding.

In this era of limited resources, funding, time, and human capital, it is more important than ever that the correct decisions are made when they might impact the long-term future of a region. As the competition for these limited resources increases, a region must use all the tools available to help its policymakers with those difficult decisions. The ability to integrate scenario planning with growth and development forecasting is one of the most valuable tools in providing the needed information to make those decisions.

Lew Villotti is SPC's planning and development director. Prior to joining SPC, Villotti worked at the Michael Baker Corporation as a project manager. He holds a B.A. in urban affairs and an M.A. in geography and regional planning from California University of Pennsylvania.

W. Kirk Brethauer is SPC's information systems director in Pittsburgh, PA. Brethauer joined SPC in 1993 and developed its 10-county GIS to support all levels of transportation planning and economic development. Today, he manages SPC's geospatial analysis, Highway Performance Monitoring System, and information technology. He holds a B.S. in planning and GIS from Pennsylvania State University.

For more information, contact Lew Villotti at 412-391-5590, ext. 302, or lewvillotti@spcregion.org.

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.

Personnel

Anthony Foxx Takes Reins as Secretary of Transportation

On July 2, 2013, Charlotte, NC, Mayor Anthony Foxx was sworn in as the Nation's 17th Secretary of Transportation by Judge Nathaniel Jones at U.S. Department of Transportation headquarters in Washington, DC. The U.S. Senate unanimously confirmed Foxx as the next Secretary of Transportation on June 27.

USDOT

Anthony Foxx was sworn in as Secretary of Transportation by Judge Nathaniel Jones on July 2, 2013. Secretary Foxx's wife and children held the Bible for the ceremony.

Prior to his confirmation, Foxx served as the mayor of Charlotte from 2009 to 2013. During that time, he made investments in efficient and innovative transportation projects the centerpiece of Charlotte's job creation and economic recovery efforts. These investments included extending the LYNX light rail system, expanding Charlotte-Douglas International Airport, and starting the Charlotte Streetcar Project. Prior to being elected mayor, Foxx served two terms as an at-large representative on the Charlotte City Council, where he chaired the Transportation Committee.

Foxx is an attorney, starting after law school as a law clerk for Judge Jones for the Sixth Circuit of the U.S. Court of Appeals. In addition, he served as a trial attorney for the Civil Rights Division of the U.S. Department of Justice and as staff counsel to the U.S. House of Representatives Committee on the Judiciary.

Foxx received his law degree from New York University's School of Law as a Root-Tilden Scholar, the university's prestigious public service scholarship. He also earned a bachelor's degree in history from Davidson College.

Management and Administration

Administrator Mendez Helps Break Ground on Alabama Complete Streets Project

In May 2013, Federal Highway Administrator Victor Mendez joined Birmingham, AL, Mayor William Bell to kick off construction of the Enon Ridge Multimodal Corridor and Civil Rights Complete Streets project. Part of a citywide bicycle and pedestrian network, the project will connect neighborhoods in the greater Birmingham area.

The project is included in the city's Roads to Recovery initiative, which includes seven projects that support multimodal transportation. Using the complete streets approach to project planning, the initiative designs streets to accommodate all users—motorists, pedestrians, bicyclists, transit riders, and people of all ages and abilities—to enable them to move around the community safely.

Initiated to assist in Birmingham's recovery from the devastating April 2011 tornado, Roads to Recovery will create a 34-mile (54-kilometer) regional transportation network with improved and new bicycle trails and sidewalks. The network will better connect 250,000 residents to public transit, employment centers, retail districts, hospitals, and other facilities. Specifically, the Enon Ridge and Civil Rights segment consists of nearly 4.5 miles (7.2 kilometers) of complete streets that will connect to some of the area's largest employers in downtown Birmingham.

Technical News

Alaska to Improve Safety on State Highways

Alaska Governor Sean Parnell, Commissioner Patrick Kemp of the Alaska Department of Transportation & Public Facilities, and Alaska Public Safety Commissioner Joe Masters recently announced that the State will take significant steps to improve safety on Alaska's highways. The improvement program emphasizes implementation of suggested strategies included in the Strategic Traffic Safety Plan and provides intermediate steps to improve safety as major projects are built incrementally.

The program advances an intelligent transportation system that includes an operations center for highway safety and integrates real-time speed and weather sensors, message boards, and systems for avalanche detection. The system will expand upon the Alaska 511 traveler information system to ensure that information is available around the clock to travelers, department of transportation (DOT) personnel, law enforcement, and emergency medical services.

Alaska has designated four safety corridors along sections of Seward Highway, Parks Highway, Sterling Highway, and Knik-Goose Bay Road to emphasize these improvements. Serious crashes are down 53 percent within these corridors due to ongoing activities focused on education, enforcement, engineering, and emergency response services.

The department began implementing improvements along the Seward Highway between Potter Marsh and Turnagain Pass, south of Anchorage, in summer 2013. Five additional slow-vehicle turnouts are being constructed

Motorists driving south from Anchorage on the Seward Highway pass through this highway safety zone, one of four designated safety corridors in Alaska. *Photo: Scott Thomas, Alaska Department of Transportation & Public Facilities.*

along the highway at mileposts 75, 76, 108, 111, and 115. Also, passing lanes are being constructed at mileposts 68, 71, and 95. Guardrail work and modification of the roadway alignment at milepost 88, which is a high-crash location, also started in summer 2013.

In addition, the Alaska Department of Public Safety will procure two 3-D laser instruments for measuring and mapping crash scenes quickly and accurately to help reduce the duration of highway closures during crash investigations.

Alaska Department of Transportation & Public Facilities

Public Information and Information Exchange

NOYS Celebrates Global Youth Traffic Safety Month

Traffic crashes are the leading cause of death for youth in the United States. In May, the National Organizations for Youth Safety (NOYS) held the kickoff event for Global Youth Traffic Safety Month in Washington, DC. NOYS is a partnership consisting of more than 70 national, youth-serving organizations in the nonprofit, business, and government sectors. All participants come together to promote safe and healthy behaviors among the Nation's young people.

As part of the launch events, the group hosted a rally followed by The Long Short Walk—a worldwide walking and bicycling initiative to raise awareness of youth traffic safety. The Long Short Walk was held in honor of Zenani Mandela, Nelson Mandela's great-granddaughter, who was killed in a crash. Former Transportation Secretary Ray LaHood, National Highway Traffic Safety Administrator David Strickland, National Transportation Safety Board Chair Deborah Hersman, and Kweku and Ndaba Mandela—Nelson Mandela's grandsons—attended the event.

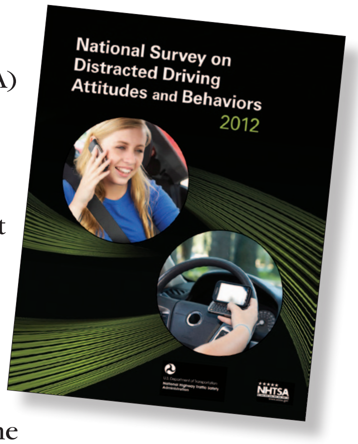
For more information, visit www.noys.org or www.mylongshortwalk.org.

American Association of State Highway and Transportation Officials

NOYS

Former Transportation Secretary Ray LaHood speaks at an event in Washington, DC, celebrating Global Youth Traffic Safety Month.

NHTSA Survey Finds 660,000 Drivers Using Mobile Devices



The National Highway Traffic Safety Administration (NHTSA) recently released survey results showing that Americans continue to use electronic devices while driving, despite warnings that it causes their own driving to deteriorate and can lead to crashes, injuries, and even death. NHTSA released the data in April 2013 at the start of National Distracted Driving Awareness Month. The data include statistics from the 2012 *National Survey on Distracted Driving Attitudes and Behaviors* (DOT HS 811 729), the 2011 National Occupant Protection Use Survey on Driver Electronics Use, and the Fatality Analysis Reporting System (FARS).

The 2011 National Occupant Protection Use Survey shows that at any given daylight moment across the United States, approximately 660,000 drivers are using cell phones or electronic devices while driving, a number that has held steady since 2010. Separate NHTSA data indicate that more than 3,300 people were killed in 2011 and more than 387,000 were injured in crashes involving a distracted driver.

According to NHTSA's 2012 *National Survey on Distracted Driving Attitudes and Behaviors*, most drivers support bans on hand-held cell phone use (74 percent) and texting (94 percent) while driving. So far 41 States plus the District of Columbia, Guam, Puerto Rico, and the Virgin Islands ban text messaging for all drivers. In addition, 10 States, the District of Columbia, Guam, Puerto Rico, and the Virgin Islands prohibit all drivers from using hand-held cell phones while driving.

NHTSA researchers interviewed more than 6,000 respondents age 16 and older by phone for the survey. Almost half of drivers said they answer an incoming call, and one in four drivers is willing to place a call on all, most, or some trips. Considering that in 2011 there were almost 212 million licensed drivers in the United States, an estimated 102 million drivers were answering calls and 50 million drivers were placing calls while driving.

For more information, download the full report at www.nhtsa.gov/staticfiles/nti/pdf/811729.pdf.

NHTSA

Maryland Reports on Biological Controls for Invasive Species

The Maryland State Highway Administration (SHA) recently released a report on use of biological controls to manage noxious and invasive weeds on highway rights-of-way. The report, *Development of Biological Agents for Invasive Species Control* (MD-13-SP009B4T), describes biological controls, such as use of beneficial insects, as a sustainable and cost-effective method for reducing the spread of invasive plants.

Noxious and invasive weeds can easily colonize disturbed areas, outcompeting and displacing native and other desirable vegetation. The result is often a loss of pollinators critical to plant reproduction, such as birds, bees, and other insects that move pollen between plants. Other impacts include diminished food and nesting resources for wildlife, as well as decreased biodiversity in general. Where invasive plants establish monocultures—the growth of only one plant species—and where highway agencies must employ remedial management, winter cover can be lost and soils destabilized. This can reduce the filtering quality of wetlands and increase siltation, the pollution of water by fine dirt, sand, or clay.

SHA spends more than $300,000 per year purchasing herbicides to control exotic weeds. This figure does not include administrative, labor, equipment, and fuel costs.

SHA

Invasive weeds, such as this purple loosestrife, can displace native vegetation along highways.

Current practices include herbicide use and mowing, which can cause even further disturbance and perpetuate the cycle of colonization by invasive plants.

A research team at the Maryland Department of Agriculture released two beneficial beetles at strategic locations to control purple loosestrife and mile-a-minute weed, two invasive plant species. The team then monitored the effects on weed populations over the course of two growing seasons. The researchers found that the impact of the beetles varied and would not eliminate the invasive plants, but could help reduce their spread to new areas.

For more information and to download the report, visit www.roads.maryland.gov/OPR_Research/MD-13-SP009B4T_Development-of-Biological-Agents-for-Invasive-Species-Control_Report.pdf.

SHA

Internet Watch

by Kate Sullivan

Bringing Sustainability to Highway Evaluation

Transportation agencies must balance a number of objectives, including safety, asset management, environmental protection, and mobility. A sustainable approach attempts to meet all of these needs while maintaining cost-effectiveness throughout a highway's life cycle. For the Federal Highway Administration (FHWA), a sustainable approach means helping stakeholders improve social, economic, and environmental outcomes—the "triple bottom line" of sustainability—that will benefit communities now and in the future.

In 2008, FHWA began developing the Infrastructure Voluntary Evaluation Sustainability Tool (INVEST), a free, Web-based collection of best practices designed to help transportation agencies bridge the gap between sustainability concepts and sustainability in practice as it applies to transportation and highways. INVEST can help State departments of transportation (DOTs), metropolitan planning organizations, councils of government, public works departments, and consultants to integrate best practices into their programs and projects.

At the launch of INVEST 1.0 in October 2012, FHWA Deputy Administrator Greg Nadeau said, "the INVEST tool is designed so that everyone can use it." The software, he added, is "customized and flexible to allow [users] to… meet [their] own sustainability goals and needs."

Version 1.0 followed beta and pilot test versions released in 2010 and 2011, respectively. Nineteen transportation agencies tested and evaluated the tool's pilot versions, and version 1.0 features substantial enhancements based on that testing as well as comments from subject matter experts and associations.

Learn, Browse, Score

When users log onto INVEST's home page located at www.sustainablehighways.org, they find announcements and a description of the tool, as well as three buttons:

- *Learn*, which links to a guided tour of the INVEST Web site, offers information about sustainable highways and integrating sustainability best practices into projects and programs.
- *Browse*, a gateway to the complete set of INVEST criteria, enables users to scroll through lists of best practices they can use to evaluate the sustainability of projects and programs.
- *Score*, a link to the INVEST self-evaluation tool, enables users to access the software to begin assessing the sustainability of projects and programs.

The self-evaluation tool has three modules—System Planning, Project Development, and Operations and Maintenance—that agencies can use to evaluate sustainability.

INVEST includes 60 criteria across the three modules. Each describes a best practice and assigns a point value based on the relative impact on transportation sustainability. These criteria include highway and traffic safety,

pedestrian access, freight mobility, energy efficiency, and mitigation of construction noise.

Scoring requires answering questions that relate to specific practices. Agencies can use the overall score to determine their progress toward achieving more sustainable infrastructure, tracking integration of best practices into projects, and conducting stakeholder and community outreach. Further, they can use INVEST to consider sustainability options during the planning stages—enabling better quantifying of sustainability during decisionmaking—or to evaluate a completed project.

Framework for Discussion

"INVEST provides a framework for staff and management to sit down and look at projects through a sustainability lens and discuss areas that might be improved," says Tina Hodges, an environmental protection specialist on FHWA's Sustainable Transport and Climate Change Team.

One of INVEST's most popular tools—developed in response to feedback during the pilot testing—is a collaboration feature. Users can set up a workspace for a specific project where they can view its scoring. They can upload documentation that supports that score, and they can record action items. Several members of a group can access the workspace.

Hodges explains, "Users appreciate the ability to collaborate using a structured framework—for example, planners, engineers, and subject matter experts on stormwater and pedestrian access can work together to identify sustainability improvements across the agency's areas of work."

Overall, says Hodges, "Sustainability is a high priority for FHWA, and we're excited to have a tool that guides stakeholders through evaluating and improving the sustainability of their transportation projects and programs."

Kate Sullivan is a contributing editor for PUBLIC ROADS.

Training Update

by Candice Jackson

Cable-Stayed Bridges Provide Option for Long-Span Projects

Roughly 90 percent of bridges in the Unites States are girder bridges, which are often supported by multiple piers. If site conditions limit the locations where piers can be placed, designers might need to consider alternative bridge types that support longer spans.

One alternative is the cable-stayed bridge, which has one or more towers from which cables support the bridge deck. Cable-stayed bridges are a small subset of alternative bridge types, and many engineers involved in bridge projects have limited familiarity with them. However, continual advances in cable stay technology, such as greater structural efficiency, lower maintenance, and improved fatigue performance, are increasing its popularity. To close the education gap, the National Highway Institute (NHI) developed its course 130096 Cable-Stayed Bridge Seminar, which provides an introduction to the planning, design, and construction of cable-stayed bridges.

Guidelines Prompt Need for Training

After developing the award-winning reference document, *FHWA Design Guidelines for Arch and Cable-Stayed Signature Bridges* (FHWA-NHI-11-023), instructors at NHI recognized the need for training courses on this bridge technology. "This type of bridge has seen more applications in recent years than arch and suspension bridges and has proven to be viable for spans between 800 and 3,400 feet [244 and 1,036 meters]," says Joe Tse of Parsons Brinckerhoff, one of the seminar's instructors.

Because of the emerging popularity of this bridge type, transportation professionals needed to learn how to apply the design guidelines properly. NHI's 130096 Cable-Stayed Bridge Seminar was the first course developed based on the guidelines. The seminar provides an understanding of the overall process of designing and constructing a cable-stayed bridge.

"The course is designed to demystify this type of bridge," Tse says. "The objective is to prepare participants to become design coordinators or members of a design or review team for cable-stayed bridge projects."

The 1-day instructor-led training covers important features of cable-stayed bridges, construction and maintenance considerations that can affect the design, and lessons on the analyses needed to design this type of structure. Course content introduces principles involved in designing cable-stayed bridges without being overly theoretical. In addition to instructor-led presentations, discussions, and group activities, participants review a case study to help understand how to apply the curriculum to basic design decisions.

Texas Pilots Course

Several engineers from the Texas Department of Transportation's (TxDOT) Bridge Division attended a course pilot in Austin, TX, in March 2013. Currently, the State has only four cable-stayed bridges, so most participants had little to no experience working on this type of structure.

"Prestressed concrete girder bridges are the most common type of bridge used in Texas," says Dacio Marin III, a senior bridge design engineer with the TxDOT Bridge Division. "There are a few locations where the cable-stayed bridge would be more effective, and we were open-minded about learning more about this less common type of bridge."

According to Marin, "The section on basic proportions was very interesting, and the ideas presented would help to plan and estimate the budget for a potential project."

Jeff Tomkins, a bridge project manager with the TxDOT Bridge Division, also attended the course and brought his perspective as an engineer focused on project development and management. He found the course useful because of its attention to considerations involved in choosing this type of bridge over others.

"The course outlines the benefits of this type of bridge," Tomkins says. Further, it "explains where we would need to use this type of bridge and also lists drawbacks and things to expect during construction, including construction conditions that could drive the end product."

Both Marin and Tomkins agreed the course instructor was "excellent" and that the course presents new information at an appropriate level of complexity for engineers who have limited experience with cable-stayed bridges.

In addition to this one, NHI's Structures program offers more than a dozen courses ranging from bridge design to inspection. For more information about this course and other NHI training, please visit www.nhi.fhwa.dot.gov.

The Cooper River Bridge, shown here, connects Charleston to Mount Pleasant, SC, and is North America's longest cable-stayed bridge. *Photo: Sparky Witte.*

Candice Jackson is a contractor for NHI.

Communication Product Updates

Compiled by Lisa Jackson of FHWA's Office of Corporate Research, Technology, and Innovation Management

Below are brief descriptions of communications products recently developed by the Federal Highway Administration's (FHWA) Office of Research, Development, and Technology. All of the reports are or will soon 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 (PDC).

When ordering from NTIS, include the NTIS publication 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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For more information on R&T communications products available from FHWA, visit FHWA's Web site at www.fhwa.dot.gov, the FHWA Research Library at www.fhwa.dot.gov/research/library (or email fhwalibrary@dot.gov), or the National Transportation Library at ntl.bts.gov (or email library@dot.gov).

Recent International Activity in Cooperative Vehicle-Highway Automation Systems (Report)
Publication No. FHWA-HRT-12-033

During the past decade, the level of activity in cooperative vehicle-highway automation systems has increased significantly in Japan and Europe, while remaining relatively low in the United States. This report summarizes the current state of development with regard to these systems and highlights the latest thinking in other countries to help inform U.S. decisionmaking.

In Europe, perspectives differ between the organizations that approach cooperative vehicle-highway automation systems as automotive products and those that approach them as a means of improving public transportation. The former emphasize partial automation systems operating in mixed traffic, while the latter emphasize fully automated (driverless) vehicles in dedicated rights-of-way.

Researchers noted that the United States could develop a robust program in automated road transportation by building on its extensive experience and capabilities in automated road transport, its current areas of international leadership, and the knowledge being developed in other countries. Future actions could include conducting concept studies of automation applications to identify which could be most beneficial in addressing the Nation's transportation problems. Where synergies and potential benefits can be established, the United States could collaborate with the European and Japanese programs.

FHWA's Exploratory Advanced Research (EAR) Program supported development of this report under the technical supervision of staff with the Office of Operations Research and Development at the Turner-Fairbank Highway Research Center. Download the report at www.fhwa.dot.gov/advancedresearch/pubs/12033/index.cfm. Printed copies are available from the PDC.

Impacts of Technology Advancements On Transportation Management Center Operations (Report)
Publication No. FHWA-HOP-13-008

Technology advances in transportation management and operations, as well as in communications and computing technology, will undoubtedly make transportation safer and more efficient over the next decade. Transportation management centers (TMCs), which have been at the forefront of leveraging technology to manage transportation, are likely to see significant changes in the systems currently relying on real-time information processing. TMC managers are under increasing pressure to adapt rapidly to these changing technologies and public expectations for accurate, real-time travel information.

This report identifies and examines potential impacts on TMC operations due to projected technology advancements in the next 10 years. It offers practices, strategies, and tools for TMC managers to build internal, technological, and broad agency frameworks to use emerging technologies and related trends.

Intelligent transportation systems (ITS) and technological trends in the areas of communications, data management, connected vehicles, agency processes, control technologies, and traveler information could have a significant impact on TMC operations. Proliferation of wireless communication and the rise of social media enable an unprecedented understanding of the transportation network in real time that TMCs can leverage into increasingly sophisticated control strategies. At the same time, expectations for high-quality information about the transportation system are likely to increase as more travelers access personalized and user-friendly commercial information through apps on mobile devices.

With more detailed and varied data coverage across geographic areas, TMCs can draw upon a greater understanding of needs and conditions. By integrating with regional partners and developing new ways of using data, they can improve multimodal options, safety, and trip and network reliability with processes and systems that are increasingly automated. Third parties can be important partners in providing data to TMCs, developing innovative transportation analysis tools, and delivering traveler information to the public. This may enable TMCs to focus on transportation management and provision of information that private industry cannot offer. Flexibility will be important so agencies can adapt to changing roles and take advantage of new opportunities.

The report is available to download at www.ops.fhwa.dot.gov/publications/fhwahop13008.

Identification of Nondestructive Evaluation Needs for the United States Highway Infrastructure (Fact Sheet) Publication No. FHWA-HRT-13-056

In September 2012, FHWA's Office of Infrastructure Research and Development held a workshop to develop and prioritize a list of needs for the nondestructive evaluation of U.S. highway infrastructure. The workshop brought together experts in the fields of nondestructive evaluation and structural health monitoring, as well as professionals from Federal and State departments of transportation, academia, and industry. This document presents the list of priorities FHWA will use to determine new research and development activities to advance a strategic vision and roadmap for the program.

Workshop participants concluded that the vision and roadmap should enable FHWA's nondestructive evaluation program to enhance its early goals while guiding the nondestructive evaluation community in its efforts to improve the health, maintenance, and repair of infrastructure. The vision and roadmap should include objectives that assist the Long-Term Bridge Performance Program in its long- and short-term goals, and should provide methods to assist States, industry, and academia with nondestructive evaluation needs. Also, the vision and roadmap should include the ways and means to reach out to other industries to develop nondestructive evaluation tools for use on structural components, materials, and systems, while fulfilling the missions of FHWA and the U.S. Department of Transportation.

Technologies should address critical conditions and weaknesses in infrastructure that diminish the capacity of the transportation system and increase the risk of failure of bridges, pavements, and other structures that could decrease safety and mobility. The program should develop solutions, demonstrate their effectiveness, and partner with stakeholders to ensure proper training is available to implement them effectively.

This fact sheet features a list of 14 pressing needs for U.S. highway infrastructure. It is available to download at www.fhwa.dot.gov/publications/research/infrastructure/pavements/13056. Printed copies are available from the PDC.

Tomorrow's Transportation Market—Developing an Innovative, Seamless Transportation System (Fact Sheet) Publication No. FHWA-HRT-13-058


Tomorrow's Transportation Market
Developing an Innovative, Seamless Transportation System

Centralized transit systems and private vehicles make limited use of available and emerging real-time data to enhance overall capacity of the transportation system. The development of a decentralized system to supply transportation services to meet demands could provide an alternative solution that improves the efficiency of both transit and private vehicles.

This fact sheet discusses FHWA's EAR Program project, Engineering Tomorrow's Transportation Market, currently underway through a contract with the University of Southern California. The project aims to leverage emerging technologies that could advance a new type of decentralized transportation system to help meet U.S. congestion challenges.

Researchers believe an integrated system would place a value on idle and unused transportation resources and facilitate resource allocation in real time in response to shifting demand. A decentralized transportation system, or transportation market, could radically transform transportation systems by using resources more efficiently. Specifically, a transportation market could reduce congestion and pollution by increasing the average number of passengers per vehicle, make more transportation options available to consumers, and increase the number of transportation providers by facilitating entrance into the marketplace.

The system uses several emerging information technologies and focuses on growing information infrastructure and ITS development. Market providers, who could be public agencies or private vendors, will use the real-time information to dynamically price transportation options that form the basis of the market. As infrastructure and vehicles become equipped with more sensors, interconnected data systems, and onboard computers, a wealth of real-time data about traffic conditions will become available.

Researchers are developing a simulator with modules that replicate the transportation market and can model a future transportation system based on the market. Software will be open access so that other researchers and companies can use it as a basis for their own work and eventually for commercialization. FHWA is conducting several outreach activities, including conference participation and an invitational workshop with leaders in the field of dynamic ridesharing.

This document is available to download at www.fhwa.dot.gov/advancedresearch/pubs/13058/index.cfm. Printed copies are available from the PDC.

Celebrate International Walk to School Day

Michael Cynecki, Lee Engineering, LLC

Wednesday, October 9, 2013

WALK TO SCHOOL DAY

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U.S. Department of Transportation
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— John D. Porcari, Deputy Secretary of Transportation, U.S. Department of Transportation

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