

HARNESSING the power of INNOVATION

To Improve America's Driving Experience



Report on the Highways for LIFE Program



Foreword

The U.S. Congress established the Highways for LIFE program to help the highway community adopt proven innovations more quickly and use them more often to build highways and bridges better. Through the program, the Federal Highway Administration has developed more effective approaches to technology deployment, shared information with stakeholders who can benefit from innovation and supported them in successful innovation implementation.

This report tells the story of the Highways for LIFE initiative through the experiences of highway community stakeholders who have participated in it over the past several years. It describes how using proven marketing approaches and dedicated teams can move innovations into mainstream use faster and more effectively. It demonstrates how providing incentives and

training encourages highway agencies to use innovations and customer-focused performance goals to improve America's highway system. It shows how filling the funding gap between research and commercialization and fostering collaboration between private industry and public agencies can put promising innovations on a faster path to the marketplace, where they can benefit the traveling public.

The report is intended as a resource for all members of the highway community as they participate in the creation of a new business model for managing highway project delivery. It can help organizations—both public and private—embrace innovation use in ways that will improve service to America's drivers and value to its taxpayers.



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Legacy for the Future

◆ Executive Summary

America's highway system faces a significant challenge: an aging infrastructure, growing traffic volumes and limited resources—both staffing and funding—make the widespread use of innovation to meet customer needs essential. The Federal Highway Administration is addressing this challenge through the Highways for LIFE initiative, a pilot program the U.S. Congress established in 2005.

The Highways for LIFE initiative focuses on using proven marketing approaches and dedicated teams to deploy innovations faster and more effectively. It gives highway agencies incentives to try innovations to build highways and bridges. It helps private industry move promising innovations into the marketplace, where they can benefit the traveling public. And it provides the highway community with tools, techniques and training to create culture change in their own organizations. This report describes how FHWA, working with highway community stakeholders, has carried out the initiative.

Through the initiative's Vanguard Technologies effort, FHWA developed a technology deployment process that combines multidisciplinary teams,

marketing techniques and focused effort to move innovations all the way to full implementation. The process, field tested on five technologies, is designed to deploy technology quickly and efficiently so that years don't elapse between the time research is done and highway users benefit from an innovation. FHWA also created a training program and a guide to developing marketing plans that organizations are using to launch their own innovation deployment efforts.

Highways for LIFE has helped highway agencies try new approaches by offering incentive funding for construction projects that employ proven but little-used innovations to boost safety and quality while speeding construction and minimizing impact on travelers. Since fiscal year 2006, the program has provided incentives totaling more than \$55 million for 60 projects in 37 states, the District of Columbia and Puerto Rico that feature innovations such as accelerated bridge construction techniques, precast concrete pavement systems and new contracting methods. Many projects feature showcases that draw transportation professionals from around the country to view innovations in person and learn from their peers what it takes to deploy them.

Recognizing that the private sector is a reservoir of innovation that can benefit the highway system, FHWA developed the Technology Partnerships Program to move useful innovations into routine practice. The program has offered grants to help industry turn promising prototypes into market-ready products and fostered partnerships with highway agencies to demonstrate the technologies under real-world conditions. It also launched a program to provide independent evaluation of worthwhile safety technologies with limited U.S. use.

Through Highways for LIFE, the highway community has begun to harness the power of innovation by identifying, promoting and deploying available technologies with immediate, tangible benefits. It has begun the process of greatly accelerating innovation use so the nation can benefit now rather than decades from now. As a result, highway community stakeholders are seeing the value of using innovation—not all the time and not everywhere, but when and where it's the best solution to achieve the desired results.

Combined, the resources and lessons that have resulted from the Highways for LIFE initiative create a legacy the highway community can continue to tap in the future. Highway agencies and industry can adopt the customer-focused performance model and rapidly make innovations that enhance the highway system standard practice. This will strengthen the highway community's ability to use technology effectively and greatly accelerate the deployment of proven, high-payoff innovations. It will change the way the nation builds highways to improve the American driving experience.



◆ The Daunting CHALLENGE to America's Highway System

Then-Deputy Transportation Secretary Michael P. Jackson was intrigued when he picked up the July/August 2002 issue of the Federal Highway Administration's *Public Roads* magazine. The cover shot featured something he had never seen before: construction workers installing prefabricated concrete pavement slabs on the Tappan Zee Bridge toll plaza in New York the way bricklayers piece together a patio. Inside, the entire issue was devoted to articles on the latest concrete

innovations, from prefabricated bridges to self-consolidating concrete to pavement performance-predicting software.

Jackson wanted to know more, so he arranged a meeting with engineers at FHWA's Turner-Fairbank Highway Research Center. What had been planned as a short presentation turned into several hours of discussion. "Are there innovations like this in other areas?" Jackson asked. "Of course," was the reply.

- Growing traffic congestion challenges highway agencies to rebuild roads and bridges with minimal traffic disruption.

Jackson told those assembled that he believed implementing innovations like the ones they described quickly and widely could play an important role in improving America's aging, congested highway system. He challenged the group to develop a plan that would enable FHWA to do just that. "Be bold and audacious in your thinking," he said.

In crafting a proposal, the group looked at a variety of approaches and sought input from throughout the highway community, including highway agencies, industry groups, contractors, manufacturers, safety experts and the driving public. From the beginning, highway community stakeholders were enthusiastic about concepts for rapid innovation deployment that later became cornerstones of the Highways for LIFE initiative.

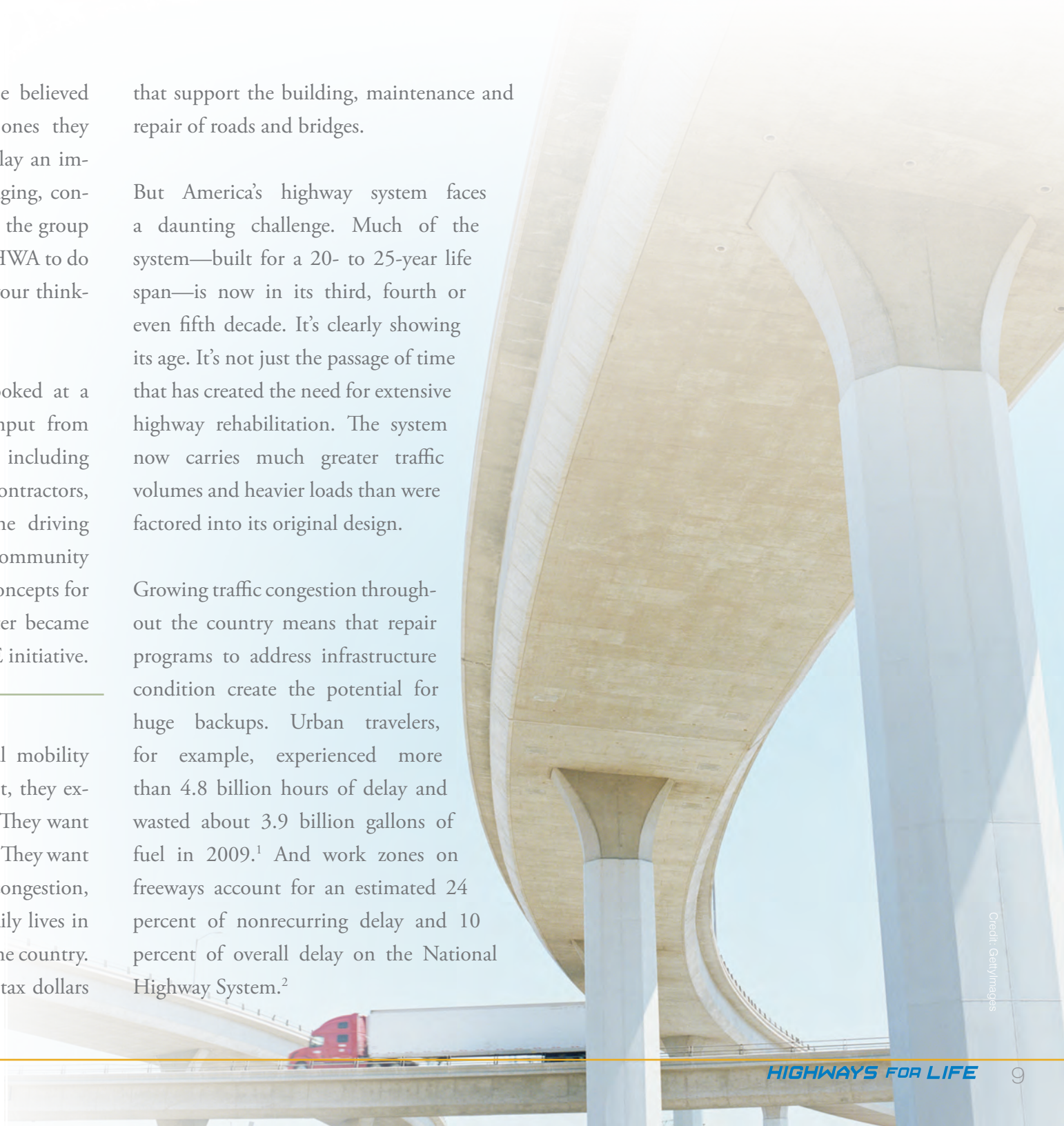
Great Expectations

Americans have long valued personal mobility and freedom of movement. As a result, they expect a lot from their highway system. They want it to be safe, accessible and convenient. They want to experience a minimum of traffic congestion, whether they are going about their daily lives in their communities or traveling across the country. And they want the best value for the tax dollars

that support the building, maintenance and repair of roads and bridges.

But America's highway system faces a daunting challenge. Much of the system—built for a 20- to 25-year life span—is now in its third, fourth or even fifth decade. It's clearly showing its age. It's not just the passage of time that has created the need for extensive highway rehabilitation. The system now carries much greater traffic volumes and heavier loads than were factored into its original design.

Growing traffic congestion throughout the country means that repair programs to address infrastructure condition create the potential for huge backups. Urban travelers, for example, experienced more than 4.8 billion hours of delay and wasted about 3.9 billion gallons of fuel in 2009.¹ And work zones on freeways account for an estimated 24 percent of nonrecurring delay and 10 percent of overall delay on the National Highway System.²





● Highway agencies can renew infrastructure faster, better, more safely and at less cost with proven innovations, such as the accelerated construction and prefabrication techniques used on this Utah bridge project.

At the same time, the price tag for the repairs needed is much greater than the resources available to pay the bill. One-third of America's major roads are in poor or mediocre condition, but current spending of \$70.3 billion a year for highway capital improvements is well below the estimated \$186 billion needed annually to substantially improve conditions.³ The \$10.5 billion spent on bridge construction and maintenance is short of the \$17 billion annual investment needed to upgrade the condition of the nation's bridges—more than 26 percent of which are either structurally deficient or functionally obsolete.⁴

In this challenging environment, highway agencies must figure out how to do more with less, both limited funds and fewer staff members. This is a situation transportation experts believe will not change any time soon. Economic, demographic and cultural events such as slower growth, a more diverse population and uncertainty about the future have created a “new normal,” Minnesota Department of Transportation Commissioner Thomas Sorel told participants at a Highways for LIFE-sponsored workshop on changing the way the transportation industry does business. “But we shouldn't fear this because it plays to our strengths,” Sorel said, such as depending on increasing productivity rather than the size

of the labor force. “Growth in efficiencies, accountability and transparency are critical parts of responding to the new normal. I believe technology is going to play a large role in how we provide solutions in the future.”

Power of Innovation

Sorel echoed what many throughout the highway community are finding: one solution to meeting the challenges the highway community faces—to doing business in the changing environment that has become the new normal—is harnessing the power of innovation. Proven technologies, materials and practices are available that can help build roads and bridges faster, better, more safely and less expensively, as FHWA engineers explained during that meeting at which the seeds for the Highways for LIFE initiative were planted. If these innovations are rapidly deployed nationwide and used when appropriate, they can dramatically change the way highways are built and improve the driving experience for America's travelers.

“Innovation is important to the customers we serve,” said Utah Department of Transportation Executive Director John Njord. “Transportation is an industry that is fraught with challenges. The processes we go through to deliver our products

are very cumbersome and difficult. And that's frustrating for our customers. So being innovative means we're finding ways to deliver our products more rapidly, more efficiently, with better quality and at less cost."

But the highway community—both public agencies and private industry—has not adopted innovation as quickly as needed to meet today's challenges. A key barrier is reluctance for risk-taking by agencies that face public scrutiny and accountability. And although using innovations can improve performance and save money over the long run, early costs of implementation may

be higher because of the learning curve and uncertainty about the risks involved. Other barriers include procurement practices such as the low-bid process, restrictions on the use of proprietary products, and the use of standards and specifications on how roads must be built rather than performance goals that spell out the results to achieve.

Because of these and other barriers, past efforts to implement innovation have taken years—in some cases decades. It took 12 years, for example, for all 50 state highway agencies to adopt Superpave technology, which produces ideal asphalt pavements using recipes tailored to an area's climate.⁵In other cases, prefabricated bridge sections, constructed off-site and transported to the work zone, were used to quickly replace and reopen bridges damaged by disasters such as a hurricane in Florida, an earthquake in California and a truck crash in Connecticut years before they became common practice for bridge construction in several states.

The challenge is clear: An aging highway infrastructure, growing traffic volumes and limited resources make the widespread use of innovation to meet customer-focused performance goals essential. The highway community can no longer build highways and bridges the way it did in the

● *Casting concrete bridge deck panels off-site and moving them to the work zone for quick installation enhances safety for motorists and workers and produces longer-lasting bridges.*




past and get the results needed to meet current and future infrastructure demands. The nation can no longer wait years while proven innovations struggle to become standard practice. Instead, proven innovations need to be propelled into routine practice quickly to build highways better, faster, less expensively and with less intrusion on traffic. The highway community needs to develop a new culture, a new way of doing business, that focuses on satisfying the travelers, residents, businesses, taxpayers and others who rely on the highway system.

The Highways for LIFE initiative, a pilot program established by the U.S. Congress in 2005, is FHWA's answer to the challenge. It focuses on using sophisticated marketing approaches and dedicated teams to deploy proven innovations faster and more effectively. It gives highway agencies incentives to try innovations to build highways and bridges. It helps private industry move

promising innovations into the marketplace, where they can benefit the traveling public. It serves as a model for programs such as Every Day Counts, FHWA's initiative to deploy innovation aimed at shortening project delivery, enhancing roadway safety and protecting the environment. Most important, it provides the highway community with the tools, techniques and training it needs to create culture change in their own organizations.


Meeting the daunting challenge:

- An aging highway system, increasing traffic and limited resources make it more and more difficult to provide America's travelers with a good driving experience.
- Highway agencies must do more with less funding and fewer staff members.
- FHWA's Highways for LIFE initiative shows how proven innovations can be used to build highways and bridges faster, better, more safely and at less cost.



● A Georgia project used prefabricated bridge beams and brief lane closures to speed construction and get traffic moving again quickly.

◆ The Highways for LIFE Approach to Accelerated Innovation Deployment



The Safety Edge™ concept originated at the Texas Transportation Institute in 1981, when a team led by Dr. Don Ivey found that a tapered transition between a paved road and an unpaved shoulder helped errant vehicles whose wheels drop off the pavement edge maintain control as they reenter the travel lane. But after the research was done and the papers were written, the idea languished, recalled Frank Julian, safety engineer at FHWA's Resource Center. "It never really got implemented," he said.

Research showed, though, that crashes related to unsafe pavement edges were a significant problem, particularly on two-lane rural roads. So more than two decades after the Safety Edge concept was devised, Julian and Chris Wagner, pavement and materials engineer at the Resource Center,

- *Highways for LIFE developed techniques to accelerate the deployment of high-payoff innovations such as the Safety Edge, a paving technique that helps save lives.*

began tossing around ideas on how to fashion that tapered edge at the pavement-shoulder interface. Wagner had experience at the National Center for Asphalt Technology with using a tapered wedge concept to create longitudinal joints in asphalt pavements. That experience gave the pair a good starting point for promoting the Safety Edge.

Julian and Wagner got together with the Georgia Department of Transportation Office of Maintenance, where Director Bryant Poole and others were collaborating on a demonstration project to study the constructability of a Safety Edge on a resurfacing project. Project Manager Lynn Bean was a key player in developing the “shoe” the Georgia DOT used to form the Safety Edge. “The godfather of the Safety Edge shoe is Lynn Bean,” said Julian. “He came up with it and did several iterations.”

Tests on the demonstration project showed that applying the treatment had little impact on paving production and added negligible cost to the

project. It also did not affect finished pavement smoothness or increase shoulder erosion.⁶ In fact, studies done since then show that the Safety Edge improves the consolidation of the pavement edge, making it tougher and longer-lasting. “It’s a double whammy, addressing both safety issues and pavement issues,” Julian said.

Around that time, Julian ran into Highways for LIFE Team Leader Byron Lord at an industry meeting. Lord had heard TransTech Systems Inc.





founder Harry Apkarian talk about his work developing a shoulder wedge maker and was interested in learning more about the Safety Edge efforts in Georgia. Lord thought Safety Edge technology might be a good candidate for the Vanguard Technologies initiative that Highways for LIFE developed to accelerate the widespread adoption of high-payoff innovations to benefit road users.

The Safety Edge was one of five proven, market-ready innovations chosen for the initiative. The others were prefabricated bridge elements and systems, a major component of accelerated bridge construction; road safety audits, a tool used to understand factors that contribute to roadway

crashes; precast concrete pavement systems, panels that speed work and cut congestion on repair and rehabilitation projects; and technologies to make work zones work better, a suite of innovations to limit the negative impact of work zones on workers and the public.⁷

New and Improved Approach

But it's not just the implementation of these worthwhile innovations that makes the Vanguard Technologies effort so valuable. The program's long-term benefit to the highway community is the approach it uses to move innovations into everyday practice, one that any organization can

- *Using the Safety Edge technique to shape the pavement edge to 30 degrees can eliminate the problem of vertical drop-off and make roads safer for drivers.*

apply to any innovative technology or process. In the past, even when millions of dollars were poured into deploying a technology, it could take years—even decades—for the innovation to gain national acceptance. With the Vanguard Technologies as test cases, Highways for LIFE has shown how innovations can be deployed quickly and effectively in the future.

The key to success in innovation implementation is what happens after the research and development process is over. Instead of just disseminating a report on an innovation, the Vanguard Technology process calls for combining multidisciplinary teams, proven marketing techniques, dedicated funding, focused effort and accountability to move the innovation all the way to full implementation. And it's designed to do it rapidly and efficiently so that years don't elapse between the time the research is done and highway users benefit from the innovation.

The process is straightforward: A team of technical and marketing experts identifies critical needs

and obstacles to implementation of the innovation. It develops a marketing plan that includes concrete goals, performance measures, and implementation tools and tactics. Team members carry out activities such as presentations at technical meetings, workshops, peer exchanges and demonstration projects for potential users. They partner with organizations throughout the highway community to champion the technologies. The process works because it breaks down the silos that divide many organizations and industry segments and creates multidisciplinary teams to champion innovations. The result is faster





and deeper deployment of innovations that can benefit the highway community and, ultimately, road users.

In the case of the Safety Edge, the deployment team, which included both safety and pavement experts, devised a plan that included loaning Safety Edge shoes to highway agencies that wanted to try the technology and evaluating about a dozen demonstration projects to document the safety, constructability and quality of the innovation. “The best way to get people to try the Safety Edge is to demonstrate it to them,” said Julian. “Once they see it, the light goes on. They understand.”

Since the Safety Edge marketing plan was launched, about 40 states have tried the technology and several have developed policies for ongoing use. Companies that manufacture devices to create the Safety Edge—now totaling seven models made by five firms—have improved their equipment to enhance pavement compaction and create an edge angle closer to the ideal 30 degrees. A *Guide Specification for Safety Edge* is available that describes what the pavement edge should look like when the technique is implemented.⁸ An FHWA field evaluation has shown that the Safety Edge can be constructed in such a way that

does not negatively impact paving operations. And a Transportation Pooled Fund Program study of crash data has estimated that the Safety Edge can cut crashes by 5.7 percent.⁹ “It’s great how far we’ve come with this technology,” Julian said. “We’re reaching critical mass.”

Plan to Succeed

The Vanguard Technologies effort has shown the highway community that a solid plan based on marketing principles can be the foundation of a successful deployment effort. Implementing a plan can encourage wider acceptance and application of innovations, moving them from state of the art to state of the practice more quickly. Highways for LIFE created a *Guide to Creating an Effective Marketing Plan*, a step-by-step manual that any agency or organization can use to build marketing plans for deploying innovations and other highway-related initiatives.¹⁰ A training course, “Leap Not Creep: Accelerating Innovation Implementation” (FHWA-NHI-134073), is also available that provides transportation professionals with the tools to put innovations to work quickly and make them standard practice in their highway programs.¹¹

Both the course and the guide are based on the experiences of the teams that developed

Implementing a plan can encourage wider acceptance and application of innovations, moving them from state of the art to state of the practice more quickly.

- *Multidisciplinary road safety audit teams study roads and intersections to identify safety issues and recommend solutions to reduce the number and severity of crashes.*

the marketing plans for the earliest Vanguard Technologies. They launched the process with a one-and-a-half-day meeting at which the Highways for LIFE team met with the team of experts assembled to promote each technology. Highways for LIFE staff briefed them on the initiative the first morning. The team spent the afternoon roughing out an action plan for the technology and the next morning refining it.

Several months after the road safety audits deployment team met to brainstorm ideas for its plan, team leader Louisa Ward, FHWA's road safety audit program manager at the time, decided to take a second look and see if there was room for

improvement. She pulled the team members together to report on what they had done since their initial meeting and update their plan.

Armed with a detailed agenda, the team spent two days in intense discussions. They broke into groups and methodically reviewed the components of a good marketing plan: the customers for road safety audits, the opportunities for promotion, the roadblocks to implementation, the goals for deployment and more. They prioritized their goals and strategies to focus on those with the greatest potential for positive payback. When the meeting was over, they left with common goals, assigned tasks and a renewed sense of purpose.

● *The Highways for LIFE program gave precast concrete pavement system technology a much-needed push on its deployment path.*



Through their collaborative effort, they had come up with a stronger plan, one they believed would yield better results.

“The overall goal of the program is to decrease serious injuries and fatalities,” said Craig Allred, transportation specialist at FHWA’s Resource Center in Colorado. The team’s revised marketing plan focused on promoting a workshop on how to conduct audits, targeted 34 states based on their crash numbers to undergo audit training and set a 2010 goal for documenting road safety audits in all strategic highway safety plans. The team also developed a peer exchange program to provide technical assistance.

“We’d like to make road safety audits a mainstream practice in all transportation and highway agencies across the country, and we’ve made steady progress toward that goal,” Allred said. Workshops have been held in at least 38 states. Three states have full-time road safety audit coordinators. Several states—including Arizona, Delaware, Iowa, Nevada, New Jersey, South Carolina, Tennessee and Virginia—have made road safety audits a standard procedure and more are joining that group all the time. In total, all states have participated in road safety audit training, piloted or performed road safety audits, or

established a road safety audit program.

“We’re seeing great interest around the country in doing road safety audits,” Allred said. “We’re not only seeing interest by the states, but also from local agencies and tribal governments. In a few cases, the local agencies are leading the states.”

Needed Push

Another Vanguard Technology, precast concrete pavement systems, might not have gotten off the ground if it weren’t for Highways for LIFE, according to Suneel Vanikar, FHWA concrete team leader. FHWA sponsored research on the technology at the Center for Transportation Research at the University of Texas at Austin in the 1990s and a couple of demonstration projects in the early 2000s, but the Vanguard Technologies initiative gave the technology the push it needed to continue on the road to deployment. “Highways for LIFE didn’t initiate the technology, but it certainly has sustained it,” said Vanikar. “Without Highways for LIFE, progress on implementing it probably would have ended five years ago.”

Instead of disappearing, precast concrete pavement systems are revolutionizing highway renewal and repair. Cast off-site and installed in just hours when traffic is low, precast concrete



pavement panels reduce traffic congestion, make the construction process safer and increase highway durability. They're particularly useful on high-volume roads where quick repairs are essential to minimize major traffic disruption and extensive user delays.

In its marketing plan, the Highways for LIFE deployment team set a goal for a dozen states to adopt precast concrete pavement systems as a standard approach for appropriate applications by 2013. Marketing tactics include demonstration showcases and Web conferences on the technology, as well as dissemination of technical information through such vehicles as DVDs and

the Highways for LIFE website. Demonstration projects have been valuable in providing states with the financial impetus they need to try precast pavement systems, Vanikar said.

At least nine states have used or are planning to use precast concrete pavement systems. Several are using Highways for LIFE grants to try the technology. California is working on standards to make precast concrete pavement systems an option for new construction, not just repairs. In addition to the nonproprietary system FHWA developed, several proprietary systems are now available and highway agencies such as those in Utah and Illinois are working on other generic

- *Highway agencies are using precast concrete pavement systems, installed quickly during off-peak travel times, to minimize traffic disruption on road repair projects.*

systems. Modular pavement technology is also part of the second Strategic Highway Research Program, which is developing tools to help highway agencies design, install and maintain the systems. “Highways for LIFE has helped keep the momentum going,” Vanikar said.

That momentum continues to build. Through the Vanguard Technologies initiative, Highways for LIFE laid the groundwork for rapid deployment of proven innovations and developed a process that organizations across the country can use. FHWA is expanding the rapid deployment effort piloted by Highways for LIFE in Every Day Counts, its

initiative to deploy innovations that shorten project delivery, enhance roadway safety and protect the environment. Through Every Day Counts, the agency is working with the transportation community to continue accelerated deployment of the Safety Edge, prefabricated bridge elements and systems, and other innovative technologies and techniques. “Highways for LIFE pioneered a lot of things that are now standard practice in how we deploy new technologies,” said FHWA Administrator Victor Mendez.

A new approach to innovation deployment:

- Don't stop at conducting research and writing reports on new technologies.
- Create teams of technical and marketing experts to identify needs, build goal-based marketing plans, and develop tools and tactics to implement innovations quickly and widely.
- Encourage the highway community to make proven innovations standard practice.

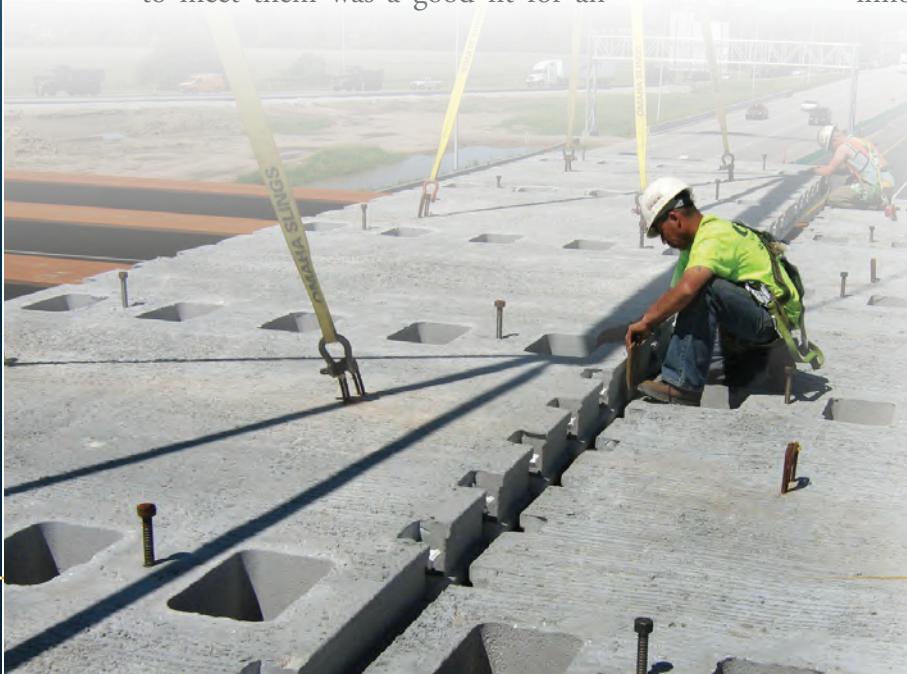
◆ Putting INNOVATIVE ideas into Action

Iowa Department of Transportation staffers first heard about the Highways for LIFE initiative at a 2005 Transportation Research Board meeting and knew it was something the agency should pursue. The Highways for LIFE philosophy of setting customer-focused performance goals for construction projects and using innovation to meet them was a good fit for an

agency with a long history of willingness to try new approaches. Right away, they started making plans to be a part of the initiative.

Back in Iowa, Kevin Mahoney, Highway Division director at the time, put together a multidisciplinary team to identify ready-to-implement innovations the agency could use on a project that would meet the Highways for LIFE requirements. The team included members from the Iowa DOT engineering, operations and research staff as well as contractors. By the time FHWA announced the Highways for LIFE demonstration project grant program, “we knew

- *Using a Highways for LIFE grant to try proven innovations such as precast concrete bridge panels gave the Iowa DOT tools to consider for future bridge projects.*



what project we wanted to submit and thought it would fit the criteria,” said Sandra Larson, director of the Iowa DOT Research and Technology Bureau.

They were right. Their candidate—a project to use precast concrete deck panels and cost-plus-time bidding to speed up reconstruction of the 24th Street Bridge in Council Bluffs—was chosen as one of the first Highways for LIFE demonstration projects. Using innovation cut building time from two construction seasons to one, eliminating hazardous winter driving conditions through a work zone and saving money. It also gave the agency proven tools to consider for future projects.

“The most important thing we learned as a result of the Highways for LIFE program was not technical,” Larson said. “Rather, it was how we worked together in identifying the most promising project and how we were able to combine promising technologies with safer construction practices to produce a long-lasting structure.”

By providing incentive funding to demonstration projects such as Iowa’s, Highways for LIFE encourages state highway agencies to try innovations they have never or rarely used and

eventually make them standard practice.¹² Since fiscal year 2006, Highways for LIFE has provided incentive funding totaling nearly \$55 million for 60 projects in 37 states, the District of Columbia and Puerto Rico. The projects have featured innovations ranging from accelerated bridge construction techniques and high-performance materials to prefabricated bridge elements and precast concrete pavement systems to new contracting and work zone management methods.

Firsthand Experience

Each project Highways for LIFE funds gives a DOT the opportunity to use a technology, process or material with potential to boost quality and safety while cutting construction congestion. Highway agencies experience firsthand the benefit of setting project performance goals and applying innovative solutions to construction challenges

● *Sculpture adorns the new 24th Street Bridge, on which the Iowa DOT combined innovation with safer construction practices to produce a long-lasting structure.*

and the value of adding those innovations to their toolkits for future projects.

To qualify for incentive funding, highway agencies set aggressive project performance goals that define desired results for safety, speed of construction, mobility, quality and user satisfaction and measure their success in meeting those goals. That's a change from the traditional practice of specifying how a project should be built. Instead, performance goals spur agencies and contractors to use creativity and flexibility to develop the best solutions to meet project goals and construction challenges. And by documenting and comparing the results of each project against the performance goals set, agencies get data on which to base future decisions. Follow-up reports on Highways for LIFE demonstration construction projects make that information widely available so all states can benefit.¹³

Highways for LIFE demonstration projects have shown that innovations in project delivery and construction methods can result in major-league cost savings for transportation agencies and taxpayers. Net savings have ranged from 8 percent on Iowa's Highways for LIFE project in Council Bluffs to 14 percent in Oregon, 21 percent in Michigan, 36 percent in Utah, 65 percent in Virginia and more than 200 percent in Washington, D.C.¹⁴

While the early costs of deploying an innovation can exceed those of traditional methods, they are nearly always offset by savings in highway user costs and safety. That's why those costs—including user delay costs from work zone congestion, vehicle operating costs from detours, safety costs from the presence of work zones and economic costs from freight movement delays—are on the agenda these days when highway agencies plan

Innovations in project delivery and construction methods can result in major-league cost savings for transportation agencies and taxpayers.

projects. In addition, the cost of innovations drops over time as they become standard practice, a market and supply chain develop, and deployment risk declines. And the superior quality of the innovations deployed can produce lower costs over the life of a road or bridge because fewer repairs are needed.

What makes the demonstration project approach particularly valuable is that it “emphasizes innovations that are already proven technologies, techniques or materials that just haven’t gotten to mainstream yet,” said Malcolm Kerley, Virginia Department of Transportation chief engineer. “The reason they’re not in the mainstream is because people may think there’s a risk involved or additional costs. When you have budget and time concerns, they can impact innovation use.”

By offering incentives to use innovation to build projects better, Highways for LIFE has made it easier for state highway agencies like Virginia’s to try something new. Participating in the program gave the agency the impetus it needed to use accelerated construction techniques to quickly replace a bridge in a congested area of Prince William County and precast pavement slabs to speed rehabilitation of a high-traffic section of

I-66 in Fairfax County and learn valuable lessons in the process.

“On any of these projects that use innovation, you learn both from the products you’re using and how you manage the projects. Sometimes what you learn not to do is just as beneficial as what you learn you should do,” said Kerley. “We have 50 states and if every one of them tried some new products, we could work some of the kinks out and use them in even more states.” What highway agencies learned about using precast concrete pavement systems on demonstration projects in some states, for example, benefits agencies in other states as they try the technology.

Highways for LIFE even sparked the idea of state highway agencies offering their own innovation incentives. Taking a cue from the demonstration project program, Minnesota DOT Commissioner Thomas Sorel launched his agency’s Destination Innovation program, which funds creative projects that improve safety and mobility, accelerate construction, affect quality of life and use innovative finance methods to maximize existing funds or leverage new funds. Employees, individually or as teams, submit ideas for the agency’s Stewardship Council to consider

for implementation. “I saw what Highways for LIFE did nationally, and I wanted to bring that idea to Minnesota,” Sorel said.

Seeing Is Believing

Highways for LIFE accelerates the spread of innovations by sponsoring showcases at which transportation stakeholders from throughout the country—decision-makers, program managers, project engineers, designers, contractors and others—can observe new technologies and processes in action on construction projects. At these events, stakeholders learn what it takes to deploy the innovations, see the benefits firsthand and exchange information with peers.

One of those showcases featured the longest two-span bridge ever moved by self-propelled modular transporters in the Western Hemisphere. More than 1,200 spectators, many toting lawn chairs and blankets, turned out for the successful five-hour move of the Sam White Bridge over Interstate 15 in American Fork, Utah, on a chilly Saturday night in March 2011.

They watched as two sets of SPMTs—computer-controlled vehicles that move heavy loads with precision—maneuvered the bridge from where it

was built on the east side of I-15 across eight freeway lanes. Despite early morning snow squalls, crews set the bridge into place at about 4 a.m. Sunday and reopened the freeway at 7 a.m., three hours ahead of schedule. “The Sam White Bridge move demonstrates our commitment to employing the latest technology to minimize delays to the traveling public and delivering our projects as fast as possible,” said Utah DOT Executive Director John Njord.

Among those who observed the historic event were about 200 transportation professionals from state highway agencies, contracting firms, universities, European organizations and FHWA. The Utah DOT and FHWA sponsored a workshop the next day featuring presentations on the engineering and technical details of the move and how to incorporate accelerated bridge construction technology into transportation programs. Combined, the work zone visit and workshop gave participants valuable experience and information to take back to their own organizations.

The bridge was part of Utah’s \$1.7 billion I-15 Corridor Expansion project, known as I-15 CORE. “Building the bridge using accelerated bridge construction eliminated the need for as



● A Utah bridge project showcase attracted local spectators and highway professionals from across the country to learn about innovation and see the benefits firsthand.



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many as 10 full freeway closures,” said Dal Hawks, I-15 CORE project director. “This reduced traffic delays and benefited the state’s economy by keeping people, goods and services moving while the bridge was being reconstructed.”

The Utah DOT’s first use of SPMTs was on a Highways for LIFE project four years earlier in which it removed and replaced a bridge over I-215 in Salt Lake City in one weekend. The agency decided to try the technique after observing a Florida project in which a prebuilt bridge was moved into place overnight with the innovative equipment, saving motorists months of frustrating traffic delays.

With the help of a Highways for LIFE grant, the agency used accelerated construction techniques to build a new structure alongside the old while traffic continued to flow. The old structure was removed and the new one shifted into place in one weekend with SPMTs, cutting the impact of construction congestion on motorists from months to days. Like the Sam White Bridge project, the I-215 bridge move attracted local residents, national media and transportation professionals from other states who had never seen such a sight.

“It generated tremendous public interest to the point that during the 36 hours that the project was under way, we had people surrounding the entire interchange,” recalled Njord. “The reason they were interested was the innovation part of this thing. Rather than impact the public for months on end with a normal bridge replacement project, we impacted them for 36 hours and it was done. That resonated with the media and the public.”

As a result of its experience on that and other bridge projects on which it used innovative techniques, the Utah DOT set a goal of making accelerated bridge construction standard practice by 2010. The Sam White Bridge move was the agency’s 23rd using SPMTs. The trend is growing as other state DOTs—including some that sent representatives to watch Utah’s first bridge move—increase their use of accelerated bridge construction techniques and other innovations to build safer, longer-lasting bridges with much less traffic disruption.

New Business Model

Through demonstration projects and showcases, Highways for LIFE is fostering the spread of a new business model for managing highway project delivery. That model uses project performance goals to define results while encouraging innovative, but proven, solutions to achieve those goals and meet construction challenges.

Among the state highway agencies adopting the new model is the Massachusetts Department of Transportation, which set an ambitious goal: replace 14 deteriorated bridge superstructures along I-93 in Medford in one summer instead of four years. Armed with a Highways for LIFE grant and knowledge gained from a Highways for LIFE-sponsored workshop on accelerated bridge construction, the Massachusetts DOT used accelerated techniques, prefabricated bridge elements and the design-build project delivery method to make it happen.

Building the bridge superstructures in sections off-site and installing them during 55-hour periods each weekend over the summer of 2011 enabled the Massachusetts DOT to minimize the impact on travelers who use the bridges, which carry 200,000 vehicles a day. Two lanes remained



open in each direction on I-93 from 8 p.m. Friday to 5 a.m. Monday while work was under way, and work was scheduled so that it would not disrupt weekday rush-hour traffic.

FHWA Administrator Victor Mendez joined former Massachusetts DOT Secretary Jeffrey Mullan and about 160 transportation professionals from around the country to view progress on the project, dubbed “Fast 14,” about halfway through. On a sunny July weekend, they watched crews use cranes to erect prefabricated steel bridge elements on I-93 south over Salem Street. “What we’re trying to do nationwide is find a different way to build,” Mendez said over the din of construction. “These technologies help keep traffic moving, which lets people spend less time in their cars and more time doing the things they enjoy.”

Mullan called the Fast 14 project—part of the state’s eight-year, \$3 billion Accelerated Bridge Program—a new way of doing business for the agency, one that’s based on innovation, customer service and engineering excellence. “It’s a better way to deliver projects for the people of Massachusetts,” he said. “Time is money. Congestion matters.”

Residents of nearby neighborhoods who came out to watch the new bridge being moved into place supported the state’s use of rapid replacement techniques on the project. “It’s a smart way to do it,” said one. “It’s amazing they can replace so many bridges in such a short period of time,” said another. “I’m very impressed with that.” So was the *Boston Globe* newspaper, which included the project and FHWA’s Every Day Counts initiative on its roster of “Boston’s best people and ideas of 2011.”¹⁵

● *Workers used accelerated bridge construction techniques to replace 14 Massachusetts bridges in one summer while minimizing impact on drivers.*



Putting innovation into action:

- Incentive funding helps states try proven innovations on highway projects to enhance safety and quality, reduce congestion and please customers.
- Demonstration showcases enable transportation professionals to observe innovation use firsthand and gather valuable information they can take back to their organizations.
- As more states try innovations—and use innovations more often—they become standard practice across the country, improving the U.S. highway system.

◆ Bringing People Together to Accelerate *Innovation*

When nearly 100 transportation professionals converged in Des Moines, Iowa, for a workshop on accelerated bridge construction, their goal was to propose ideas for the state's highway agency to consider for upcoming projects. For many, it was also an experience that whetted their appetites for using innovative construction techniques on their own bridge projects.

Highways for LIFE partnered with the Iowa DOT, FHWA's Office of Bridge Technology and the Iowa State University Bridge Engineering Center to host the event, which brought together bridge engineers from public agencies and private industry. They listened to expert presentations to bring them up to date on accelerated bridge

construction developments across the country and set the stage for the workshop discussions. Then they got to work. Three teams looked at what could be done to speed construction and minimize traffic disruption on specific bridge projects, while a fourth considered design details for jobs involving prefabricated bridge components.

For the Broadway Viaduct in Council Bluffs, Team 1 recommended using detour rental for the closure period, precasting the caps and columns, and prefabricating the deck systems. For a steel arch bridge in Iowa Falls, Team 2 suggested erecting the ribs and struts around the existing bridge, skidding the arch into place and prefabricating

the floor system components. Team 3 proposed reusing the steel beams and prefabricating the superstructure on an I-80 reconstruction project in Des Moines. And Team 4 advised the highway agency to focus on researching and developing standards for precast deck systems, precast substructures and precast integral abutment-to-superstructure connections.¹⁶

Workshops like the one in Iowa are key to effective deployment of innovations such as accelerated bridge construction, said Mary Lou Ralls, engineering consultant and former Texas Department of Transportation state bridge engineer, who moderated the event. “It’s really important that we look at innovative technologies in the transportation industry, but as bridge engineers we need to have comfort with change,” she said. “That’s why these workshops are so important. They bring everyone together to hear from the people who are using the new methods, and they gain confidence that these methods will work for them in their state.”

James McMinimee, workshop presenter and Utah DOT director of project delivery at the time, agreed. “Workshops such as this can really be a springboard for departments of transportation,” he said. The Utah DOT, which uses accelerated

bridge construction as a standard practice, got the idea to try the technique at a Washington, D.C., workshop. Staff members visited other states to see how they used accelerated bridge construction. They were so impressed when they observed a Florida project in which a prebuilt bridge was moved into place overnight with innovative equipment that they decided to try it themselves. “We had some of our contractors with us, and seeing self-propelled modular transporters helped them gain confidence in using them,” McMinimee recalled.

● *Using accelerated bridge construction techniques, including prefabricated bridges that are built off-site and installed rapidly, cut the time needed to replace several Utah bridges.*



“The conference was an eye opener for me,” said Marlene Messam, senior project manager for the Collier County Division of Transportation in Florida. “I’ve gathered a tremendous amount of knowledge and made a lot of connections.” She planned to take what she learned back to her agency to apply. “ABC is not only the national vision. We want to use these technologies at the county level as well. I have several bridges right now that need immediate attention.”

“The conference has done a wonderful job of educating the folks in attendance,” said John Dick, a Precast/Prestressed Concrete Institute

consultant. “There’s a broad need in the industry to get information into people’s hands at all levels, from the administrators at the public agencies to the practitioners in the design firms.”

Power of Many Minds

The Iowa workshop on accelerated bridge construction is one of many FHWA-sponsored events with a goal of bringing transportation professionals together to learn about innovations and exchange ideas they can use to improve the way they build America’s highway system. Involving stakeholders from all areas of the highway community is part of the Highways for

● *Good traffic management and innovative work zone techniques can smooth the way to more successful highway projects.*



LIFE philosophy. From the beginning, FHWA established a process to include organizations and people affected by the nation's highway system in the program. Many stakeholders—public agencies, highway groups, builders, suppliers, manufacturers, academia and road users—have provided valuable input on everything from program goals to construction projects. In the process, they have learned from the experiences and perspectives of other stakeholders.

When FHWA developed the Highway for LIFE strategy, it started with a series of stakeholder meetings with highway agencies, industry organizations and public interest groups. It sought input on program concepts and began to foster support for the changes the program brings to the highway community. In reaching out to stakeholders, FHWA's key question was "What would help you learn about and implement innovation?" The answers helped the Highways for LIFE team develop the program components, including demonstration projects to encourage

highway agencies to try innovations to achieve performance goals, technology partnerships to help industry develop marketable innovations, and technology deployment efforts to support highway agencies in innovation implementation.

As the Highways for LIFE team focused on creating plans to encourage broader use of specific innovations, it assembled experts from highway agencies, associations and industry. Again, the objective was to get input on their needs and concerns—whether the topic was prefabricated bridges or road safety audits—and build support for implementing innovation. The team used the same stakeholder involvement approach for other technology deployment efforts, such as developing the "Seeking the Best Solutions" and "Performance Contracting for Construction" workshops and the "Leap Not Creep: Accelerating Innovation Implementation" training course. The input they received helps make the workshops and course more useful to those taking them.

Bringing people together is a feature of ongoing activities. Highways for LIFE builds in opportunities at its showcases, workshops, Web conferences and "Leap Not Creep" course.



Credit: Gettyimages

Bringing people together is a feature of ongoing activities. Highways for LIFE builds in opportunities at its showcases, workshops, Web conferences and “Leap Not Creep” course for participants to share information, ideas and advice about innovation implementation. By providing financial support to cover travel expenses to targeted events, Highways for LIFE makes it possible for more transportation professionals to participate. Not only do participants benefit from what they learn at the events, they broaden the network of professionals they can call on in the future.

The networking benefits impressed the transportation professionals who attended a Highways for LIFE showcase demonstrating the use of precast concrete pavement systems to speed up rehabilitation of a California roadway. They overwhelmingly rated attending the event a valuable experience, according to a follow-up survey, and 64 percent said they will use or consider using the technology as a result of seeing it in action at the showcase. But the biggest value of the event, one survey participant reported, “is that when we are ready to implement these technologies, we will

have people to reach out to.” Another said, “The fact that you had manufacturers present—it was great to have that kind of personal contact with those folks.”

Creating Goodwill

Highways for LIFE places great emphasis on sharing information with and getting feedback from the ultimate customers of the highway community’s efforts—road users and taxpayers. Members of the public are significantly more satisfied with the results of a project if they are informed beforehand about its purpose and the innovations planned to enhance its outcome and given an opportunity to provide input. They also are more appreciative of highway agencies’ efforts if they are kept up to date and involved throughout the construction process. That helps keep projects on track, saving time and money, and builds support for future efforts.

Customer engagement was a key component of a Highways for LIFE demonstration project in Oregon. When the state’s highway agency replaced five aging bridges with prefabricated bridge components and accelerated construction techniques, it fostered community goodwill along the route by recruiting schoolchildren to build bat boxes and design bridge pylons

illustrating local wildlife. The effort was part of a public involvement program designed to draw community residents into the process and build support to keep construction moving forward smoothly. “When it comes to public projects, residents are the owners and it’s important to recognize that,” said Lois Cohen, president of Lois D. Cohen Associates, the firm that led the community involvement effort.

Involving schoolchildren was just part of the program, which also included open houses and meetings with local government, civic and business leaders. Strong participation from contractors and Oregon Department of Transportation staff contributed to the program’s success, Cohen said. In Reedsport, at the western end of the project corridor, middle school students learned that bridges provide roosting sites for bats and built bat boxes for installation under four of the bridges. The project contractor cut wood for the students, who assembled and signed the boxes.

In Drain, at the corridor’s eastern end, elementary school students learned about the bridge-building process and constructed their own with gumdrops, toothpicks and saltine crackers. Their creations were displayed at an open house next to the bridge project team’s exhibits. “That

increased open house attendance exponentially,” said Cohen. “The parents and grandparents who came with their children realized that ODOT was trying to constructively engage and educate the community, not just tell them what was going to happen.”

In Elkton, in the middle of the corridor, high school students created designs that were carved on the pylons of a bridge over Elk Creek. The designs feature Douglas firs and grapevines to honor the town’s logging and winemaking industries and highlight area wildlife, including the monarch butterfly, elk, osprey and salmon. Elkton students also made a time capsule to embed in a pylon. Each grade chose items such as poems and CDs for the capsule, which will remain in the pylon until the bridge—expected to last 75 years—is replaced.

Goodwill built with community involvement can help move construction projects forward faster and with fewer roadblocks, Cohen said. “Whatever reaction you generate on a project—be it good or bad—lays the foundation for how the community might respond to a later project.” In Oregon’s case, accelerated construction and thoughtful public involvement produced positive

results: an after-the-fact survey found that 96 percent of respondents were somewhat to very satisfied with the project approach, while 95 percent were satisfied with the completed bridges.

Building Public Support

Public support was also crucial to the success of a Highways for LIFE project in Minnesota that involved completely closing part of Highway 36 for five months and detouring drivers to other routes through North St. Paul. The unprecedented full-road closure cut the amount of time drivers were inconvenienced by construction by nearly a year.

Minnesota Department of Transportation staff knew the project needed to be done. Congestion was an issue for motorists, who often had to stop for six intersections along the short route through the city. Pedestrian safety was also a concern because students at a high school on the route had to cross the busy highway in the mornings and afternoons.

But how would people react to a full-road closure? A survey of residents, commuters and local businesses found that they were split 50-50 on whether a five-month full closure or a 16-month partial closure should be used. The agency



decided that cost and time savings, safety benefits to workers and motorists, and project quality justified the full closure.

At the same time, agency staff knew they needed to take steps to reduce the impact of the closure on residents and businesses. They hosted open houses for residents to explain project details and provided regular construction updates at

city council meetings and business gatherings. They brainstormed advertising and marketing ideas with local merchants to help them attract customers to their businesses during construction. They sponsored “Detour Days” to mark the highway’s official closing, a celebration featuring a road race, a coloring contest for children and local vendors selling food and other items. They held a grand opening for the new pedestrian

- *The Minnesota DOT worked with residents and businesses to make a project involving a five-month full road closure a success, even protecting North St. Paul’s iconic snowman during construction.*

bridge that now provides safe passage across the highway for students and residents. “Mn/DOT worked extensively with the citizens and businesses to make this project as painless as possible and provide some benefits for them,” said Jan Walczak, North St. Paul City Council member.

During the reconstruction project, crews also took great care to protect the North St. Paul snowman, a metal and stucco icon that has stood watch over the city for more than three decades. They drilled soil borings to determine the soil composition and drove pilings to support the 44-foot-tall snowman, assuring that it would continue its vigil along Highway 36 long after construction was completed.

A post-project survey showed that the agency’s commitment to work closely with the community paid off. Nine out of 10 residents and commuters were positive about the project approach, while 83 percent of local businesses were pleased. Speed of project completion was the most commonly cited reason for positive feelings. “Going the extra mile with the market research and working with residents and businesses to devise and promote community events around the construction were critical to the project’s success,” said Chris McMahon, then director of the Minnesota DOT’s market research unit. “That extra effort paid off.”

Bringing people together:

- It ensures that the best strategies are identified and used to accelerate innovation.
- It creates networks that can spread the word on how innovation can be implemented successfully.
- It builds public confidence that when taxpayer dollars are spent on projects that use innovation, the outcome will be successful and will improve the public’s driving experience.



● A strong public involvement program and accelerated construction techniques helped the Oregon DOT keep a five-bridge replacement project on track and win high marks on a post-construction customer survey.

◆ PARTNERING with **Industry** to *Improve* Highways

Dr. Sang-Soo Kim and student researchers at Ohio University spent years developing the right design for a device to pinpoint the temperature at which asphalt binders will crack. Cold-weather cracking is a major cause of asphalt pavement failure, an expensive problem for the nation's highway system. Resistance to thermal cracking comes mainly from the asphalt binder that bonds with aggregates to create hot-mix asphalt. Kim's Asphalt Binder Cracking Device, known as the ABCD, had the potential to become a simple, reliable testing tool that could help engineers select the best asphalt binders for paving projects based on climate.

But making the leap from late-stage research prototype to market-ready product can be a challenge for even the most promising technologies. Kim, an associate professor

of engineering, formed EZ Asphalt Technology to commercialize his invention. He sought a Technology Partnerships grant from Highways for LIFE to fund the final development and evaluation in a real-world setting that the ABCD needed to become a marketplace contender.

Unlike conventional test methods, the ABCD creates thermal cracking conditions similar to those in the field. It consists of a metal ring fitted with



temperature and strain sensors tucked into a silicone mold. Heated asphalt binder is poured around the ring and the device is cooled. As the temperature drops, the asphalt binder contracts more than the metal ring, causing the binder to fracture. Data from the test can be used to grade asphalt for expected climate conditions and develop new binders that can stand up to cold temperatures.

In the first phase of the Technology Partnerships project, Kim and his researchers improved the ABCD test procedures. They added a turntable to make it easier to prepare samples without overfilling the mold or spilling the binder. They determined the optimum cooling rate for conducting the test. And they upgraded the data analysis software to make it easier to use.

In the project's second phase, 31 laboratories took part in a study to evaluate the repeatability, accuracy and simplicity of the testing system. Technicians at each lab set up the ABCD testing system and conducted three test runs on three sets of asphalt binder specimens. They provided feedback on their testing experience, which researchers used to further refine the test procedure. Several reported that trimming the asphalt sample was tricky, so the test procedure was simplified

to eliminate that step without affecting the test's accuracy. "Most labs reported that ABCD was an easy test to run," said Kim. "Engineers and technicians liked the fact that they could see the performance of the tested binder directly without additional analysis."

Data generated during the Technology Partnerships evaluation resulted in development of an American Association of State Highway and Transportation Officials provisional standard, TP92—Determining the Cracking Temperatures of Asphalt Binder Using the Asphalt Binder Cracking Device. That puts the ABCD in a good

● *Highways for LIFE gives problem-solving tools such as the Asphalt Binder Cracking Device the push they need to move from promising prototypes to market-ready products.*



position for eventual widespread adoption by transportation departments.

After the Technology Partnerships project was completed, EZ Asphalt planned to develop a range of ABCD models to satisfy the paving industry's different needs for a simple, reliable method to test asphalt binders. "Thermal cracking is a significant and costly problem," said Kim. "Highways for LIFE helped transform ABCD from a research tool to a problem-solving tool that can be used in real life."

Crucial Funds

Filling the funding gap between research and commercialization is the goal of the Technology Partnerships Program.¹⁷ It funds the critical final steps in developing technologies with potential to improve highway quality or safety or reduce construction-related congestion and its impact on motorists. It also fosters partnerships between private industry and highway agencies and other transportation stakeholders to demonstrate technologies in real-world situations and evaluate their effectiveness, building a cadre of potential users.

FHWA has a rich history of supporting technology research and development, but the Technology Partnerships Program is the agency's first to provide funding to general industry for late-phase technology development and evaluation. The program uses two approaches to help industry move new technologies closer to deployment. In the first, it funds competitive grants to private sector organizations to help industry develop promising prototypes into market-ready products. This approach involves refining and testing late-stage prototypes and promoting partnerships to demonstrate the technologies under real-life conditions.

The value of this approach is that it provides needed funding at a crucial stage of innovation commercialization by leveraging private sector ingenuity and highway agency participation. It focuses on testing, evaluating and demonstrating the best ideas already developed by industry.

Through its industry leadership and extensive network, FHWA encourages highway agencies and other stakeholders to participate in pilot projects to demonstrate the technologies, providing

potential users with experience using an innovation and helping overcome some of the aversion to taking a risk on an unfamiliar technology or practice.

“A lot of times, state highway agencies don’t have the money to take a risk on these new technologies. This program really helps reduce that risk,” said Thomas Baker, state materials engineer for the Washington State DOT, which participated in two interlaboratory studies under the Technology Partnerships Program. “Agencies can try technologies at a modest investment, mainly just the time to do the evaluation. Meanwhile, we provide a useful evaluation for the manufacturer.”

FHWA funded eight projects under the first Technology Partnerships approach with grants

ranging from \$200,000 to \$500,00 for a total of nearly \$2.8 million. Three projects feature innovations to improve asphalt pavement quality, including the ABCD; the Aggregate Image Measurement System, a product that analyzes the characteristics of aggregates used in paving; and the Intelligent Asphalt Compaction Analyzer, a quality-control tool to aid contractors in hot-mix asphalt paving operations. Three technologies are bridge related, including lightweight composite bridge decking for rapid installation on movable bridges, fully precast bridge bents for use in regions prone to seismic activity, and waffle bridge panels made of full-depth ultra-high-performance concrete that offer greater durability and use less concrete than conventional panels. Two projects focus on safety, including an all-weather pavement marking system that incorporates materials

Under the Technology Partnerships Program, “Agencies can try technologies at a modest investment, mainly just the time to do the evaluation. Meanwhile, we provide a useful evaluation for the manufacturer.” — *Thomas Baker, Washington State DOT*



to make it easier for drivers to see markings on wet roads and an automated pavement marker placement system that allows safer, quicker installation of reflective pavement markers.

All of these technologies have traveled a faster path to commercialization as a result of the Technology Partnerships Program. “This program accelerates the process of getting technology research from just an idea to where it can be a beneficial tool for the whole industry,” said Jay Lemon, president of Haskell Lemon Construction Co., whose company worked with Dr. Sesh Commuri, University of Oklahoma professor, to develop the Intelligent Asphalt Compaction Analyzer. “The scale and complexity of the problems facing the road and transportation infrastructure in our country require novel, collaborative partnerships between industry, researchers, and federal and state agencies,” said Commuri. “It is exciting that the Highways for LIFE program is leading the charge in this effort.”

Highways for LIFE is piloting a second Technology Partnerships approach in which it is demonstrating and evaluating the effectiveness of innovative road infrastructure safety technologies that are fully developed and market ready, but that have had little, if any, application on U.S. roads.

Like the first approach, FHWA foster partnerships between industry and highway agencies willing to have the technologies installed, but FHWA contracts with an independent organization to evaluate the technologies. The resulting evaluation report will provide credible, comprehensive performance information on technologies to help highway agencies make informed purchasing decisions.

Under the second approach, the Technology Partnerships Program is conducting a performance evaluation of solar road markers, which are designed to improve visibility and safety on roadways. Participating companies will install their products on demonstration sites provided by highway agencies, and an independent organization will evaluate the road markers for two years. The first product to undergo testing is the Sequential Curve Warning System, a solar-powered system that uses LED-illuminated traffic signs to warn drivers of and guide them through horizontal curves, particularly those with higher-than-average crash rates.

Tapping Industry Expertise

In addition to fostering Technology Partnerships, Highways for LIFE has provided transportation-related industry stakeholders with opportunities

● *A solar-powered traffic signage system, designed to limit roadway departure crashes on curves, is undergoing a Technology Partnerships evaluation.*

to help states consider and use innovation in their construction programs. Industry experts have participated on Vanguard Technology teams to develop and implement deployment plans on technologies such as prefabricated bridge elements and systems and precast concrete pavement systems. Representatives of contracting and manufacturing firms have discussed the private sector perspective on technology use at showcases for Highways for LIFE demonstration projects, as well as at workshops and Web conferences on innovations.

Contractors have also stepped forward to try new contracting methods on Highways for LIFE demonstration projects, such as the performance contracting for construction method used on a Michigan road reconstruction project. Performance contracting is an approach in which the contractor is responsible for achieving defined goals and proposing how it will meet those goals. The Michigan Department of Transportation was interested in trying performance contracting as a way to get roadwork done more safely and cost effectively with minimal traffic disruption. The agency had a project in mind: refurbishing a road linking Detroit to the state's northwest tourist area. Highways for LIFE

sent a team of experts to Michigan for a hands-on workshop to acquaint contractors and agency staff with performance contracting.

A stakeholder group of Michigan DOT managers and representatives from the Michigan Infrastructure and Transportation Association defined performance goals to incorporate into the request for proposals to measure the effectiveness of the selected contractor's work. The agency based contractor selection on both best-value qualifications and price, according to Jack Hofweber, development engineer. "What was exciting was that we could get it out to the contractors with the goals we wanted to achieve through the project, and we could sit back and see what they would change about the contract to make the project work better," he said.

Central Asphalt Inc. came up with several ideas to win the contract. It proposed a pavement design to better ensure pavement performance during the warranty period. It added a temporary travel lane alongside the existing roadway to speed construction and meet motorist travel delay goals. It used self-adjusting temporary signals to regulate traffic constrained to one lane during the reconstruction of two small bridges along the route. And it used

● *The risky job of installing pavement markers by hand is now safer because of a Technology Partnerships project to evaluate an automated installation system.*

precast concrete beams and deck members to replace the bridges quickly. “We’re very happy with the way everything has gone,” said Aaron White, Central Asphalt’s vice president of operations, as the project neared completion. “We’ve had great success up to this point. We plan on in the next two weeks being done and having a successful project here.”

White was correct. The contractor earned incentives totaling about 7 percent of the bid price for achieving goals for date open to traffic, construction and cleanup completion, pavement performance, work zone safety and minimizing motorist delay. And because of its positive experience with performance contracting, the Michigan DOT plans to use it on at least 10 percent of its future projects. “It worked wonderfully. A lot of good ideas and innovations came out of it,” said Bill Mayhew, Michigan DOT delivery engineer.

Partnering with industry:

- The private sector is a reservoir of innovation and creativity that can benefit the highway system.
- Providing support and flexibility can encourage industry to step forward with its contributions.
- Bringing industry and highway agencies together to develop and evaluate promising innovations can help them get to the marketplace faster.



◆ Telling *the* *Highways for LIFE* Story

On the last day of the Transportation Research Board's 2011 Annual Meeting, Washington, D.C., was dealing with the aftermath of a heavy, wet snow that paralyzed the metropolitan area. But the Highways for LIFE workshop still attracted a crowd of transportation professionals who wanted to learn what the highway community can do to cultivate a more innovative culture. Before facing the return home on icy roads and delayed flights, workshop participants listened as industry leaders outlined the approaches they're using to transform their organizations.

The highway community needs to work on delivering projects faster, providing more value for the dollar and expanding revenue sources, Hal Kassoff, senior vice president at Parsons Brinckerhoff, told workshop participants. That calls for organizational leadership that is both

inspired and inspiring, that engages both internal and external stakeholders. "You can be a leader if you're a first-line employee or at the top," he said. It also requires integrative management that recognizes that different viewpoints are useful, he said, and a culture in which innovation is not just allowed, but celebrated from the front office to the front lines.

Organizational congruency is essential to delivering transportation services effectively, Minnesota DOT Commissioner Thomas Sorel said. "There needs to be alignment in the vision our external stakeholders see and our behavior, so we've been very clear about our vision, our mission and our strategic direction," he said. "We put the citizens of Minnesota at the top of our organizational structure because we serve them."

● *Unique V-pier structures provide support on a project to replace the Woodrow Wilson Bridge across the Potomac River and improve traffic flow on a congested Washington, D.C., -area corridor.*



“We put the citizens at the top of our organizational structure because we serve them.” — *Thomas Sorel, Minnesota DOT*

It’s important for transportation professionals in both the public and private sectors to do a better job of speaking up about the positive impacts the industry’s work has on society, said Dr. T. Peter Ruane, president and chief executive officer of the American Road & Transportation Builders Association. “It’s imperative that the engineering community assume responsibility for communicating the benefits, the breakthroughs and the uniqueness of its efforts to legislators, the public and the media,” he said.

Ready to Innovate

Bringing together industry leaders at a workshop to talk about how they are pursuing transformational change is one of the many ways Highways for LIFE spreads the philosophy of harnessing

the power of innovation. Using techniques ranging from old-fashioned face-to-face meetings to new technology, Highways for LIFE is putting the information, tools and training the highway community needs to transform itself into the hands of those who can make it happen.

Sharing information is an essential component of deploying technology. The initiative uses a variety of tactics to tell the innovation story, including workshops, demonstration showcases, presentations at industry meetings, exhibits at trade shows and Web conferences. It produces videos, DVDs, brochures and articles for industry publications. Technical reports on demonstration projects provide details on the innovations and performance goals used.¹⁸ The *Innovator*



newsletter¹⁹ chronicles the progress of Highways for LIFE and other industry efforts to apply innovation in a reader-friendly format, while the Highways for Life website,²⁰ mobile applications and video-sharing services provide online access to innovation information.

Through targeted workshops, Highways for LIFE gives transportation professionals the skills to apply the new business model for managing highway project delivery. “Seeking the Best Solutions” workshops, held in 10 states, help highway agencies develop a process for setting customer-focused performance goals and incorporating innovations into highway projects. “Accelerated Bridge Construction” workshops cover the latest on using innovation to speed up renovation and replacement of bridges. So far, 18 states have held workshops, and many are applying what participants learned to their bridge programs. “Performance Contracting for Construction” workshops, held in five states, provide practical information on using this innovative contracting method, in which the highway agency defines performance goals for projects and the contractor determines how to accomplish the goals.

- *The Highways for LIFE trade show booth brings information on using innovation to build roads better to industry events around the country.*

A “Seeking the Best Solutions” workshop helped the Massachusetts DOT plan a statewide program to reduce the number of structurally deficient bridges. “We focused on accelerated construction technologies and learned some new ideas from other states,” said Frank Tramontozzi, chief engineer for the highway agency. “The workshop got us to brainstorm and start thinking about performance measures. It was beneficial because we knew we had to do things differently to reduce our structurally deficient bridges.”

“I was impressed with the way the ‘Seeking the Best Solutions’ workshop was conducted,” said Rodger Rochelle, state alternative delivery engineer for the North Carolina DOT. “It validated a lot of the things we’re already doing and gave us ideas for what we ought to be doing. The workshop really encouraged a multidisciplinary approach to problem-solving and goal-setting.” Rochelle also liked the workshop’s SMART approach to setting goals that are specific, measureable, achievable, results-oriented and timely. “That’s something we’ve taken from the workshop and plan on implementing across the board,” he said.

The “Innovation” Web conference series offers access to technical information on an even wider scale.²¹ It features innovative technologies and

practices that can be incorporated into highway construction programs, everything from accelerated bridge construction techniques and ultra-high-performance concrete to work zone best practices and 3D design. Experts from the public and private sectors share real-life experiences with the innovations and invite participants to ask questions. Through “Innovation,” Highways for LIFE partners with the National Highway Institute to use Web conferencing as a time-saving mode of technology delivery that enables highway professionals to learn without incurring travel expenses. Highways for LIFE was an early user of the Web conference format and worked to advance this technology delivery method.

Deployment How-To

When the Highways for LIFE team identified a need for in-depth training in technology deployment, it used its philosophy of accelerated action to develop and deliver a course in pilot format in under a year. The course, “Leap Not Creep: Accelerating Innovation Implementation,” provides transportation professionals with the tools to put innovations to work quickly and make them part of a highway agency’s standard operating procedures.²² A team of technology deployment experts from throughout the highway community partnered with course development



specialists from the National Highway Institute to design the course in less than a year, compared to the three to four years it normally takes. After being piloted in California, the course has been held in seven additional states. It also has been used to train teams for FHWA's Every Day Counts innovation initiative and the second Strategic Highway Research Program's effort to deploy innovative tools and methods.

Not only is the course the National Highway Institute's first on technology deployment, it's the first to combine Web conferencing with classroom time to provide efficient, yet comprehensive, training. The blended format includes a two-hour Web conference participants view on their computers, followed a week or two later by a two-day, in-person session with technology transfer experts. Participants learn the features of successful implementation, components of an implementation plan and strategies for overcoming barriers to adopting innovation. They bring ideas for an innovation they'd like to deploy

and learn the same techniques the Vanguard Technologies teams used to develop marketing plans. By the time they leave, they have the basics of their own plans in place, ready to be fleshed out and implemented by teams in their organizations.

Over the years, FHWA has told and retold the Highways for LIFE story throughout the highway community, encouraging and challenging highway professionals to adopt innovation to improve America's highways. Today, FHWA is building on the Highways for LIFE model of bringing people together to accelerate high-payoff innovations through Every Day Counts, an initiative to deploy innovation centered on cutting project delivery time, enhancing roadway safety and protecting the environment.²³

"Every day we're on the job, we've got to find ways to maximize value to the taxpayers, minimize impact on communities, protect the environment and, above all, keep our highways as safe as possible," said FHWA Deputy

Administrator Gregory Nadeau. “Every Day Counts is an organized way to identify priority innovations that will help our partners achieve those goals most effectively.”

After targeting technologies and techniques to promote, FHWA formed teams of professionals to speed adoption of the concepts. They went through the “Leap Not Creep” training course and participated in retreats to develop action strategies and communications tools, the concepts for which had been extensively field-tested under the Highways for LIFE program.

With the teams and plans in place, it was time to form partnerships throughout the highway community. FHWA spread the message of Every Day Counts to a nationwide audience of state highway agencies and other stakeholders through

a series of regional summits in 2010. The gatherings provided a forum for discussions on the key technologies: prefabricated bridge elements and systems, the Safety Edge, warm-mix asphalt, adaptive signal control and the geosynthetic reinforced soil integrated bridge system. Afterward, individual state agencies worked with FHWA to decide which initiatives they wanted to implement and started moving forward.

It was one of the most comprehensive efforts FHWA has ever put together to engage stakeholders around new ideas. “It was a significant undertaking and one that was absolutely necessary to help people understand the initiatives and start implementing them,” said FHWA Administrator Victor Mendez. “Every Day Counts represents our commitment to moving forward toward the goal of better, faster and smarter project delivery.”

The Highways for LIFE story:

- Highways for LIFE fosters the use of customer-focused performance goals and proven innovations to change the way highways are built and transportation agencies operate.
- It has developed tools, techniques and training highway agencies can use to adopt innovations quickly and use them frequently.
- The momentum continues to grow as culture change spreads throughout the highway community.

◆ Stakeholder Views on *Highways for LIFE*

As the Highways for LIFE initiative began winding down in late 2012, FHWA gathered feedback from key stakeholders, both to assess how well the program achieved its goals and to generate ideas for future programs on innovation deployment. Information was collected from owner-agency representatives, industry suppliers, highway users and industry professionals through focus groups, telephone interviews and an online survey.²⁴

The stakeholders' overall view was that the Highways for LIFE initiative is a good program that focuses needed attention on innovation and it will be a loss when it ends. "It served as an innovation incubator," one survey respondent said. It provided "the invitation to think outside the box," said another.

The general consensus among survey participants was that the program achieved its goals, including improving safety during and after construction, reducing congestion caused by

construction, improving the quality of the highway infrastructure, speeding up construction and reducing construction costs. Participants reported that improving safety was the goal with the highest achievement rate, while cutting costs had the lowest achievement rate.

Positive Program Features

Survey respondents gave high marks to several program features:

- Competitive grants for construction projects using innovation
- Peer-to-peer exchanges that provide opportunities to network with and learn from highway community counterparts around the country
- Demonstration projects that enable transportation professionals to see firsthand how innovation can be deployed
- Flexibility to tailor Highways for LIFE's goals to highway agency needs

In particular, respondents said that offering seed funding for projects created excitement, spurred innovation and provided a buffer that enabled highway agencies to take risks with innovative projects. Nearly half of the respondents noted that pilot project funding was one of the greatest benefits of Highways for LIFE, particularly during a time of constrained funding for the highway system. They expressed disappointment that other FHWA programs do not have a competitive grant component for innovative pilot projects.

“For all of the potential pitfalls and barriers, FHWA has done a great job in encouraging states to try new processes or products,” a survey participant commented. “I hope that a next generation of this program will continue with sufficient funding to encourage the use of innovative products and ideas.”

A positive outcome of the Highways for LIFE program was that it “highlighted innovative construction techniques on a project that otherwise would have gotten little recognition,” a survey respondent said. “I think a national leadership role in encouraging innovation and

providing some funding to support that position was probably the greatest outcome,” another respondent noted.

Ideas for Improvement

Survey participants had several suggestions for improving future programs on innovation deployment:

- More transparency in the selection of pilot projects
- Streamlined requirements for program participation
- More emphasis on recruiting state champions who can drive innovative deployment and provide technical support
- Long-term monitoring of projects to provide agencies with feedback on the performance of innovations
- Increased outreach on innovation and marketing of program activities, particularly to the public
- Better communication between FHWA and state highway agencies

“The paperwork for submission is cumbersome,” a state highway agency official said about the Highways for LIFE project application process. “The process was time-consuming and rigid for



people providing applications that may not fit the mold,” said another respondent.

In recommending broader efforts to market innovation to the public, a respondent said, “No matter how much FHWA feels like it was communicating and marketing the program, it’s difficult to maintain the momentum with all of the changes that states and industry go through over a decade.”

Stakeholder Recommendations

Recommendations on innovation programs that emerged from the research include the following:

- Innovation is best achieved when FHWA provides technical and financial support to State DOTs in the form of competitive grants.



- Collaboration between FHWA and state agencies is important to ensure that programs are flexible, regulatory requirements are reasonable, and state needs and resources are considered.
- Innovative products should not be excluded from programs merely because they are proprietary. Instead, the best options available should be promoted.
- Future programs should streamline the application process and reporting requirements because they deplete scarce time and resources.
- FHWA should identify champions to foster advocacy in States that might not have an obvious champion for innovative initiatives.
- A comprehensive marketing and outreach effort is needed to promote the successes of innovation programs, educate the public and policymakers, and improve perception of Federal and State highway programs.
- FHWA should invest in improving knowledge management infrastructure and processes for sharing lessons learned, best-

practice templates and success stories.

- FHWA regulatory requirements should be simplified to allow States to take ownership and make projects fit their needs and resources.
- Future FHWA programs should have longer project timeframes to ensure sustainability of innovations. They should include long-term monitoring of project performance to gauge the true success of a program.
- FHWA should strive to create a failure-tolerant environment so that States do not fear taking risks.

Encouraging appetite for risk is key to the success of future innovation programs, survey respondents said. “Programs like Highways for LIFE help lay the foundation for top leadership and industry to accept and promote innovation-driven contracts,” one said. “The Highways for LIFE program enables states to try something new,” another commented.



“For all of the potential pitfalls and barriers, FHWA has done a great job in encouraging states to try new processes or products” — *survey participant*

◆ Legacy for the *Future*

Since 2005, Highways for LIFE has brought a higher level of innovation and technology to improving America's roadways. It has advanced a business model that focuses on setting customer-based performance goals and seeking the best solutions to meet those goals. It has encouraged a culture that routinely invites proven, market-ready innovation and rapidly adopts new practices. It has emphasized effective technology deployment and improved ways to get innovation into mainstream use faster.

Through Highways for LIFE, the highway community has begun to harness the power of innovation by identifying, promoting and deploying available technologies with immediate, tangible benefits. It has begun the process of greatly accelerating innovation use so America's travelers can experience the benefits years sooner than in the past. As a result, highway agencies and industry are seeing the value of using innovation when it's the right choice to meet transportation challenges and meet customers' needs.

- *The highway community is accelerating the use of innovation, such as warm-mix asphalt on a Northern California highway, so travelers can experience the benefits sooner than in the past.*



Innovation Lessons

In addition to the many tools, techniques and resources created under the initiative to enhance innovation use, Highways for LIFE has yielded valuable lessons that will benefit the highway community as it continues its efforts to mine the full potential of innovation to improve the way highways and bridges are built:

Proven, readily available innovations can be used on construction projects to save money, increase safety, minimize construction impact on road users and extend the time until roads and bridges need to be rebuilt or repaired. Barriers to innovation in the highway community include the desire to do what is familiar, lack of confidence or understanding, risk of failure, additional cost and potential delays.

Innovation should be used on a project because it is the best solution available to meet customer-focused performance goals. Highway agencies and contractors should assure that customer needs and performance goals

drive the use of a new technology, not design a project around the use of that technology.

Although hundreds of millions of dollars are spent on highway research, only a fraction is dedicated to deploying innovations and making them standard practice. Some believe efforts to expand innovation can stop at the research level and innovations will be adopted automatically. While funding research is important, adequate resources—both qualified people and funding—also need to be dedicated to technology deployment. Successful deployment cannot end with introduction of a technology. It requires focused follow-through all the way to mainstream implementation.

Transportation agencies need effective incentive mechanisms to encourage the use of new technologies. Agencies face many barriers to innovation, including funding limits and low tolerance for risk-taking because of public scrutiny and accountability.

● *Proven innovations, including the accelerated bridge construction techniques used on a Massachusetts project, can enhance safety, reduce traffic congestion and extend the time until roads and bridges need to be rebuilt.*

A program that encourages agencies to try new ideas by providing financial support and technical assistance helps them overcome barriers.

A valuable way to advance innovation implementation is to enable potential users to witness new construction techniques firsthand.

When potential users can see an innovation in action during a technology demonstration or project showcase, they get a better understanding of its uses and benefits. They also gain confidence that the innovation works in real-life applications.

Peer group support and exchange are valuable tools in advancing innovation implementation. Highway professionals have great trust in what their peers tell them. They can learn much from their colleagues' experiences using new technologies and benefit from technical advice on how to implement innovation in their own organizations.

The private sector is a reservoir of innovation and creativity. Conventional approaches to project delivery do not always encourage creativity and innovation. The use of incentives and performance goals provides the opportunity for the private sector to step forward with its insights and capabilities.

Bringing industry and highway agencies together to develop and test prototypes of promising innovations that benefit road users and highway agencies helps those innovations get to the marketplace faster. FHWA is filling a significant funding gap by providing grants that target late-stage development of innovative prototypes and evaluation of useful technologies that have had little or no application on U.S. highways.

FHWA's institutional knowledge and extensive network of contacts in the highway community enable it to play a national leadership role in technology advancement and deployment. In many cases, stakeholders become involved in initiatives such as Technology Partnerships and Vanguard Technologies because FHWA is leading the effort and brokering the participation of other transportation agencies, organizations and industry.

It's important to involve stakeholders at all levels—national, state and local—early in the innovation implementation process. Stakeholder input and support are essential to make implementation a success. Not only does early involvement of stakeholders help overcome resistance to new techniques and practices, it also enables them to offer their own insights and gear up to use innovations effectively.

Members of the public—the highway system's ultimate customers—are more satisfied with the results of a project if they are informed beforehand about its purpose and the innovations planned to enhance its outcome and given the opportunity to offer input. Surveys also show that road users are more appreciative of highway agencies' efforts if they are kept informed and involved throughout the construction process.

Combined, the resources and lessons that have resulted from the Highways for LIFE initiative create a legacy that the highway community can continue to tap in the future. The initiative's philosophy and concepts are designed to become a way of life for transportation stakeholders. Already, highway agencies and industry are adopting the customer-focused performance model and rapidly making innovations that enhance transportation system performance standard practice. Many aspects of Highways for LIFE are reflected in the FHWA Every Day Counts initiative to shorten project delivery time and the second Strategic Highway Research Program to develop innovative tools and practices that advance highway performance and safety. The Moving Ahead for Progress in the

● *To enhance safety and efficiency when it relocated a bridge over the Providence River, the Rhode Island DOT built the structure off-site, loaded it onto barges and floated it into place.*

21st Century Act includes provisions designed to encourage innovation use and speed up project delivery. All of these efforts will strengthen the highway community's ability to use technology effectively and greatly accelerate the deployment of proven, high-payoff innovations. It will change the way the nation builds highways to improve the American driving experience.



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