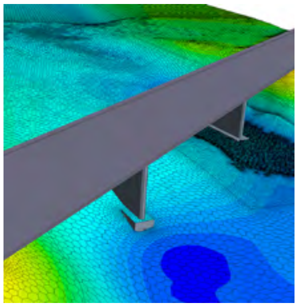
On-Ramp to Innovation
every day counts

U.S. Department of Transportation
Federal Highway Administration





Every Day Counts:

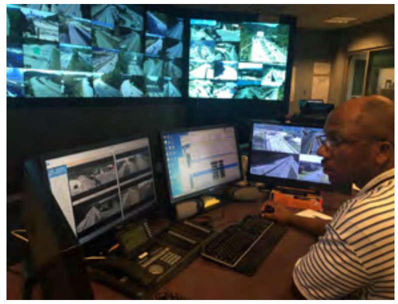
An Innovation Partnership With States

EDC-4 Final Report

April 2019

Foreword






Every Day Counts (EDC) is a Federal Highway Administration program to advance a culture of innovation in the transportation community in partnership with public and private stakeholders. FHWA coordinates rapid deployment of proven strategies and technologies to shorten the project delivery process, enhance roadway safety, reduce congestion, and improve environmental outcomes through this State-based effort.

This report summarizes the December 2018 status of innovation deployment for the 11 innovations in the fourth round of EDC and highlights innovation success stories. It is intended to be a resource for transportation stakeholders as they implement innovation deployment plans and encourage ongoing innovation in managing highway project delivery, better serving the Nation.

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"Every Day Counts inspires State and local governments to adopt cutting-edge technologies and practices in their ongoing quest to save lives, shorten project delivery, improve overall quality, and minimize cost to the taxpayer."

Brandye Hendrickson, FHWA Deputy Administrator

Every Day Counts: An Innovation Partnership With States

Every Day Counts (EDC) is a Federal Highway Administration program that works in partnership with the **American Association of State Highway and Transportation Officials** (AASHTO) and other transportation stakeholders to foster a culture of innovation. It focuses on accelerating project delivery and deploying proven innovations that facilitate greater efficiency at State and local levels. EDC is designed to complement other initiatives promoting innovative technologies and practices, playing an important role in helping transportation agencies fulfill their obligation to the American people—deliver the greatest value for the tax dollars spent.

Every two years, FHWA works with State departments of transportation, local governments, tribes, private industry, and other stakeholders to identify a new set of innovative technologies and practices that merit widespread deployment through EDC. Selected innovations share common goals: shortening project delivery, enhancing the safety and durability of roads and bridges, cutting traffic congestion, and improving environmental sustainability. **EDC round four** (EDC-4) promoted adoption of 11 innovations in 2017 and 2018, built on the success of previous deployment efforts.

After the process of selecting EDC innovations for each 2-year deployment cycle is completed, transportation leaders from across the country gather at regional summits to discuss the innovations and commit to finding opportunities to implement those that best fit the needs of their State transportation programs. After the summits, **State Transportation Innovation Councils** (STICs), which bring together public and private stakeholders, meet to evaluate innovations and spearhead their deployment. STICS are active in all 50 States, Washington, DC, Puerto Rico, the U.S. Virgin Islands, and Federal Lands Highway (FLH).

EDC's collaborative, State-based approach to deploying innovation enables States to determine which innovations will work best for them and their customers. States, working through STICs, can consider EDC innovations along with other recommendations from sources such as the AASHTO **Innovation Initiative** and the **second Strategic Highway Research Program,** adopting those that add value to their transportation programs.

FHWA's role in the EDC process is to provide national leadership in encouraging adoption of innovations that can improve the Nation's transportation system. The agency forms a multiagency deployment team for each EDC innovation to assist States in implementation efforts. Using feedback from stakeholders obtained through communication opportunities such as EDC summits, teams offer technical assistance, training, and outreach to help the transportation community adopt innovations and make them standard practice.

FWHA also offers assistance through its **STIC Incentive** and **Accelerated Innovation Deployment (AID) Demonstration** programs to encourage and provide incentives for innovation deployment. The STIC Incentive program provides up to $100,000 a year per STIC to help make innovations standard practice. The AID Demonstration program provides an incentive up to $1 million to support the cost of deploying an innovation in any phase of a highway project. The program allocates up to $10 million a year in incentive funds.

The EDC program has had a significant positive impact on the transportation community's adoption of new technologies and processes. Since the program began, every State transportation agency has used 14 or more of the 43 EDC innovations, and some have adopted more than 30. Many of these innovations are now mainstream practices across the country. The 2015 **Fixing America's Surface Transportation Act** included EDC by name, directing FHWA to continue fostering a culture of innovation with stakeholders to deploy innovative practices and technologies.

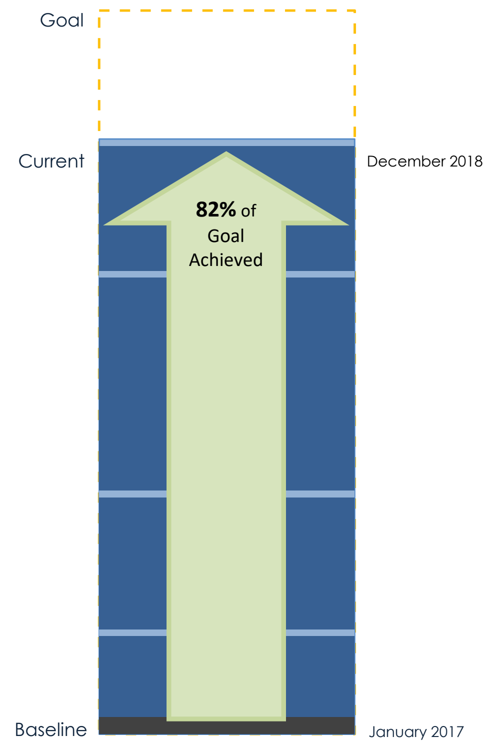
EDC-4 Innovation Implementation

Every six months, FHWA compiles a status report on the state of practice for the current round of EDC innovations. This section provides details on the 11 innovations in EDC-4 and includes maps and charts that show the progress made in advancing the technologies and practices by the end of December 2018.

The maps illustrate the innovation implementation stage in each State. The charts show the number of States that have demonstrated, assessed, or institutionalized the innovation. The charts also compare the December 2018 state of practice to the January 2017 baseline data and December 2018 goals set by States.

"State" is used as a general term that includes the State transportation department, metropolitan planning organizations, local governments, tribes, private industry, and other stakeholders in a State or territory. Information is provided for the 50 States, Washington, DC, Puerto Rico, the U.S. Virgin Islands, and FLH, a total of 54 entities.

The following table defines the innovation deployment stages displayed on the maps and chartts.



Attainment of Demonstration, Assessment, or Institutionalized Implementation Across All Innovations and States
Final Report

Innovation Implementation Stages

Not Implementing	The State is not using the innovation anywhere in the State and is not interested in pursuing the innovation.
Development Stage	The State is collecting guidance and best practices, building support with partners and stakeholders, and developing an implementation process.
Demonstration Stage	The State is testing and piloting the innovation.
Assessment Stage	The State is assessing the performance of and process for carrying out the innovation and making adjustments to prepare for full deployment.
Institutionalized	The State has adopted the innovation as a standard process or practice and uses it regularly on projects.

Automated Traffic Signal Performance Measures

Automated traffic signal performance measures (ATSPMs) will revolutionize the management of traffic signals by providing the high-resolution data needed to actively manage performance. High-quality service can be delivered to customers with significant cost savings to agency maintenance and operations. They enable transportation agencies to incorporate objectives and performance-based approaches in traffic signal operations, maintenance, design, and management. Using ATSPMs can improve safety and customer service while cutting congestion and costs.

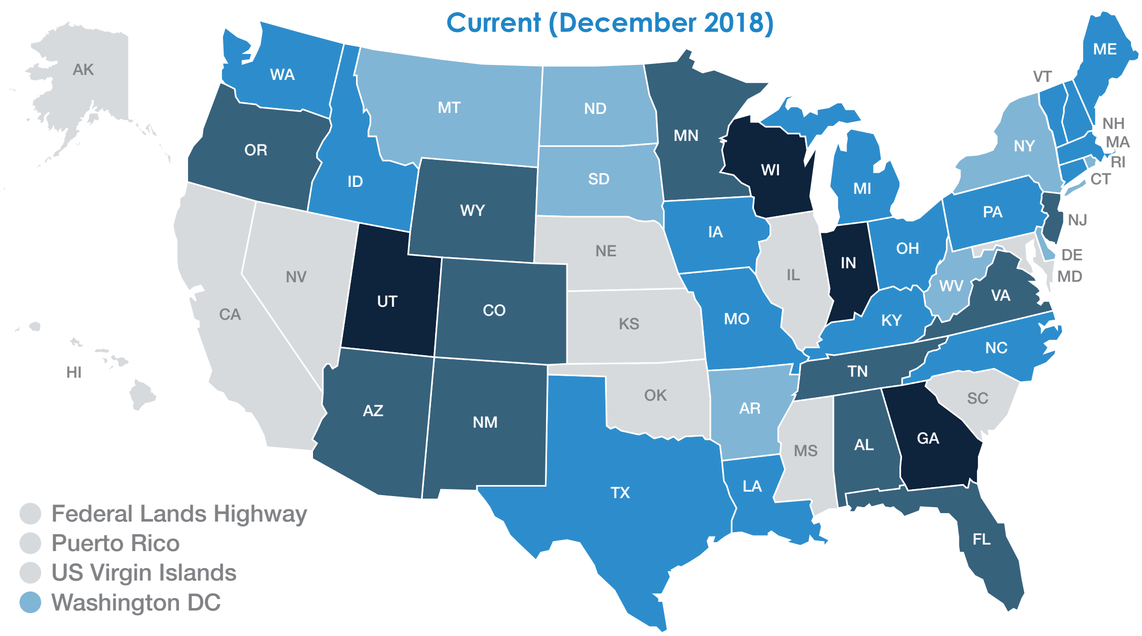
More than 330,000 traffic signals operate in the United States. Typically, agencies retime signals on a 3- to 5-year cycle at a cost of about $4,500 per intersection. Citizen complaints are the primary performance measure for most signals. The need to use software modeling to simulate performance and manually collected traffic data drives up retiming costs.

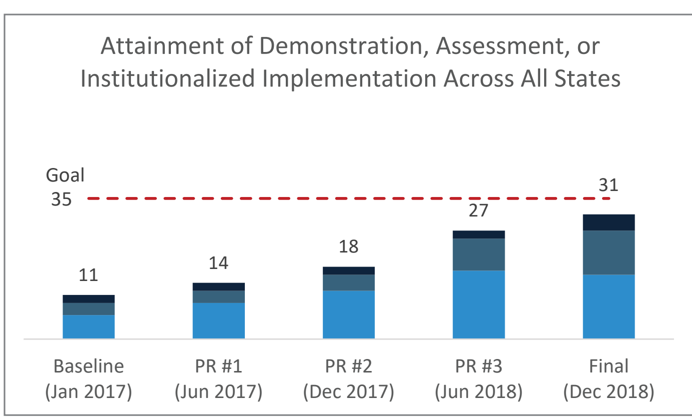
ATSPMs consist of a high-resolution data-logging capability added to existing traffic signal infrastructure and data analysis techniques. This cost-effective technology provides the information needed to manage traffic signal maintenance and operations in support of an agency's safety and mobility goals.

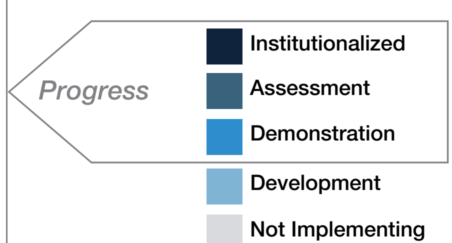
Thirty-one States attained demonstration, assessment, or institutionalized stages of ATSPM implementation in EDC-4.

View **Innovation Spotlight: Automated Traffic Signal Performance Measures**.

Innovation Spotlight







Innovation Spotlight

| Automated Traffic Signal Performance Measures |

In California, the San Francisco Bay Area's Metropolitan Transportation Commission developed a $13 million challenge grant program called **IDEA: Innovative Deployments to Enhance Arterials**. The commission launched the IDEA initiative after a seminar for agencies in the region sparked interest on how ATSPM technology enhances safety and mobility and reduces congestion at signalized intersections. The initiative's objective is to help Bay Area cities and counties improve the operation of major arterial roadways and prepare them for connected and automated vehicle technologies. Among the IDEA applications were 11 to support implementation of ATSPM projects. The commission has begun systems engineering for many of the projects, which are expected to provide a foundation for continued expansion of ATSPM in California.

Automated Traffic Signal Performance Measures

An **Arizona** network is modernizing signal management by piloting the country's first regional ATSPM system. Maricopa County spearheaded the ATSPM implementation through a collaborative effort with the AZTech regional traffic management partnership, Arizona Department of Transportation (ADOT), and local agencies in the Phoenix area. The program started in 2016 with 70 signalized intersections and today integrates 273 signals equipped with high-resolution controllers. After successfully overcoming controller setup and data transfer challenges, Maricopa County and the city of Tempe are using their experience to help partner agencies troubleshoot common challenges associated with implementing ATSPMs.

In **Florida**, the city of Tallahassee deployed ATSPMs on 40 signals and expanded its data storage capability to accommodate the influx of new data. ATSPMs are helping city engineers monitor signals and critical detectors for malfunctions, track arrivals on red and green lights, reduce delays, and improve progression at several intersections. Seminole County implemented ATSPMs on its 383 signals and reports that ATSPMs reduced the need to conduct traffic counts, making data collection funding available for other initiatives. After requesting help with ATSPM data storage, Seminole County and other local agencies transitioned to Florida Department of Transportation (FDOT) District 5 servers. FDOT District 5 installed ATSPMs on more than 500 traffic signals and plans to double deployment to 1,000 signals. FDOT defined a Statewide Arterial Management Program identifying ATSPMs as a traffic signal control strategy.

Automated Traffic Signal Performance Measures

The **Georgia Department of Transportation** (GDOT) uses ATSPM as a primary tool to improve operations and manage maintenance. GDOT traffic engineers use data visualizations from the ATSPM system to determine if a signal retiming project is producing benefits. GDOT also uses ATSPM data when developing alternate routing plans for events and emergencies. GDOT reports ATSPMs enable the agency to diagnose problems and focus resources across its entire system.

In **Kansas**, the cities of Overland Park and Olathe have implemented ATSPMs. Both agencies have actively supported the advancement of the technology by sharing their experience and knowledge during ATSPM Workshops in MO, CA, GA, and IA. The City of Overland Park has adopted an objectives and performance based approach to managing, operating and maintaining signalized intersections and traffic signal systems and is working to support incorporation of ATSPM into the agency's central traffic signal system.

In **New Mexico**, the City of Albuquerque worked with the ATSPM EDC-4 team to learn more about ATSPMs through coordinated peer to peer knowledge transfer. City traffic engineers worked with local vendors to explore and plan a pilot implementation of ATSPMs. The city shared their systematic process for planning and funding the deployment of ATSPM in Albuquerque during a national webinar in January 2018.

The **Pennsylvania Department of Transportation** (PennDOT) is piloting ATSPM technology at multiple sites and developing an implementation framework to guide ATSPM deployment at local agencies. PennDOT is also advancing ATSPMs by collaborating with other States in Transportation Pooled Fund Study TPF-5(377) on Enhanced Traffic Signal Performance Measures. PennDOT is leading the development of tools to evaluate delay, reliability, variation, and environmental impacts using vehicle probe data. This fusion of data will support trend analysis over regional areas and time periods, enabling users to evaluate the long-term effectiveness of activities resulting from performance-based traffic signal management.

The **Utah Department of Transportation** (UDOT) developed open-source **ATSPM software** and collaborated with FHWA to host it on the FHWA Open Source Application Development Portal. The ATSPM software was later transitioned to an **open-source software collaboration platform** that supports ongoing enhancement by public agencies and private industry. UDOT staff participated in peer-to-peer workshops, webinars, and user group conference calls to share their experience with day-to-day management, operation, and maintenance of ATSPM technology. After installing and evaluating the UDOT ATSPM software, the Indiana Department of Transportation (INDOT) is making the connection of traffic signals a priority. The agency has scheduled capital projects over the next 5 years that will implement ATSPMs on all of INDOT's 2,500 traffic signals.

As EDC-4 began, the **Vermont Agency of Transportation** (VTrans) was completing a Traffic Signal Management Plan detailing an objectives- and performance-based approach to traffic signal management, operations, and maintenance practices. VTrans explored integrating ATSPMs into planned traffic signal system upgrades and embarked on a scan tour to evaluate the technology and organizational capability requirements to support successful deployment. VTrans engineers visited Indiana, Georgia, and Utah to gain insights and establish peer-to-peer relationships that facilitated pilot implementation and subsequent deployment of ATSPMs. VTrans, in turn, provided peer support to Montana by sharing its deployment experience at an ATSPM workshop.

Collaborative Hydraulics: Advancing to the Next Generation of Engineering (CHANGE)

The initiative on **collaborative hydraulics: advancing to the next generation of engineering** (CHANGE) uses hydraulic tools to improve understanding of complex interactions between river or coastal environments and transportation assets. This enables better design and more efficient project delivery.

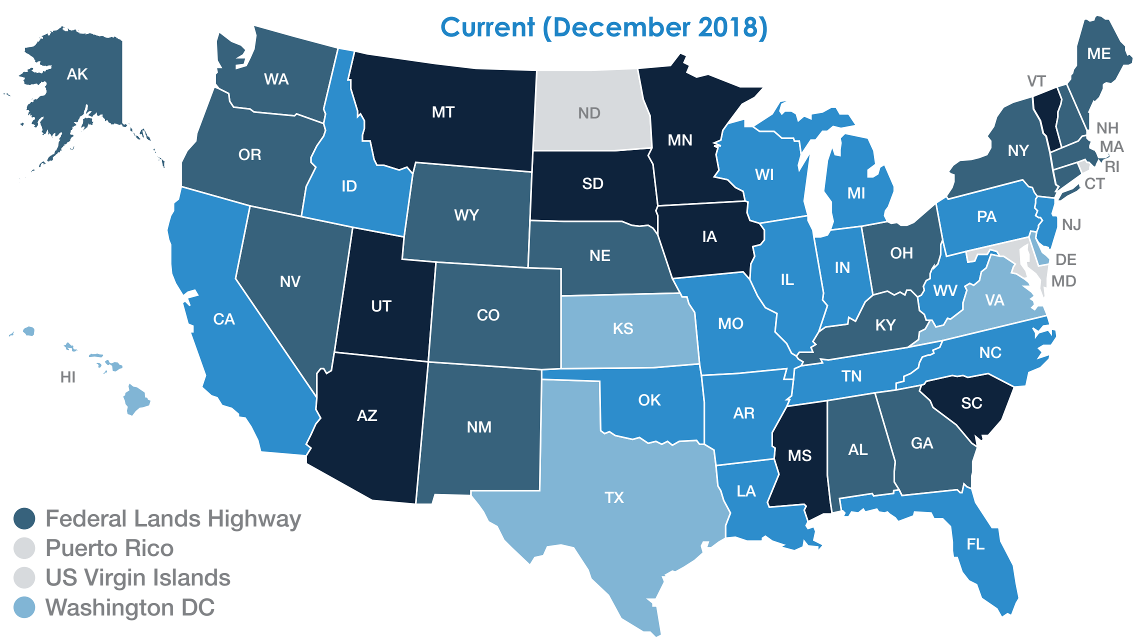
The next generation of hydraulic engineering tools provides planners and designers data they can use to improve project quality. The technology can be used to illustrate patterns of flow discharge, water surface elevations, depth, velocity, and shear stress. Results allow for more accuracy estimating flow conditions and paths, evaluating hydraulic considerations, and assessing extreme weather event scenarios.

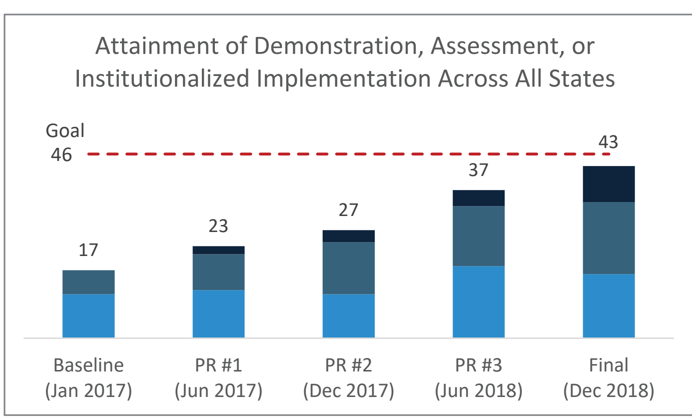
These new hydraulic modeling tools represent a significant evolution in hydraulic modeling theory and practice, with potential for streamlining environmental, regulatory, engineering, and other aspects of project delivery. Results can improve the ability of highway agencies to design safer, more cost-effective, and resilient structures on waterways.

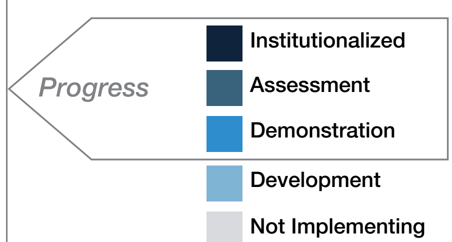
Forty-three States reached demonstration, assessment, or institutionalized stages of CHANGE implementation.

View **Innovation Spotlight: Collaborative Hydraulics: Advancing to the Next Generation of Engineering**.

Innovation Spotlight



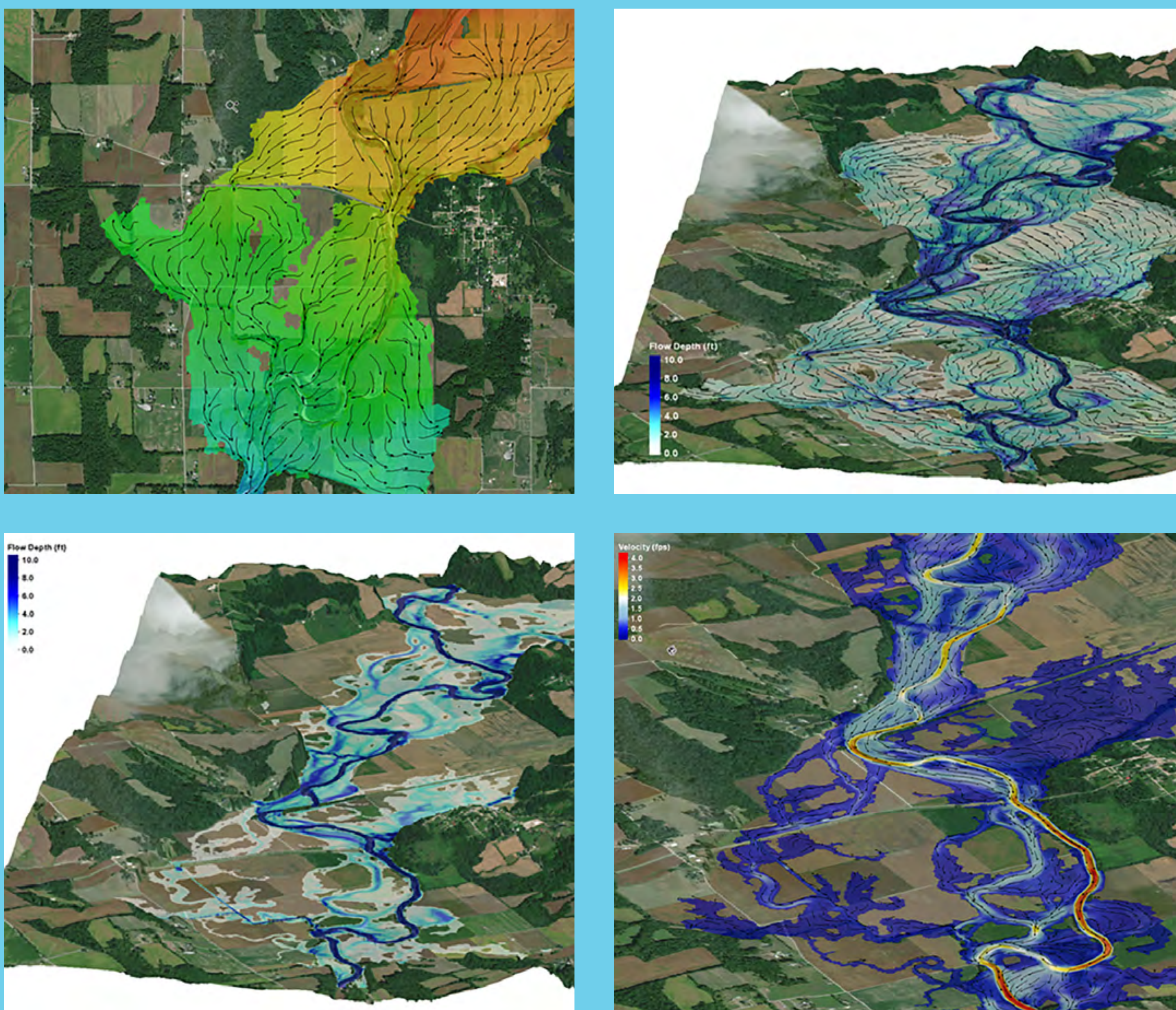




Innovation **Spotlight**

|Collaborative Hydraulics: Advancing to the Next Generation of Engineering (CHANGE)|

A demonstration project in Indiana highlighted the enhanced accuracy of two-dimensional (2D) hydraulic modeling, one of the technology's key benefits. INDOT compared one-dimensional (1D) and 2D modeling results and measured gage (water level) data at a multiple-opening bridge crossing on the Eel River. INDOT found that 2D modeling results were within about 5 percent of the measured values at the bridge crossing, while 1D modeling results were more than 40 percent different than what was measured.

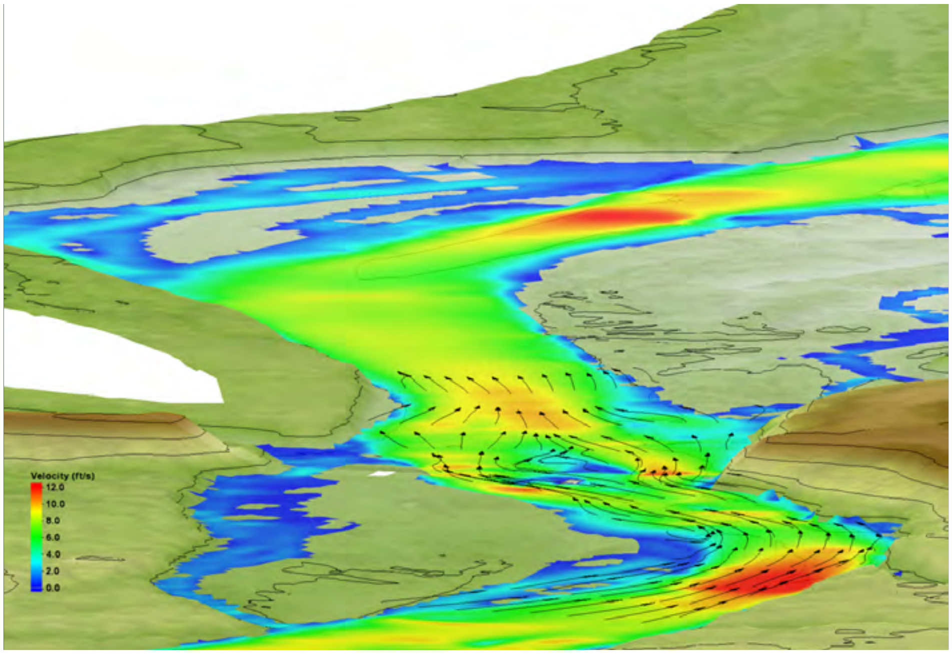


Credit: Indiana Department of Transportation

At an Eel River bridge crossing, the Indiana Department of Transportation confirmed that 2D hydraulic modeling is more accurate than 1D modeling.

Collaborative Hydraulics: Advancing to the Next Generation of Engineering (CHANGE)

In **Arizona**, ADOT conducted several comparisons of 2D and 1D modeling tools. ADOT discovered benefits of 2D modeling over 1D modeling including: more accurate representations of water surface elevations, velocities, and flooding extents; superior visualization of modeling results; and better linkage of 2D modeling tools with advanced surveying methods. With the successful completion of 2D modeling pilot projects and the implementation of new guidance, ADOT noted agency leadership has a greater understanding that 2D hydraulic modeling tools are practicable, cost-effective, and superior to traditional methods.



The **Central Federal Lands Highway Division** hydraulics team completed several complex hydraulics projects using 2D hydraulic modeling to quantify and visualize flow patterns, which led to more informed discussions with the project team during project development. Following a significant flash flood in Death Valley National Park, 2D modeling enabled the hydraulics team to evaluate complex flow patterns and the project team to identify critical roadway sections that required realignment or additional hydraulic structures to protect the roadway from future flood events. FLH expects the result to be a more sustainable roadway.

The **Colorado Department of Transportation** (CDOT) used 2D modeling to design repair work after a 2013 presidential emergency disaster declaration for flooding. Analysis with 2D modeling saved more than $9 million in construction costs on the U.S. 34 repair project along the Big Thompson River, and CDOT applied the methods used to value-engineer savings on other projects in northeastern Colorado. Collectively, CDOT documented $13.5 million in construction material savings by applying 2D hydraulic analyses to reduce design risk and uncertainty. CDOT is adapting its 2D analytical process to develop a statewide framework that it expects to save $20 million a year, inform CDOT resiliency measures and metrics, and enhance safety.

In **Georgia**, GDOT experienced the benefits of 2D modeling on several bridge replacement projects. Through the knowledge exchange opportunities provided in EDC-4, GDOT streamlined its hydraulic modeling and data gathering processes and found that 2D projects, which in the past needed extra time budgeted in the schedule, were completed in roughly same amount of time as a typical 1D modeling project. GDOT also found that results generated by 2D modeling were more accurate and easier to interpret visually than traditional 1D models.

The **Illinois Department of Transportation** (IDOT) used a multiyear process to retool from 1D to 2D hydraulic modeling. IDOT used STIC Incentive funds to pursue 2D hydraulic modeling training and develop three 2D courses to further the agency's knowledge base on the technology. IDOT's initial 2D modeling efforts have improved scour design recommendations at several major river crossings.

Collaborative Hydraulics: Advancing to the Next Generation of Engineering (CHANGE)

The **Mississippi Department of Transportation** (MiDOT) has incorporated 2D modeling into all its hydraulic analysis. In Jackson, it was successfully used to analyze a particularly complicated project. The Lynch Creek project is in an urban area with skew and a series of State-maintained bridges as well as local bridges and a culvert under a string of buildings. Using the 2D modeling technology, the images showed water flows and elevations at a glance that helped visualize the project for leadership and elected officials.

The **South Dakota Department of Transportation** (SDDOT) completed several 2D models and gained a better understanding of hydraulic response at complex locations involving waterways that would have been difficult to represent with traditional 1D modeling. In one example, 2D hydraulic modeling provided SDDOT with insight on a recurring highway overtopping location and justified a moderate reinforced concrete box culvert increase and ditch block to prevent future occurrences.

The **Washington Department of Transportation** (WSDOT) conducted a hydraulic modeling pilot project on the Sauk-Suiattle Confluence River, one of the State's **chronic environmental deficiency** (CED) sites where frequent road repairs impact fish and fish habitats. The CED program focuses on long-term solutions to optimize improvements for fish while addressing transportation needs. WSDOT completed a preliminary hydraulic design with the **SRH-2D hydraulic model**, which proved to be effective in demonstrating areas of concerns in the project to stakeholders and resource agencies. WSDOT plans to continue to implement 2D modeling in its hydraulic designs and hydraulic manual for future projects.

Community Connections

Community connections are performance management approaches for planning, designing, and building transportation projects that promote connectivity, revitalize communities, and improve public health and safety.

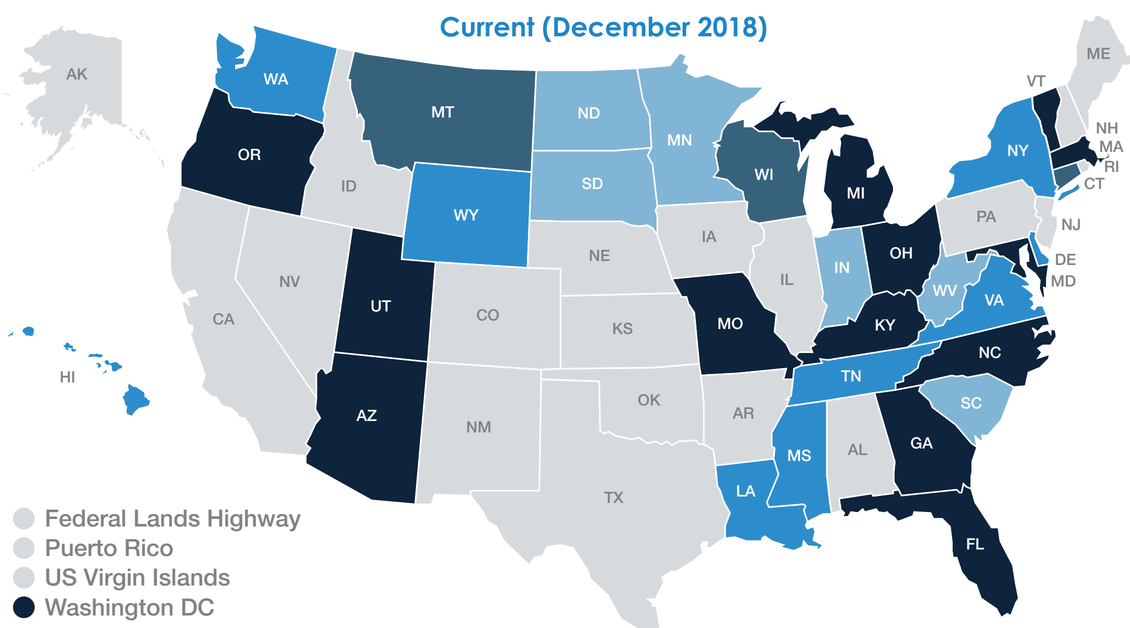
Transportation can play an important role in supporting community revitalization. Using performance-based management approaches can help transportation agencies develop highway retrofitting, rehabilitation, or removal options that turn aging infrastructure into opportunities for reestablishing community connections and cohesion.

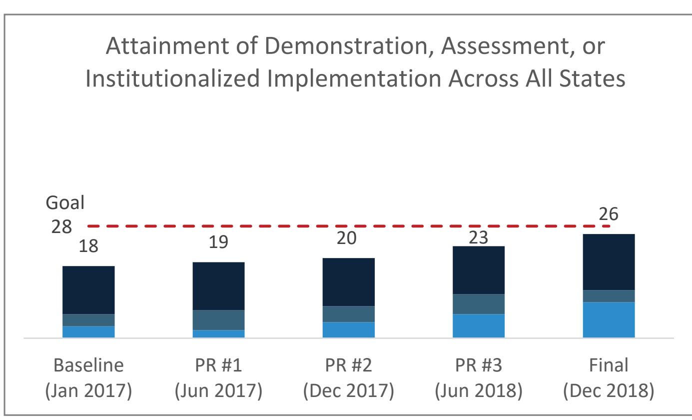
Strategies planners and designers can use to connect communities and retrofit transportation infrastructure include visualization tools, scenario planning techniques, public involvement techniques, context-sensitive solutions, and design and construction processes. The community connections framework and tools can help agencies identify gaps and work to ensure that all users have access to safe, reliable, affordable, and multimodal transportation networks.

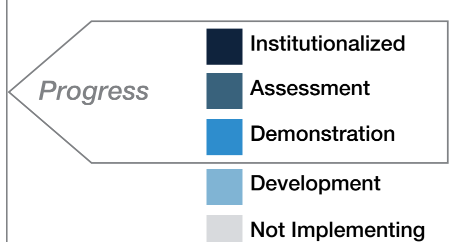
Twenty-six States achieved demonstration, assessment, or institutionalized stages of implementing community connections strategies.

View **Innovation Spotlight: Community Connections**.

Innovation Spotlight







Innovation Spotlight | Community Connections |

The **Ohio Department of Transportation** (ODOT), which institutionalized community connections, developed an **Active Transportation Policy** to direct its planners and engineers to consider the need for community connections on all projects. The agency routinely evaluates projects for safe, convenient access for all users, including pedestrians, bicyclists, transit users, and motorists, and assesses how connectivity will be provided or enhanced between neighborhood, commercial, institutional, and recreational destinations. ODOT also partnered with Stark County's metropolitan planning organization to use STIC Incentive funds to develop a planning and analysis tool for scenario planning along Interstate 77 in Canton. The decision matrix, which allows input of multiple variables, aids in making informed choices on how to connect communities and optimize the flow of people.

Community Connections

In **Arizona**, ADOT is partnering with the Maricopa Association of Governments to use AID Demonstration funds to develop a regional geographic information system (GIS) for the Sun Corridor megaregion. Partnering agencies will use the **Sun Cloud** data portal to collect and analyze socioeconomic and transportation performance data. The goals are to help community leaders make transportation decisions that improve safety, equity, and mobility and to streamline the project development and environmental review processes.

The **Connecticut Department of Transportation** (CTDOT) launched the **Community Connectivity Grant Program** to support pedestrian and bicycle safety and accessibility in urban, suburban, and rural community centers. The program provides construction funding for local initiatives that make roadway conditions safer for people of all ages to walk, bike, and use transit. The grants also target strengthening Connecticut's community centers and fostering more accessible places to live and work.

The **Delaware Department of Transportation** (DelDOT) partnered with the Wilmington Area Planning Council (WILMAPCO) to provide interactive public outreach opportunities for the update to WILMAPCO's 2050 Regional Transportation Plan using STIC Incentive funds. WILMAPCO hosted an online virtual workshop for stakeholders, developed a series of informational displays, and conducted pop-up meetings at local community events. The interactive public outreach doubled prior engagement from participants and received 634 comments.

The **Hawaii Department of Transportation** (HDOT) partnered with Smart Growth America (SGA) to improve HDOT's business processes for transportation planning, design, construction, operations, and maintenance. HDOT and SGA identified ways to make HDOT's planning and decision-making processes more practical and multimodal and improve performance-based outcomes. HDOT and SGA are now working on project prioritization guidelines to address safety, system preservation, community access, congestion, and environmental impacts for all travel modes while reducing costs.

The **Michigan Department of Transportation** (MDOT) used STIC Incentive funds to improve its Multimodal Development and Delivery (M2D2) approach and institutional capacity to plan, design, construct, operate, and maintain the State's transportation system. M2D2 helps MDOT consider complete streets and the interactions of all modes of travel, such as automobile, transit, bicycle, pedestrian, truck, rail, and aviation, from a capital investment, physical construction, and operational perspective.

The **Minnesota Department of Transportation** (MnDOT) established an Office of Community Connections to advance innovative planning and design techniques, public involvement strategies for reconnection, and multimodal operational improvements. The Office of Community Connections is building partnerships with stakeholders and analyzing opportunities to improve MnDOT's planning and environmental review processes.

The **New York State Department of Transportation** (NYSDOT) is developing a GIS to analyze potential transportation projects for opportunities to establish community connections. NYSDOT is testing the system using funding applications for the Transportation Alternatives Program and the Congestion Mitigation and Air Quality Improvement Program. The programs support bicycle, pedestrian, multiuse path, and nonmotorized transportation-related projects, as well as projects to reduce congestion and improve air quality.

With the help of STIC Incentive funds, the **Oregon Department of Transportation** (ODOT) is partnering withcOregon State University to develop a new standard for public transit ridership data based on the **General Transit Feed Specification** (GTFS) format for transit schedules, fares, and geographic information. The goals of the partnership are to promote the new **GTFS-ride** data standard and develop software tools to support more informed investment decisions. GTFS-ride standard allows for improved data collection, storing, sharing, reporting, and analysis.

Community Connections

The **Tennessee Department of Transportation** (TDOT) is assisting rural communities with multimodal planning through **Community Transportation Planning Grants**. TDOT provides funding and technical assistance to cities and towns to develop planning documents for complete streets, bicycle and pedestrian accessibility, **road diets**, transportation systems management and operations, and community mobility. The goal is to support community visions, local land use objectives, and statewide transportation goals for safety, mobility, and efficiency.

The **Washington State Department of Transportation** (WSDOT) and city of Mercer Island are partnering to develop a master plan for the **Aubrey Davis Park** highway lid over Interstate 90. The plan will establish long-term vision for facilities, trails, and open space in the 25-year-old, 90-acre park. WSDOT and Mercer Island are collecting stakeholder feedback to incorporate into the plan through community open houses, online surveys, and a **virtual town hall**.

Data-Driven Safety Analysis

Data-driven safety analysis (DDSA) uses tools to analyze crash and roadway data to predict the safety impacts of highway projects, enabling agencies to target investments with more confidence and reduce severe crashes on roads.

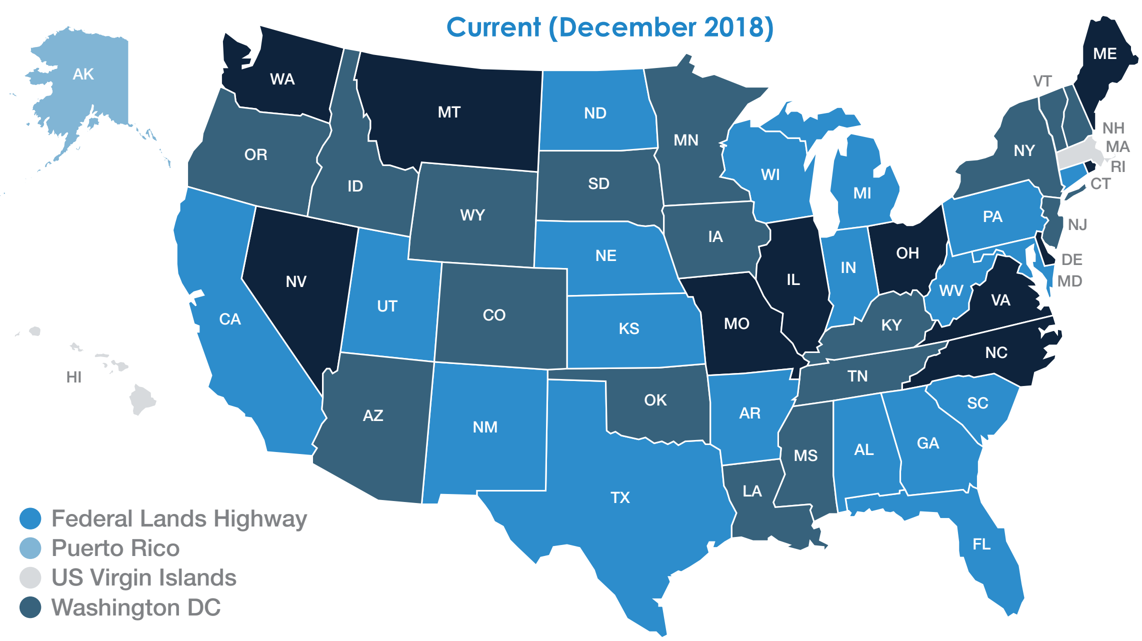
Traditional crash and roadway analysis methods rely mostly on subjective or limited quantitative measures of safety performance. DDSA employs new, evidence-based models that provide agencies with the means to quantify safety impacts. In EDC-4, FHWA continued to help States incorporate DDSA into processes and policies, but a new focus was on assisting local agencies in gaining proficiency with DDSA tools.

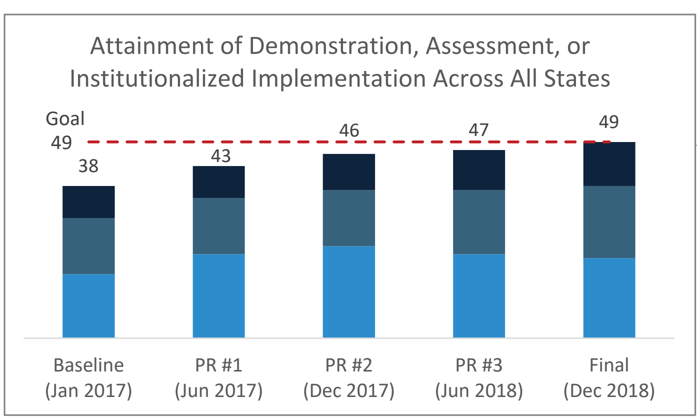
DDSA includes two approaches agencies can implement individually or in combination. Predictive analysis helps identify roadway sites with greatest potential for improvement and quantify expected safety performance of project alternatives. Systemic analysis uses crash and roadway data to identify roadway features that correlate with particular crash types.

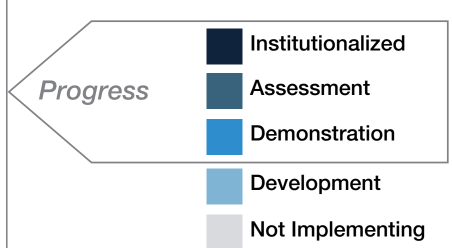
Forty-nine States attained demonstration, assessment, or institutionalized stages of DDSA implementation.

View **Innovation Spotlight: Data-Driven Safety Analysis**.

Innovation Spotlight







Innovation Spotlight | Data-Driven Safety Analysis |

The Arizona DDSA team, chaired by ADOT and the Maricopa Association of Governments, made progress in expanding DDSA capabilities in the State. The team partnered with the Arizona Governor's Office of Highway Safety, law enforcement agencies, and local planning and engineering departments to implement three tools to enhance the quality and analysis of crash data. This data included the 2017 Arizona Traffic Crash Form, the new Arizona Crash Information System, and the **AASHTOware® Safety Analyst** predictive modeling tool. ADOT used the Arizona Crash Information System to conduct regional and statewide network screening and continues to provide system access to regional and local agencies. The Navajo Nation is using FHWA Tribal Transportation Safety Program funds to deploy Traffic and Criminal software for law enforcement personnel, enabling progress using electronic crash reporting.

Credit: tashka www.fotosearch.com

Data-Driven Safety Analysis

The **Alaska Department of Transportation and Public Facilities** (DOT&PF) has started a review of Model Inventory of Roadway Elements (MIRE) data elements to identify elements deemed essential for an Alaska-specific, robust systemic safety process, intended to improve Alaska's Highway Safety Improvement Program. The systemic process will be based on FHWA's Systemic Safety Project Selection Tool. Input from regional personnel is being used to develop cost estimates from data collection. When the review is complete, DOT&PF will collect roadway data necessary to make improved decisions for selection of systemic safety projects, using the process laid out in FHWA's **Systemic Safety Project Selection Tool**.

The **California Department of Transportation** (Caltrans) expanded DDSA capabilities in several areas. Caltrans conducted a data readiness analysis for the AASHTO **Highway Safety Manual** (HSM), performed a data assessment of the Statewide Integrated Traffic Record System, and modified **Highway Safety Improvement Program** (HSIP) guidelines with new methodologies and tools. The agency developed guidance for incorporating HSM into project analysis, building on a pilot effort using predictive analyses to quantify safety impacts of alternatives, design exceptions, and performance-based practical design. Caltrans initiated a project to create data definitions, quality assurance procedures, and performance measures so metropolitan planning organizations and local agencies can collect **Model Inventory Roadway Elements** (MIRE) data and perform robust safety analysis.

Colorado advanced DDSA at State and local levels. On the State system, CDOT performed HSM-based crash prediction analysis using the Enhanced Interchange Safety Analysis Tool and **Interactive Highway Safety Design Model**. CDOT conducted analysis on such projects as the U.S. 160/550 interchange, Interstate 25 between Colorado Springs and Denver, Interstate 70 from Avon to Vail, and Interstate 70 mountain express lanes from Empire to Idaho Springs. On the local front, CDOT, the Colorado Local Technical Assistance Program (LTAP), and six local agencies participated in a national pilot effort to develop **Local Road Safety Plans** (LRSPs). To share information learned in the pilot, the LTAP hosted an LRSP peer exchange for cities and counties. CDOT will continue the momentum by offering technical support for additional counties to develop LRSPs and will revise its HSIP manual to include LRSPs.

In **Connecticut**, CTDOT developed a roadway database that complies with MIRE for use in advanced DDSA. CTDOT completed inventories with fully applicable MIRE attribution for all State-to-State and State-to-local intersections and integrated the information into the agency's location reference system. CTDOT is participating in a research project to customize a field data capture tool that would allow agency staff to update MIRE-related roadway features, characteristics, and asset locations in a geospatial environment from field observation.

The **Illinois Department of Transportation** (IDOT) developed State and local "5 percent" lists of top severe safety locations that can be used to prioritize safety efforts. IDOT developed a guidance document to perform systemwide safety analysis on roadway segments, intersections, and curves. IDOT created heat maps for emphasis areas in the Illinois Strategic Highway Safety Plan and data trees to target systematic safety efforts. The agency also developed heat maps and data tables State and local agencies can use to identify high-crash locations and better allocate resources for conducting enforcement activities on major holidays.

The **Kentucky Transportation Cabinet** (KYTC) DDSA implementation team formed four subcommittees to determine how to deploy DDSA: DDSA in Planning, DDSA in Highway Design, DDSA Safety Analysis Tools and Training, and Fostering DDSA Culture and Marketing. KYTC reports the benefits of creating the multidisciplinary subcommittees include spreading workload across the agency and allowing for exploration of a wide range of ideas and implementation opportunities.

In **Minnesota**, MnDOT integrated systemic and predictive analyses into its routine business practices. MnDOT updated its District Safety Plans using systemic data analysis and is working with local partners to update County Roadway Safety Plans. MnDOT developed a systemic approach to prioritize locations for the Railroad Highway Crossings program. On the predictive analysis side, MnDOT published a Performance-Based Practical Design guidance document, which emphasizes use of the AASHTO HSM to inform decisions. The agency made

Data-Driven Safety Analysis

crash modification factors (CMFs)—used to compute expected number of **crashes** after implementing safety countermeasures at a specific site—a standard practice to quantify benefits of spot location safety projects. MnDOT plans to develop Minnesota-specific CMFs to better quantify benefits and costs for HSIP projects.

In **Ohio**, ODOT institutionalized DDSA, incorporating safety analysis procedures into its **Project Development Process**. After updating manuals and guidance documents, ODOT is implementing the process, which requires varying levels of safety analysis based on a project's scope, complexity, and potential environmental impact. As a result, safety performance will be considered on all highway projects, leading to more targeted investments to help reduce fatalities and serious injuries on Ohio's roadways.

PennDOT made progress using DDSA in the project development process. PennDOT updated its District Highway Safety Guidance Manual and Safety Predictive Analysis Methods Manual, including a modified design exception policy requiring HSM analysis that exceeds basic historical crash data summaries and crash rates. PennDOT performed network safety screening and developed evaluation lists for intersections and roadway segments for all 67 counties. PennDOT now calibrates freeway, ramp, and ramp terminal safety performance functions (SPFs)—statistical models used to estimate average crash frequency—and is working with Pennsylvania State University to develop SPFs for urban and suburban collector roadways and intersections. These efforts will allow PennDOT to use predictive analysis on more roadway facility types and expand network screening.

The **Wisconsin Department of Transportation** (WisDOT) has worked on numerous activities to further DDSA. Wisconsin-specific safety performance functions (SPFs) have been finalized for two-lane highway segments. Both network screening and project level SPFs were developed. The State has continued development of a state-specific spreadsheet tool to run the highway safety manual (HSM) predictive methods for two-lane highways, rural multi-lane and urban and suburban arterials. WisDOT is also continuing data collection to develop an intersection inventory. Design Standards and the project delivery process have been updated to include DDSA/HSM methodologies. FHWA's Interactive Highway Safety Design Model (IHSDM) will play a large role in project development in WI.

e-Construction and Partnering: A Vision for the Future

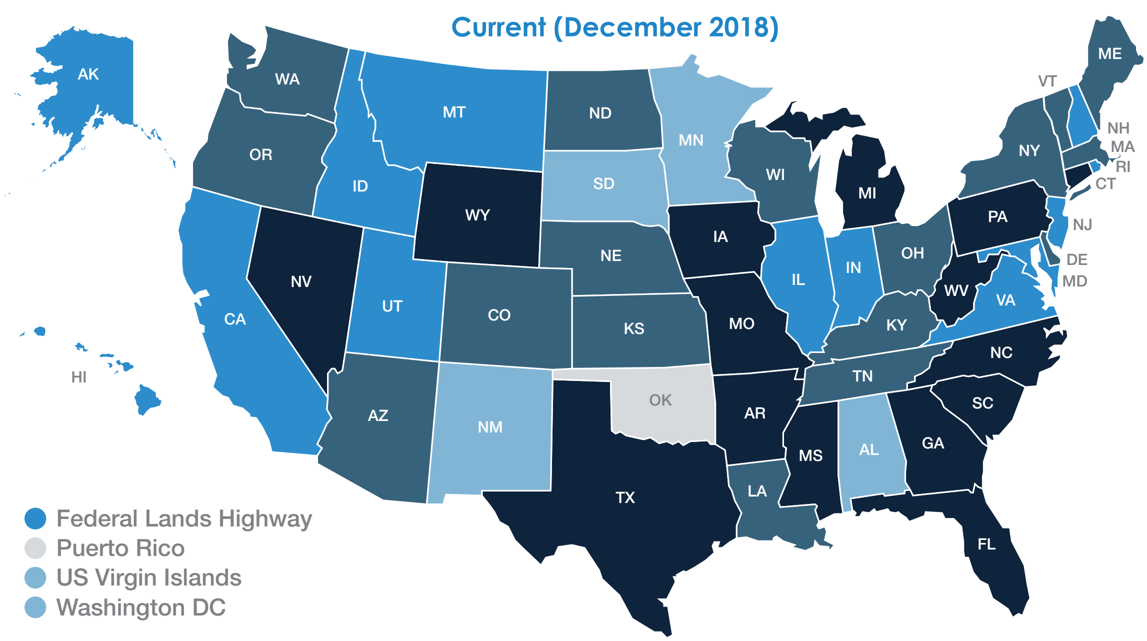
e-Construction and partnering: a vision for the future uses paperless technologies to enhance partnership among stakeholders on construction projects, improving communication and workflows while streamlining project delivery.

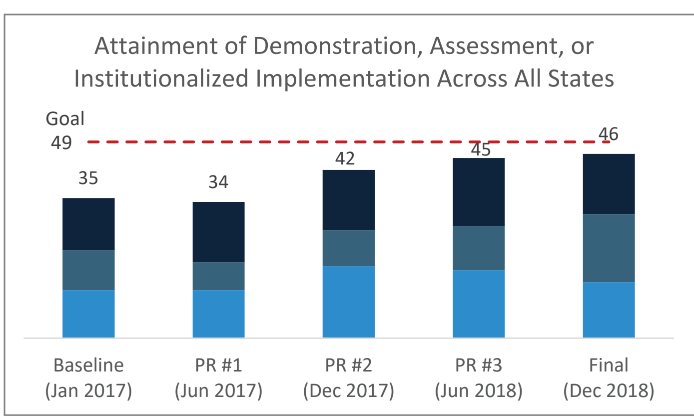
e-Construction is the digital creation, review, approval, distribution, and storage of highway construction documents. It uses readily-available technologies to improve construction document management and saves time by decreasing delays inherent in paper-based project administration. It also saves paper, printing, and document storage and transmission costs.

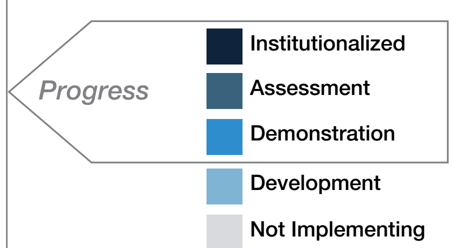
Construction partnering is a project management practice in which transportation agencies, contractors, and other stakeholders create a team relationship of mutual trust and enhanced communication. Partnering builds connections among stakeholders to improve outcomes and complete quality projects that are focused on safety and built on-time and within budget.

e-Construction

Forty-six States reached demonstration, assessment, or institutionalized stages of e-Construction implementation.



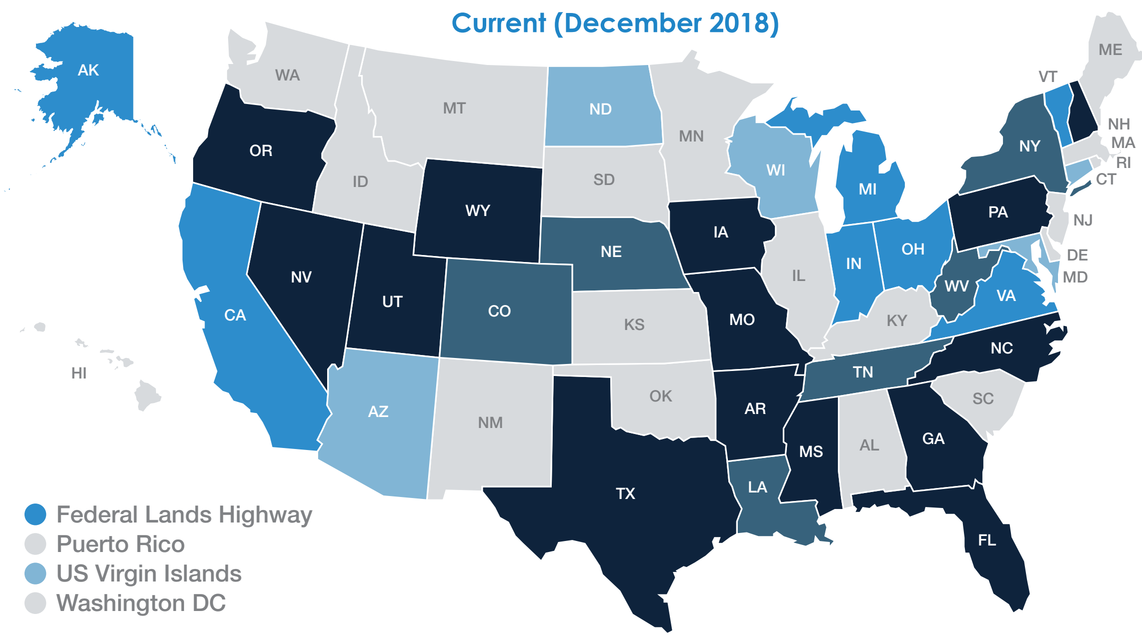


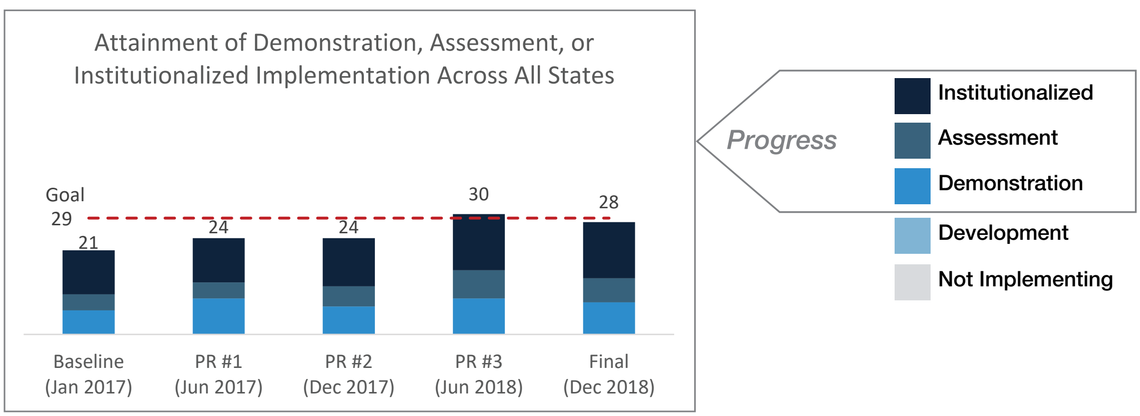


e-Construction and Partnering

Twenty-eight States attained the demonstration, assessment, or institutionalized stages of e-Construction and partnering implementation.

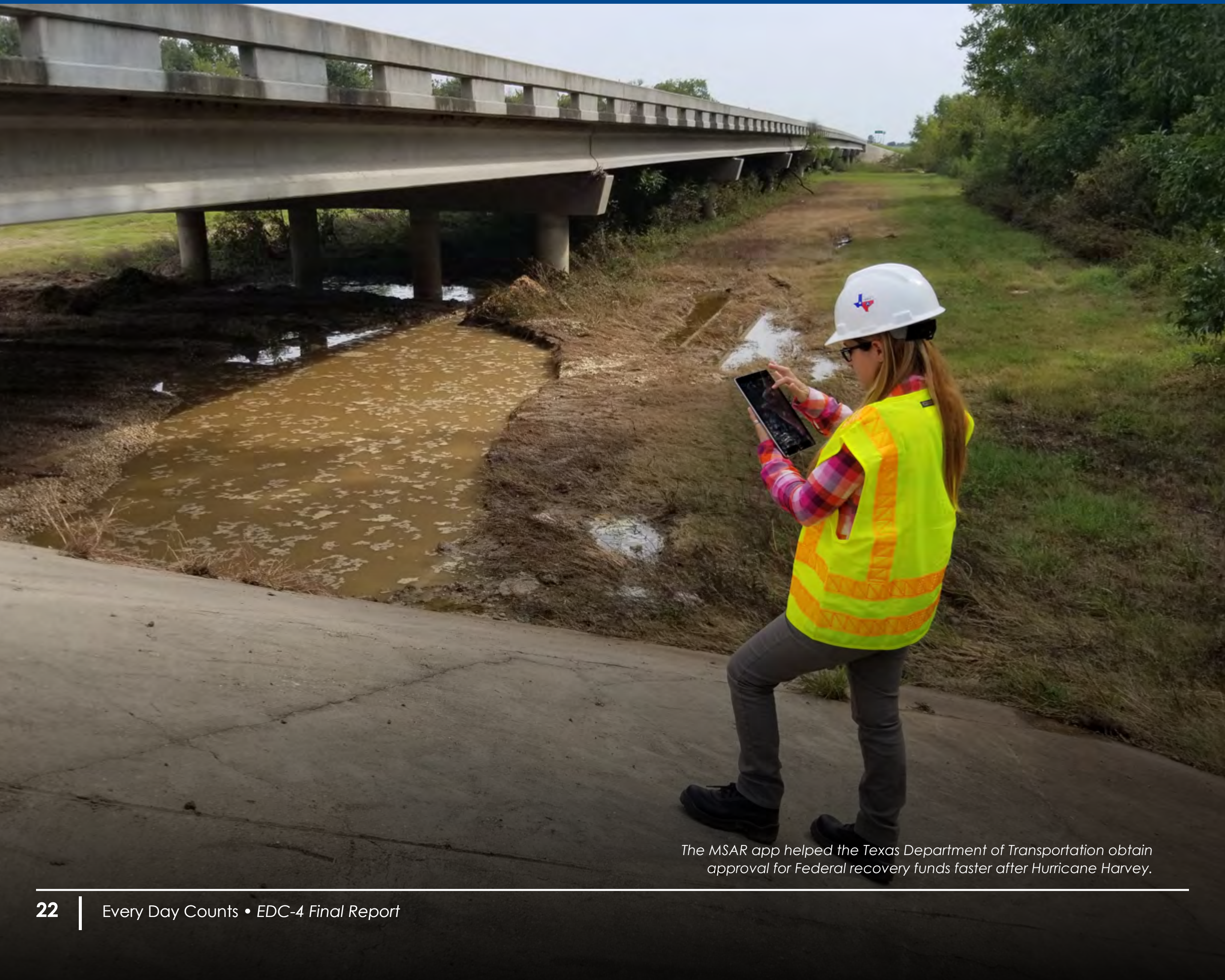
View **Innovation Spotlight: e-Construction and Partnering: A Vision for the Future**.





Innovation Spotlight | e-Construction and Partnering: A Vision for the Future |

The **Mobile Solution for Assessment and Reporting** (MSAR) application played a key role in disaster recovery after some of the largest natural disasters in U.S. history. The MSAR app replaces time-consuming paper surveys and inspection reports on disaster damage required for FHWA Emergency Relief programs. A dozen States, the U.S. Virgin Islands, Puerto Rico, and Federal land management agencies participated in FLH's MSAR pilot program. After Hurricane Maria devastated Puerto Rico in 2017, damage surveys were conducted for 1,300 sites within 3 weeks with MSAR, compared to paper surveys that took a year after Hurricane Katrina in 2005. When the Texas Department of Transportation (TxDOT) used the app after Hurricane Harvey in 2017, more than 500 sites were approved for Federal recovery funds within 7 months instead of up to 2 years for prior paper-based processes. Reducing clerical work and time needed to create reports saved TxDOT about $1.3 million.



The MSAR app helped the Texas Department of Transportation obtain approval for Federal recovery funds faster after Hurricane Harvey.

e-Construction and Partnering: A Vision for the Future

The **Idaho Transportation Department** (ITD) institutionalized the use of project collaboration software for document management. ITD shared the software with the Local Highway Technical Assistance Council and local agencies and encouraged them to use it on Federal-aid projects. Traditionally, project documents were reviewed and approved by email, but ITD started using a PDF viewer to streamline plan reviews, comments, and revisions.

In **Indiana**, INDOT implemented several technologies to support its e-Construction initiative. INDOT manages construction contracts from preconstruction to closeout using AASHTOWare software. INDOT also uses electronic bidding software, project collaboration software, and a custom electronic records management system for document archiving. Technologies INDOT is investigating include e-ticketing for material tracking and quantity payments for hot-mix asphalt, concrete, and aggregate; **three-dimensional (3D) engineered models** for construction inspection; and dynamic 3D modeling tools for design, utilities, and drainage applications.

In **Kentucky**, KYTC implemented an all-electronic change order process, which is expected to take significantly less time to complete than previous paper processes. After demonstrating e-ticketing on two paving projects, the agency reports that benefits included allowing inspectors to monitor asphalt deliveries from a safer distance, improving communication between inspectors and contractors on material quantities and truck locations, and moving from paper to digital information storage. KYTC is evaluating technology to further its e-Construction program, including mobile inspection, contractor payroll, and construction data analytics software packages. The agency plans to pilot a mobile inspection platform on multiple projects in 2019.

The **Louisiana Department of Transportation and Development** (DOTD) is piloting a mobile inspection platform on construction projects. The Louisiana DOTD, which expects to complete the pilot in spring 2019, already sees improvements in project documentation, data gathering for potential claims, and time savings for construction staff. The agency plans to implement e-construction inspection on all future projects.

The **Massachusetts Department of Transportation** (MassDOT) used STIC Incentive funds to enhance its construction project documentation collaboration system, which the agency is deploying on a pilot program that includes eight design-bid-build projects and two **design-build** projects. Enhancements include the ability to run project-specific and enterprise-wide reports. MassDOT plans to assess the collaboration system's rollout and expand its use to additional projects. The agency is expanding use of its **ProjectInfo** project tracking system to approve contract amendments, including time extensions and fund increases. MassDOT deployed 200 tablets providing construction staff access to internal and external applications. Resident engineers use them to file electronic daily reports.

The **Missouri Department of Transportation** (MoDOT) institutionalized e-Construction practices, including use of a collaborative platform and digital signatures for project documents. The collaborative site enables MoDOT to organize, store, and archive all contract documents. MoDOT reports using digital signatures and PDF software reduces paperwork required for the traditional signature process and saves on time and postage.

The **Montana Department of Transportation** (MDT) is nearing completion of AASHTOWare Construction & Materials implementation. MDT is piloting and implementing the use of WipWare to analyze the gradation of riprap and has implemented use of StockpileReports to measure and manage stockpiles. Also, MDT is developing pilot projects to test e-Signatures, including automating the associated workflow. The agency is piloting and implementing Trimble Business Center for use with Construction Survey and Layout, automated machine guidance (AMG), use of 3D models and building information modeling (BIM). Also, MDT is piloting PlanGrid and Bluebeam to view and markup plan sheets among other functions. Additionally, MDT continues to leverage mobile devices and is developing an in-house UAS program. It is believed these implementations will improve performance, efficiencies, and reduce costs over legacy processes.

The **North Carolina Department of Transportation** (NCDOT) has a process for e-construction inspection that includes signing plans and documents electronically, electronic plans and contracts, and certified payroll submission. The e-construction process was introduced through pilot projects that showed: enhanced communication between the field and resident engineer's office, sharing project related documents between

e-Construction and Partnering: A Vision for the Future

the contractor and inspection team increased efficiency, electronic forms save tremendous space in the office, and photograph documentation in electronic diaries greatly enhance information. The next step in the NCDOT e-construction process is to fully implement barcode/RFID tags for material product approvals and complete evaluation of e-ticket use for material delivery.

PennDOT developed a formal partnering specification to increase communication and improve relationships between the department and industry partners. The agency expects implementing the partnering specification will result in improved quality, safety, and cost savings on projects. PennDOT created electronic forms to facilitate partnering, including a **Project Facilitation Type Score Sheet**, **Partnering Workshop and Facilitator Evaluation**, and **Project Partnering Survey**. The agency also shares a variety of e-Construction apps with its partners to improve transparency and allow communication to take place in real time.

After using a digital collaboration tool on several **Tennessee** pilot projects, TDOT plans to begin using it on all projects in 2019. This will facilitate instant communication of plan revisions to field staff and contractors, allowing them to have updated versions of project plans at their fingertips at all times. TDOT is also implementing the AASHTOWare Project Civil Rights and Labor module. The agency now uses the subcontractor payment function, which provides contractors, subcontractors, suppliers, and haulers access to enter or view payment information. TDOT plans to begin testing the payroll function, which is expected to save contractors time in documenting payroll information.

In **Utah**, UDOT is transitioning to e-Construction software for civil rights assessment and contractor prequalification using a cloud platform. UDOT completed its conversion to electronic field booking, daily diaries, and construction documentation. With the help of STIC Incentive funds, the agency is piloting e-ticketing for asphalt deliveries, using electronic scale tickets and asphalt material haul summaries on several UDOT projects.

Integrating National Environmental Policy Act and Permitting

Integrating National Environmental Policy Act (NEPA) and permitting processes enable concurrent, synchronized environmental and permitting reviews that save time and reduce costs for involved agencies.

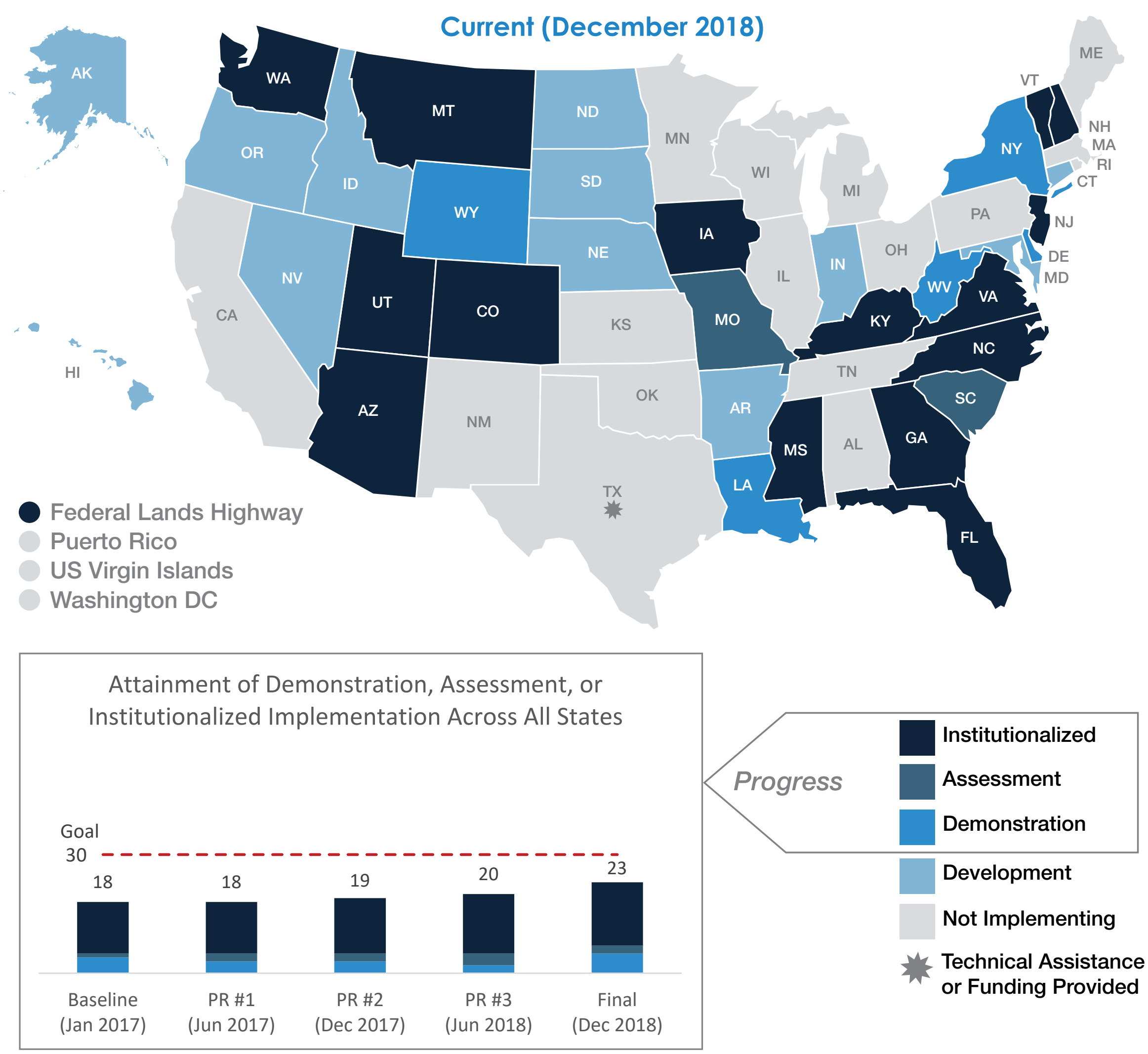
Integrating NEPA and permitting processes allows various environmental reviews and permitting procedures required for Federal-Aid Highway Program projects to be performed simultaneously rather than sequentially. The resulting synchronization provides for more effective and efficient regulatory reviews, leading to projects with reduced environmental impacts as well as time and money savings.

The EDC-4 initiative focused on outreach, training, and technical assistance to help transportation departments integrate NEPA and permitting processes. The effort featured proven best practices, data management, and tools for navigating environmental assessments and environmental impact statements needed for transportation projects. It also offered assistance on using FHWA's online collaboration tool, eNEPA, to support timely and consistent coordination among agencies to complete necessary permitting processes.

Twenty-three States reached demonstration, assessment, or institutionalized stages of integrating NEPA and permitting.

View **Innovation Spotlight: Integrating NEPA and Permitting**.

Innovation Spotlight



Innovation Spotlight

| Integrating National Environmental Policy Act and Permitting |

The New York State Department of Environmental Conservation (DEC), U.S. Army Corps of Engineers (USACE), and FHWA are developing a programmatic agreement for assessing culverts and bridges for aquatic organism passage (AOP) at highway-stream crossings. The DEC and USACE require that all replaced, rehabilitated, and new stream crossings provide AOP, but New York has no standard method of assessing crossings or barriers. This makes the permitting process inconsistent and time-consuming for both NYSDOT and regulators. The agencies agreed to adopt the North Atlantic Aquatic Connectivity Collaborative method to bring more predictability and transparency to culvert assessments. This programmatic effort is expected to reduce permitting timeframes.

Credit: New York State Department of Transportation

USACE, New York State agencies, and FHWA worked together to improve fish passage at highway-stream crossings and accelerate permitting of culvert projects.

Integrating National Environmental Policy Act and Permitting

In **Georgia**, GDOT developed a programmatic agreement to streamline project reviews under Section 106 of the National Historic Preservation Act. Section 106 requires agencies to consider effects of federally funded projects on cultural and historic resources. This effort has involved close coordination among GDOT, USACE, the Georgia State Historic Preservation Office, the Advisory Council on Historic Preservation, and FHWA, as well as outreach to federally recognized tribes. The programmatic agreement is expected to improve efficiency by providing a more predictable, transparent process for project review and consultation.

USACE has authority to issue permits on a regional basis for activities causing minimal environmental impact, which helps avoid duplicate efforts by other Federal and State agencies. USACE and FHWA partnered on development of a **New York Transportation Regional General Permit** (RGP) to conduct environmental analyses in a more coordinated, consistent, predictable, and timely manner. The RGP eliminates duplication in several areas where USACE can adopt FHWA's determinations through their respective NEPA responsibilities. It authorizes certain routine activities, including transportation projects, temporary dewatering of waterways, and emergency activities, without formal notification to USACE and is expected to significantly accelerate project delivery in New York.

FHWA and USACE are developing a NEPA/Clean Water Act Section 404 (NEPA/404) merger handbook for States interested in developing new integration processes or updating existing ones. This effort will support implementation of One Federal Decision—under which one agency takes the lead in navigating a project through the review process— and reduce duplication during permitting of projects with impacts on aquatic resources. The handbook will provide step-by-step instructions on using the NEPA/404 merger agreement template, which can be customized to a State's needs. Other features will include a coordination chart that details agency processes, permitting timetable and coordination plan examples, a generic project schedule, and an integration flowchart.

The **West Virginia Department of Transportation** (WVDOT) is developing two projects, Kanawha Falls Bridge Replacement and Van Voorhis Road Project, in which the NEPA document and permit application are being developed concurrently. It is anticipated that these two projects will progress to the construction phase much quicker by integrating the NEPA and permitting phases. The results will include time and cost savings. WVDOT continues to work on developing a regional permit with FHWA, USACE, EPA, and USFWS.

Pavement Preservation (When, Where, and How)

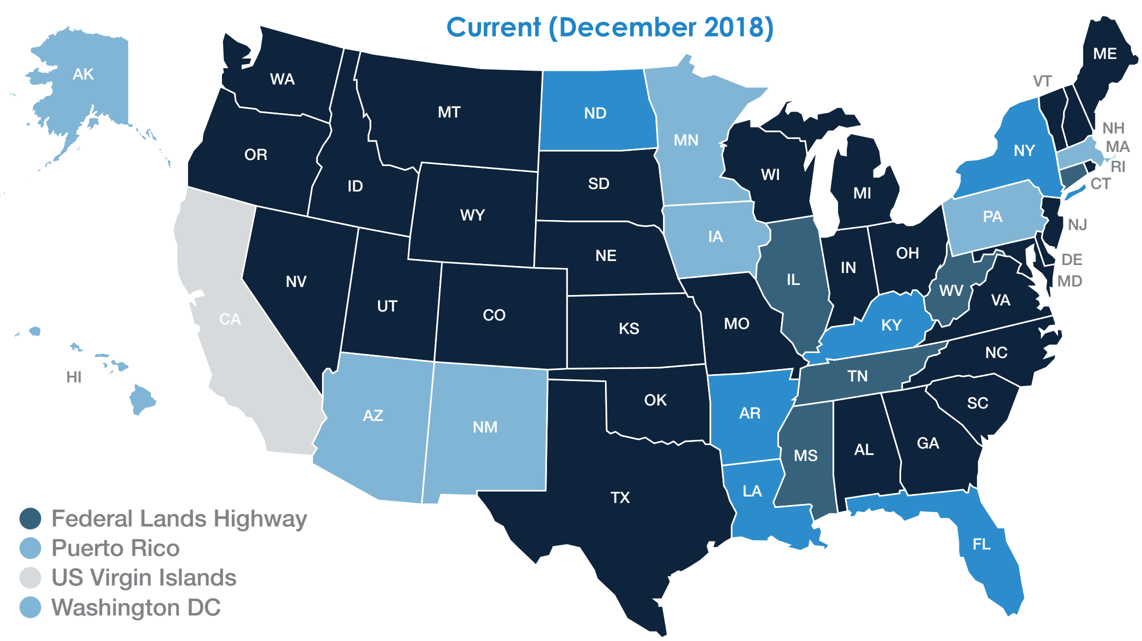
Pavement preservation (when, where, and how) involves applying a pavement preservation treatment at the right time on the right project with quality materials and construction, offering a critical investment strategy for optimizing infrastructure performance. This innovation helps deploy an array of different analyses, treatments, and construction methods to help infrastructure owners achieve and sustain a desired state of good road repair despite tight budgets. Pavement preservation practices provide a cost-effective approach to extending the service life of pavements and achieving smoother, safer roads with fewer costly repairs.

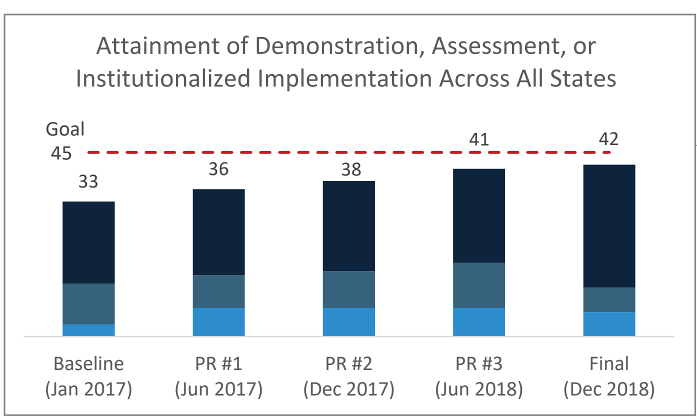
The "when and where" component of pavement preservation supports preservation of highway investments by managing pavements proactively. Whole-life planning defines expectations for the long term and provides more stability to the cost of operating and maintaining highway pavements. Identifying preservation strategies at the network level reduces need for frequent or unplanned reconstruction.

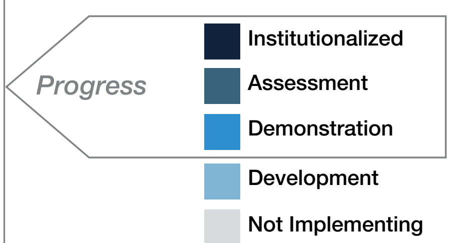
The "how" component of pavement preservation promotes quality construction and materials practices, including treatment options that apply to flexible and rigid pavements. Successful construction practices contribute to improved pavement performance, providing smoother, safer roads and delaying need for rehabilitation.

Pavement Preservation: When and Where

Forty-two States attained demonstration, assessment, or institutionalized stages of implementing pavement preservation: when and where.







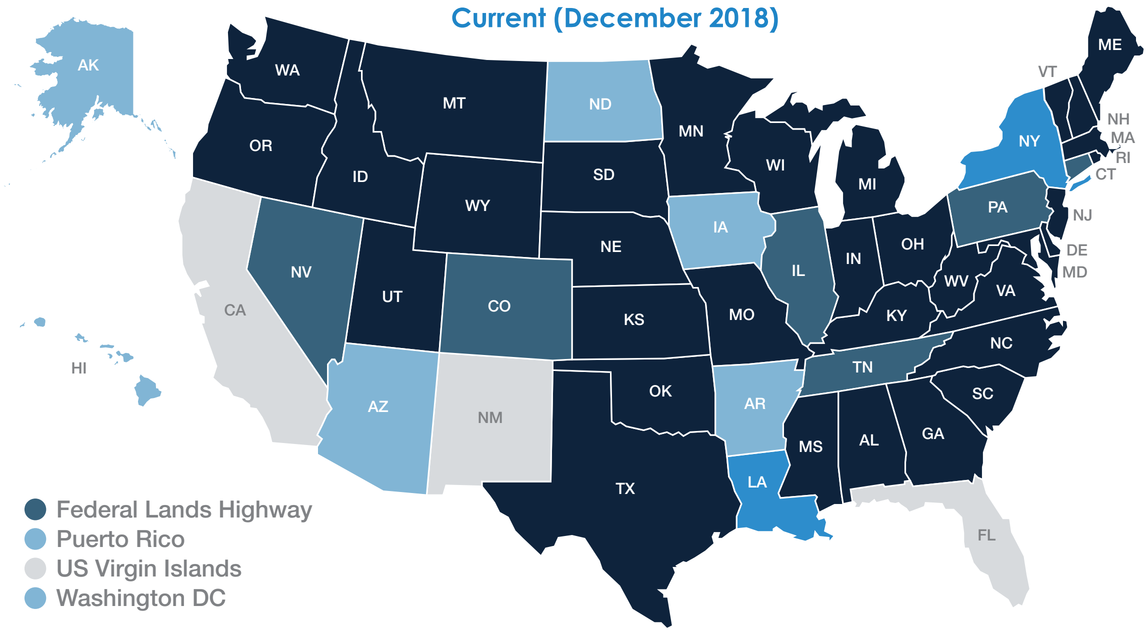
Pavement Preservation: How

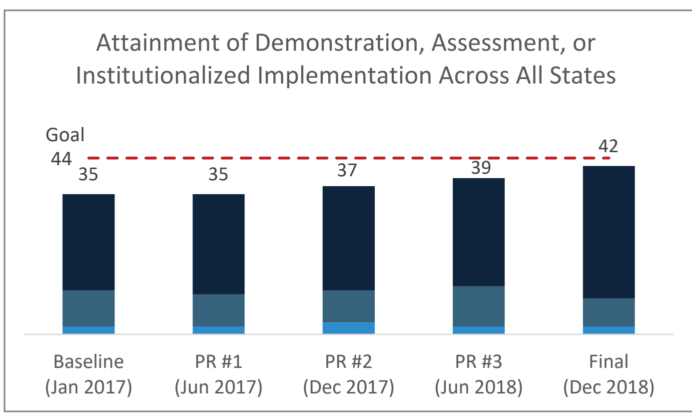
Forty-two States achieved the demonstration, assessment, or institutionalized stages of implementing pavement preservation: how.

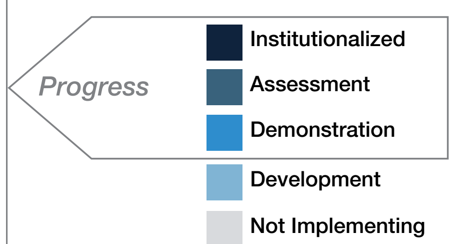
View **Innovation Spotlight: Pavement Preservation (When, Where, and How)**.

Innovation Spotlight

Current (December 2018)







Road Weather Management—Weather-Savvy Roads

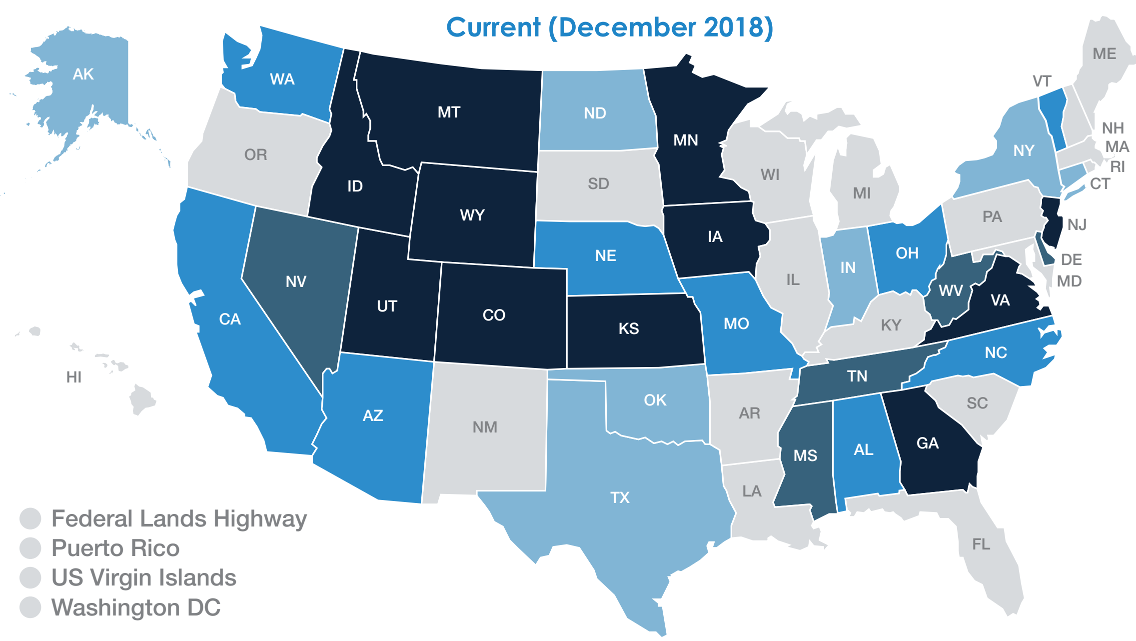
Road weather management—weather-savvy roads integrates mobile observations and Pathfinder strategies that can help agencies manage road systems and inform travelers ahead of and during adverse road weather conditions. Twenty-two percent of all vehicle crashes in the past decade were weather-related. On average, these crashes resulted in about 6,000 deaths a year. Adverse weather causes about 25 percent of nonrecurring traffic delays, and weather-related delays add about $3.4 billion a year to freight costs.

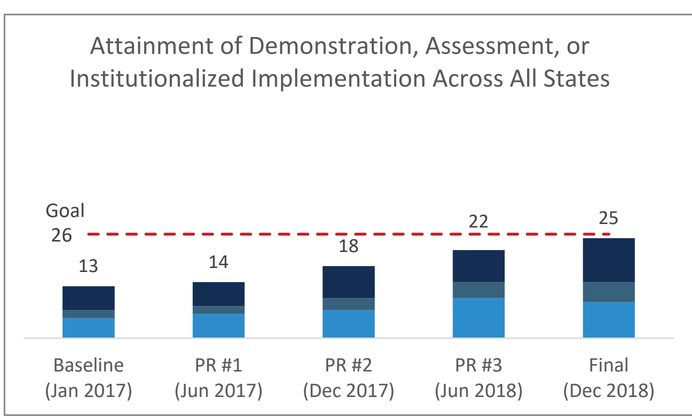
The **Pathfinder** process enables transportation departments, the National Weather Service (NWS), and private weather service providers to collaborate on clear, consistent road weather messaging. It provides the foundation for coordination across agencies to develop cohesive weather impact information, helping drivers make better travel decisions. Ultimately, it saves lives, protects property, and minimizes the impact of weather events.

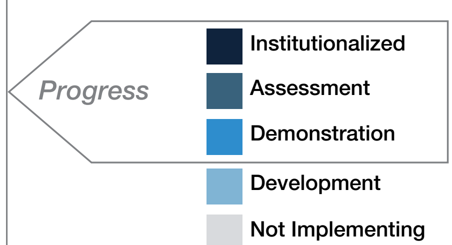
Integrating mobile observations (IMO) is a cost-effective way to gather information on weather and road conditions using existing fleet vehicles. Vehicle-based technologies provide agencies with data to manage transportation systems before negative impacts of road weather occur. Maintaining a high level of service on roads can reduce crashes and keep traffic moving smoothly.

Road Weather Management: Pathfinder

Twenty-five States attained demonstration, assessment, or institutionalized stages of Pathfinder implementation.





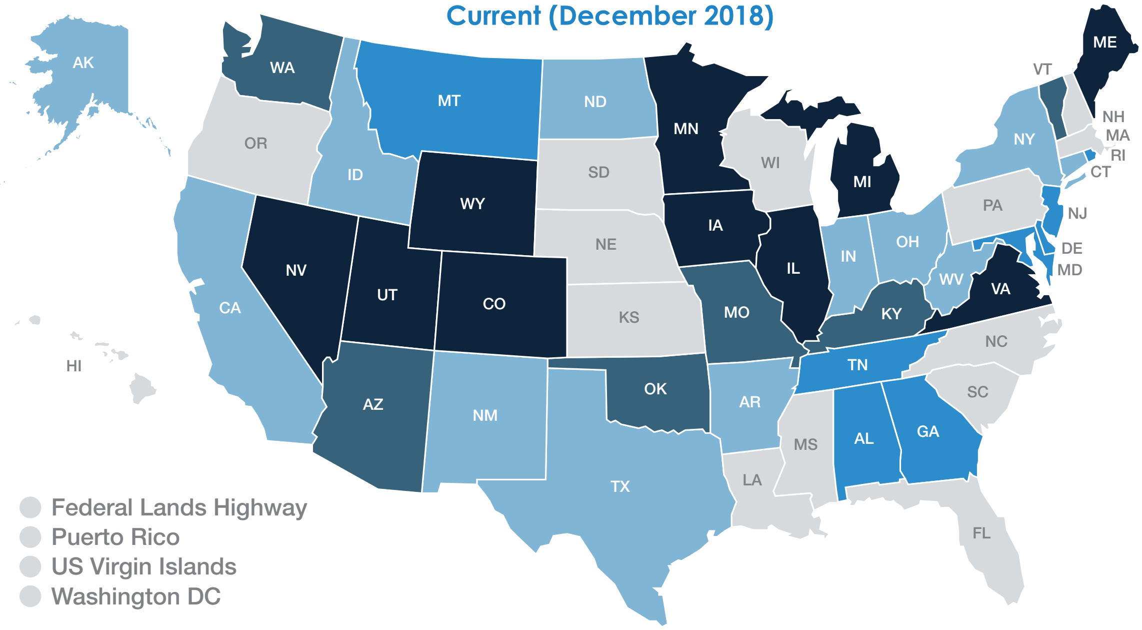


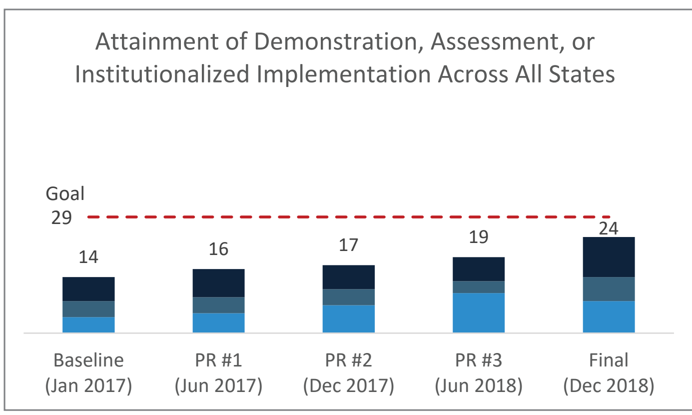
Road Weather Management: Integrating Mobile Observations

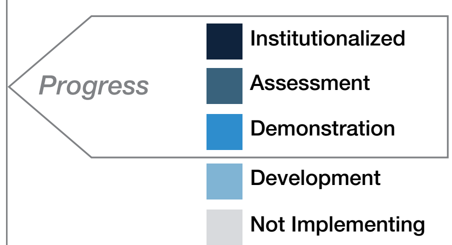
Twenty-four States attained the demonstration, assessment, or institutionalized stages of IMO implementation.

View **Innovation Spotlight: Weather-Savvy Roads**.

Innovation Spotlight







Innovation Spotlight

| Road Weather Management—Weather-Savvy Roads |

CDOT institutionalized the Pathfinder process to collaborate on road weather messaging in Colorado. In addition to coordinating with local law enforcement and emergency operations centers in the State, CDOT works with partners in surrounding States during storm events to create consistent prestorm weather messaging at State borders. During EDC-4, CDOT sent more than 200 forecast emails and held more than 50 coordination calls about adverse weather events, including winter storms, severe convective storms, and fire weather. Before the August 2017 **solar eclipse**, CDOT discussed predicted cloud coverage and resulting traffic flows with its Pathfinder partners. When surveyed, 90 percent of CDOT respondents said Pathfinder improves prestorm operational readiness. As a result of Pathfinder's success, CDOT plans to hire an additional meteorologist to meet the year-round forecasting need.

Credit: Colorado Department of Transportation

The Colorado Department of Transportation uses social media to deliver weather messaging.

Road Weather Management—Weather-Savvy Roads

The **Alabama Department of Transportation** (ALDOT) held two Pathfinder collaboration events in January 2019 for winter weather. The State used conference calls and email messaging to discuss anticipated roadway impacts. With the information gained from that communication, the State worked with public information sections within the State's core partners to develop a common message for public dissemination through media releases ahead of and during the events. Additionally, multiple forms of social media were used as well as dynamic message signs along roadways and notifications pushed out through ALDOT's Traveler Information System, Algotraffic.com. Implementation cost was negligible and primarily only involved extra time for the participants. The State believes it was successful in changing enough drivers' behavior such that roadways saw lower volumes during these times.

As part of Arizona's IMO deployment, **ADOT** equipped 25 plow trucks with a compact sensor that provides relative humidity, dew point, ambient temperature, and road temperature. When integrated with automatic vehicle location data, this information provides ADOT with real-time weather data to supplement road weather information systems. This enables plow operators to make better road treatment strategy decisions. ADOT also applies the data to poststorm analysis. The data enable ADOT to better determine conditions such as freezing fog or black ice, as well as whether pretreatment is needed based on differences in air temperature and dew point. ADOT can also alert the Traffic Operations Center to post appropriate messaging where hazardous driving conditions develop.

Credit: Arizona Department of Transportation

Sensors on Arizona plows provide weather and road condition data for use in operational decision making.

In **Idaho**, where Pathfinder is institutionalized, ITD and NWS fostered a strong working relationship with monthly meetings. The partners identified consistent weather terminology, coordinated message distribution channels, and developed sample flowcharts of decision-making processes for dynamic message sign posting activities. ITD and NWS held webinars to discuss expected conditions on high-impact road segments 24 to 36 hours before storms were predicted to arrive. During adverse conditions, they used uniform messages and a list of triggering events to develop postings. Pathfinder activities also enabled the **Idaho 511** traveler information system to provide more accurate, real-time information. ITD reports that it believes in the effectiveness of Pathfinder and plans to continue advancing the program as technology improves.

The **Maryland State Highway Administration** (SHA) deployed 50 mobile road weather sensor devices on fleet vehicles to increase the amount of information gathered during storms. The data include road surface temperature, ambient temperature, dew point temperature, precipitation level, water film height, relative humidity, ice percentage, and friction. Maryland SHA uses the data to paint a more complete picture of road conditions than it can obtain through the State's stationary weather sensors. The agency considers the ability to capture this information without driver action a significant benefit. It provides real-time conditions for better precision when salting roadways. Maryland SHA can also compare the data with information on previous storms to identify potential problem areas and better plan for future storms.

The **Rhode Island Department of Transportation** (RIDOT) is equipping its snowplows with weather sensors that provide temperature and road condition data along with dashboard camera images that show precipitation and road conditions in real time. At the end of the 2018–2019 winter season, RIDOT plans to compare the data with information from previous winters to identify trends it can apply in future decision making on weather event response.

Safe Transportation for Every Pedestrian (STEP)

Safe transportation for every pedestrian (STEP) features proven, cost-effective countermeasures that can reduce pedestrian fatalities at uncontrolled crossing locations and unsignalized intersections. Pedestrians account for more than 16 percent of all traffic fatalities. More than 72 percent of pedestrian fatalities occur at nonintersection locations such as midblock areas.

The EDC-4 STEP program includes six safety countermeasures:

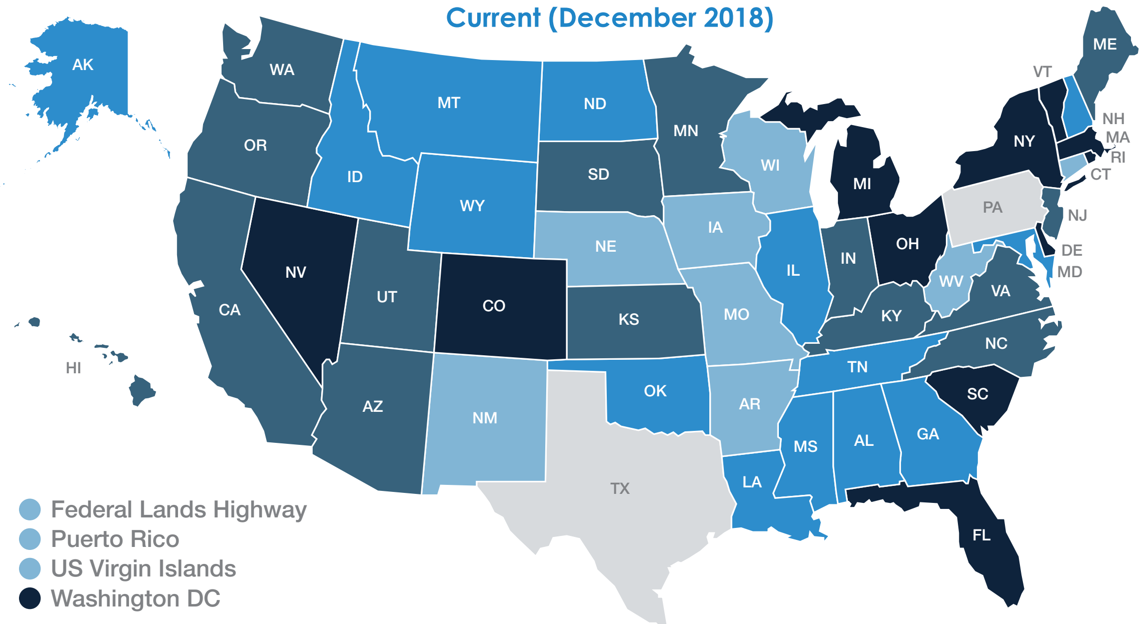
- **Crosswalk visibility enhancements**, such as crosswalk lighting and enhanced signing and marking, help drivers detect pedestrians.
- **Raised crosswalks** are a traffic calming technique that can reduce vehicle speeds and encourage drivers to yield to pedestrians.
- **Pedestrian refuge islands** provide a safer place for pedestrians to stop at the midpoint of the road before crossing the remaining distance.
- **Pedestrian hybrid beacons** provide pedestrian-activated stop control in areas where pedestrian volumes are not high enough to warrant a traffic signal.
- **Road diets** reconfigure a roadway cross-section to safely accommodate all users.
- **Rectangular rapid flashing beacons** (RRFBs) are active (user-actuated) or passive (automated detection) amber light-emitting diodes that use an irregular flash pattern at mid-block or uncontrolled crossing locations to increase driver yielding behavior.

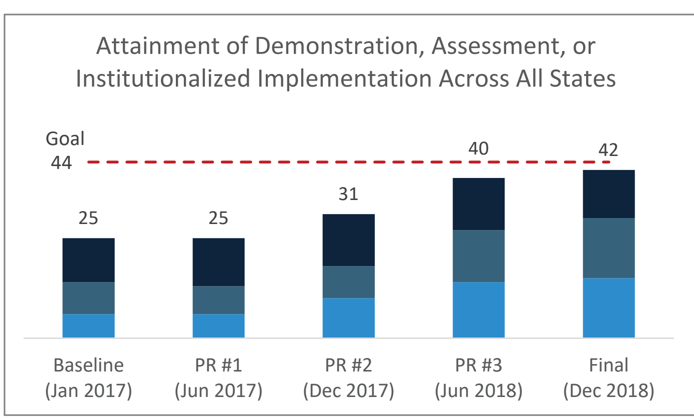
Forty-two States achieved demonstration, assessment, or institutionalized stages of STEP implementation.

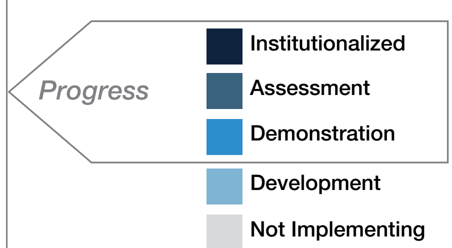
View **Innovation Spotlight: Safe Transportation for Every Pedestrian**.

Innovation Spotlight

Current (December 2018)







Innovation Spotlight

|Safe Transportation for Every Pedestrian (STEP)|

Oklahoma agencies are applying STEP countermeasures to make communities and highways safer for pedestrians. The Oklahoma Department of Transportation (ODOT) developed an **Action Plan for Implementing Pedestrian Crossing Countermeasures at Uncontrolled Locations** to provide guidance for ODOT and communities to accelerate STEP deployment. After hosting a regional STEP peer exchange and several local agency workshops that generated interest in STEP, ODOT used STIC Incentive funds to develop an outreach strategy and materials to promote its STEP efforts. The materials include an **informational brochure**, a **media release**, and an educational **video** highlighting how Oklahoma communities benefit from implementing countermeasures such as road diets and crosswalk visibility enhancements.

Credit: Amy M. Echo-Hawk, Tribal Tech Initiative, Oklahoma State University

A Tulsa road diet reuses roadway space to create parking and curb extensions that shorten the distance for pedestrians to cross.

Safe Transportation for Every Pedestrian (STEP)

ADOT organized an AZ STEP team with representatives of local governments and FHWA to identify strategies for increasing awareness and implementation of STEP countermeasures in Arizona. Through a statewide survey, the team identified STEP deployment obstacles, such as a need for how-to information for local agencies. As a result, the AZ STEP team developed a manual and flowchart to guide users in identifying pedestrian safety improvements.

The **Arkansas Department of Transportation** (ArDOT) participated in a regional STEP peer exchange and training workshops in pursuit of its STEP deployment goals. ArDOT staff sought information about installing STEP countermeasures along multilane roadways and visited multiple sites in Memphis and Nashville, TN, during a scan tour to learn about planning and design considerations. ArDOT partnered with the city of Little Rock and the Northeast Arkansas Regional Transportation Planning Commission to study potential locations for implementing STEP countermeasures.

Through its ongoing pedestrian safety programs, the **Maine Department of Transportation** (MaineDOT) collaborated with local governments to deploy STEP countermeasures such as RRFBs, road diets, and crosswalk visibility enhancements. MaineDOT and FHWA facilitated two pedestrian-focused road safety assessments and held a workshop to develop a toolbox of pedestrian and bicycle safety countermeasures.

MassDOT continued to integrate pedestrian safety countermeasures into Massachusetts policies, plans, and projects. In Chelsea, MassDOT looked at ways to make systemic improvements to pedestrian crossings along bus routes, beginning with an inventory of pedestrian accommodations at bus stops and an evaluation of pedestrian crashes in the study area. MassDOT will review this analysis and lead a road safety assessment, identifying potential countermeasures. The agency plans to use this process as a model for how roadways with bus routes can be improved for pedestrian safety.

In **New York**, NYSDOT applied its **Pedestrian Safety Action Plan** to institutionalize the process of improving safety at uncontrolled and signalized crossing locations using a variety of pedestrian safety countermeasures. NYSDOT is deploying STEP countermeasures such as crosswalk visibility enhancements, pedestrian refuge islands, and RRFBs across the State highway system.

In **Tennessee**, TDOT finalized new multimodal access design guidelines and a **Multimodal Project Scoping Manual** that includes guidance on pedestrian safety countermeasures. TDOT organized several workshops on applying these new design and project resources. TDOT installed its first temporary pedestrian refuge island at an uncontrolled crossing with a high frequency of serious injury and fatal pedestrian crashes in Nashville. Walk Bike Nashville collaborated with TDOT to monitor the site and reported that no pedestrian fatalities occurred after the countermeasure was installed in December 2017, compared to six in the six previous years.

The **Virginia Department of Transportation** (VDOT) used systemic and crash-based analysis to identify priority corridors and sites for installing pedestrian safety countermeasures. After developing the Virginia **Pedestrian Safety Action Plan**, VDOT issued a call for projects that met the objectives of the safety analysis and advanced implementation of STEP countermeasures. In late 2018, VDOT announced 25 projects totaling more than $8 million to implement pedestrian safety improvements.

Safe Transportation for Every Pedestrian (STEP)

The **Virgin Islands** Department of Public Works (VIDPW) is partnering with the U.S. Virgin Islands Walkability Institute to promote pedestrian safety. A demonstration to enhance an uncontrolled crossing is planned and will include an assessment stage with the University of the Virgin Islands to evaluate the crossing before and after the enhancements. The Veteran's Drive project currently in construction features enhanced uncontrolled crossing that include raised pavement crossings along with other features. These crosswalks will be assessed for safety performance. VIDPW will assess other uncontrolled crosswalks throughout the territory for possible enhancements.

In **Washington**, WSDOT hosted multiple STEP training workshops for State and local practitioners, including training on tools for prioritizing pedestrian improvements. WSDOT is collaborating with university partners to develop models that pinpoint high pedestrian crash locations and risk factors associated with severe injury and fatal pedestrian crashes. This information and a statewide network analysis will help identify priority locations for implementing STEP countermeasures across the State.

Ultra-High Performance Concrete Connections for Prefabricated Bridge Elements

Ultra-high performance concrete (UHPC) can be used to create simple, strong, long-lasting connections needed for successful construction using prefabricated bridge elements (PBEs). UHPC is a steel fiber-reinforced, portland cement-based composite material that delivers performance far exceeding that of conventional concrete.

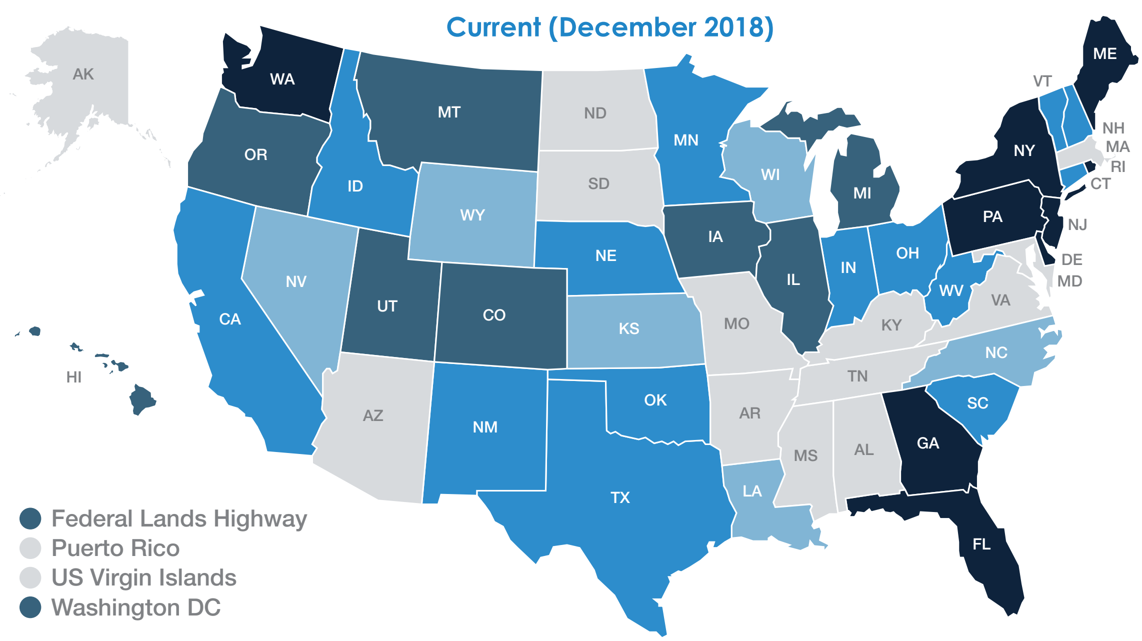
PBEs, structural components built offsite and brought to the project location for installation, shorten onsite construction time, enhance safety, and offer superior durability. Field-cast UHPC has emerged as a solution for creating connections between prefabricated components with better long-term performance than typical connection designs.

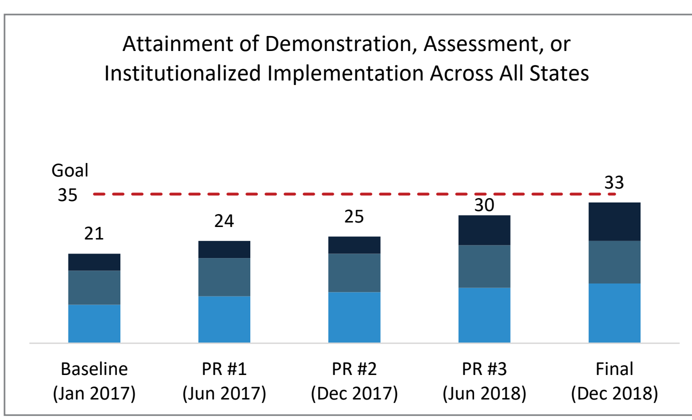
UHPC allows for small, simple-to-construct connections that require less concrete and do not require post-tensioning. The mechanical properties of UHPC allow for redesign of common connection details in ways that promote ease and speed of construction. This makes using PBEs simpler and more effective.

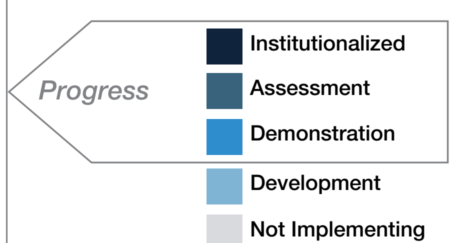
Thirty-three States attained demonstration, assessment, or institutionalized stages of implementing UHPC connections for PBEs.

View **Innovation Spotlight: Ultra-High Performance Concrete**.

Innovation Spotlight







Innovation Spotlight | Ultra-High Performance Concrete Connections for Prefabricated Bridge Elements |

The 3.5-mile-long Pulaski Skyway deck replacement in northern New Jersey was completed in 2018 after nearly 5 years of construction. The New Jersey Department of Transportation (NJDOT) used precast deck panels connected with UHPC, stainless steel rebar, and a polyester concrete overlay to maximize the durability of the new deck and minimize the need for future repairs and traffic disruption on the heavily traveled bridge. The project is the largest user of UHPC to date in North America, using more than 5,000 cubic yards of UHPC to connect nearly 1 million square feet of deck panels. Only five other transportation agencies had used UHPC for bridge construction when NJDOT selected UHPC for the Pulaski Skyway in 2012. Since then, the skyway has served as an important and informative example for other agencies. In addition to the skyway, NJDOT completed five other bridges in 2018 using UHPC connections, bringing the State's total to nine.

Credit: WSP USA

The Pulaski Skyway deck replacement in New Jersey is the largest use of UHPC on a single project.

Ultra-High Performance Concrete Connections for Prefabricated Bridge Elements

ITD has rapidly become a frequent user of UHPC connections for PBEs, completing 20 projects across Idaho. After ITD constructed its first bridge with UHPC connections in 2016, the agency completed five in 2017 and 14 in 2018. ITD used precast concrete slab deck beams for 12 of the 2018 bridges and deck bulb-tee girders for the other two. ITD used precast deck beams with UHPC connections for rapid replacement of smaller rural bridges, providing more durable structures with longer service lives.

New York has 76 bridges that incorporate UHPC, the most of any State. NYSDOT completed 19 bridges with UHPC in 2018. On 13 of the bridges, NYSDOT used UHPC for link slabs to connect bridge decks across expansion joint locations and improve the long-term durability of the decks. The agency pioneered the use of UHPC for link slabs to address durability issues with expansion joints, a leading cause of reduced bridge service life. NYSDOT piloted use of UHPC link slabs on two bridges in 2013. The number of link slabs constructed in 2018 signals growing acceptance of this innovative solution.

MaineDOT developed a Full-Depth Precast Concrete Deck Panel Manual to provide design guidance, standard details, and specifications for precast concrete bridge deck panels and UHPC connections, an example of agencies creating their own standards and guidance for UHPC connections. MaineDOT completed its first bridge using UHPC connections in 2016, two additional bridges in 2017, and a fourth in 2018. The agency used UHPC to connect full-depth precast deck panels on the 2016 and 2018 projects. In 2017, MaineDOT used UHPC to connect precast concrete double-tee beams on the 1,282-feet-long, 20-span Bath Viaduct superstructure replacement over U.S. 1.

The replacement of the Hanging Rock Creek Bridge in Kershaw County is enabling the **South Carolina Department of Transportation** (SCDOT) to compare the performance of different types of precast concrete deck beams and UHPC connections. SCDOT constructed one span of the Hanging Rock Creek Bridge using double-tee deck beams, two with hollow core slab deck beams, and the fourth with solid slab deck beams. The precast concrete beams connected with UHPC helped accelerate construction, which started late in 2016 and concluded in summer 2017. SCDOT and Clemson University are monitoring the performance of the three different beam types, and connections and will publish a report expected to provide information for future projects.

Using Data to Improve Traffic Incident Management

Using data to improve traffic incident management (TIM) focuses on advancing the collection, analysis, and use of incident data to better understand the effectiveness of current TIM strategies and to enhance TIM planning and response efforts to promote safer, reliable roadway operations.

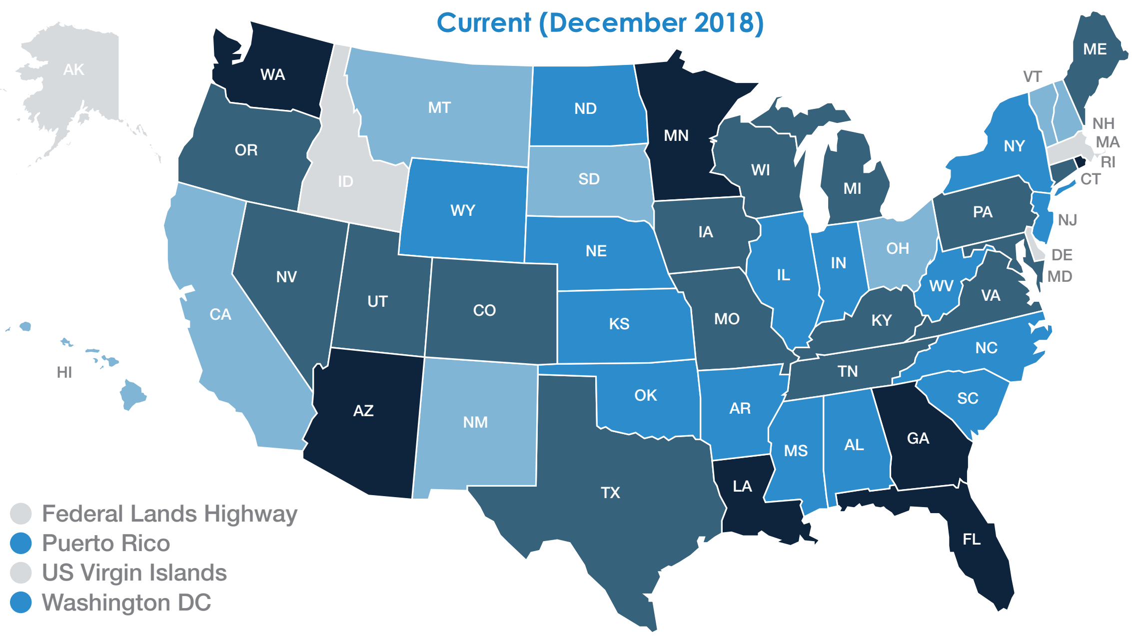
Traffic incidents put travelers' and emergency responders' lives at risk and cause a quarter of all traffic delays. Resulting congestion can lead to secondary crashes. TIM programs plan for and coordinate incident response among agencies are reducing the duration and impact of incidents.

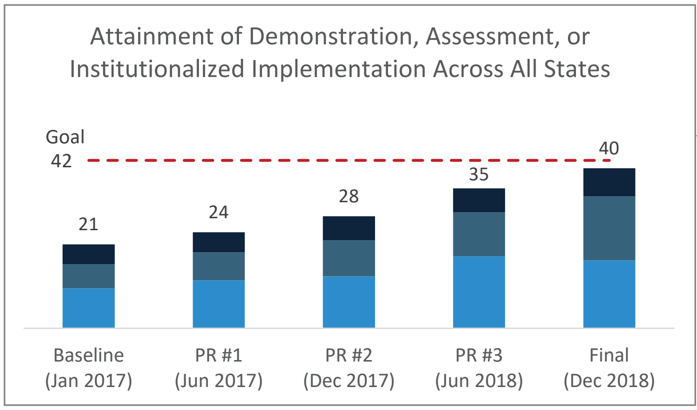
FHWA promotes the use of low-cost, often off-the-shelf technologies to collect foundational as well as innovative data to help agencies enhance TIM programs. FHWA first encourages adoption of three key TIM performance measures: roadway clearance time, incident clearance time, and number of secondary crashes. With improved roadway monitoring and data collection, other data such as incident response time, time to return to normal flow, lane-specific closures, responder-specific on-scene times, and roadway conditions are also collected. With better data and analytics, agencies can quantify program performance, demonstrate program effectiveness, and improve TIM planning and resource management.

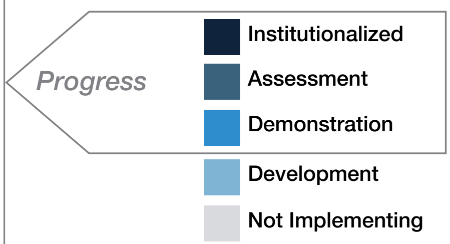
Forty States reached demonstration, assessment, or institutionalized stages of implementing the use of data to improve TIM.

View **Innovation Spotlight: Using Data to Improve Traffic Incident Management**.

Innovation Spotlight







Innovation Spotlight

|Using Data to Improve Traffic Incident Management|

The Puerto Rico Highway and Transportation Authority (PRHTA) improved TIM data collection, use, and reporting during EDC-4. An application to support safety service patrol operations enables personnel to easily input key TIM data elements, including secondary crashes. The agency uses the data to support decisions, including resource allocation and incident hot spot countermeasures, and identify special circumstances, such as the need for more towing time. PRHTA also uses the data to support policies, propose legislation, and review lessons learned with TIM stakeholders. New safety service patrol dashboards help decision makers understand trends and performance by facility and services, including incidents per day, incidents per road, incident type, services provided, and average response times.

Using Data to Improve Traffic Incident Management

In EDC-4, **Arizona** expanded the analysis of TIM data from the Arizona Department of Public Safety (AZDPS) to agencies statewide, including examining the thoroughness of TIM performance measure collection. An analysis of statewide crash data from January 2015 to December 2017 showed collection of TIM performance measures for non-AZDPS agencies increased steadily. AZDPS collection of TIM performance measures reached 100 percent in 2016. Arizona is now targeting specific law enforcement agencies to further improve TIM performance measure collection.

In its search for a statewide source of TIM performance measures, **Caltrans** assessed multiple data sources—traffic management centers (TMCs), the safety service patrol, and the California Highway Patrol computer-aided dispatch (CAD) system—and determined the CAD system offered the best potential. Caltrans used text mining techniques to calculate response times, roadway clearance times, and incident clearance times. California benefited by realizing it could use an existing data source to measure TIM performance.

In **Florida**, FDOT set a goal to improve the quality, analysis, and use of data it collected on three TIM performance measures via crash reports and TMCs. FHWA helped FDOT create a TMC operator guide for secondary crashes that resulted in a threefold increase in capturing secondary crashes. FDOT improved its analysis by creating a dashboard that automates and visualizes trends and statistics for TIM performance measures. Data use also improved when Florida Highway Patrol added TIM performance measures to its TroopTrac performance management system.

In **Indiana**, INDOT transitioned from using text-based descriptors of incidents to a quantitative data system. INDOT trained operations center staff to enter key incident timeline data points in the system to estimate roadway and incident clearance times. Using the data, INDOT can now identify when an incident occurs, number of lanes affected, when one or more lanes open, and when all lanes clear. INDOT adopted the MnDOT DOT IRIS open-source advanced traffic management system (ATMS) and will use it to deploy web-based dashboards and outcome-based performance measures.

Iowa, **Nebraska**, and **Nevada** added all three TIM performance measures to their statewide crash reports in 2018. The States also trained law enforcement officers on TIM performance measure definitions and the importance of collecting data.

Maine and **New Hampshire** collaborated to create a TIM data dictionary that enables consistent reporting and communication among TMC staff in both States. The Southern Maine Planning and Development Commission (SMPDC) generates TIM performance measures for the New Hampshire Department of Transportation and Maine Turnpike Authority. The Maine Turnpike Authority routinely reviews performance data to ensure consistency in reporting and strives for improvement in incident response strategies. SMPDC automated TIM data analysis to generate monthly and quarterly performance measures and reviews the distribution of incident clearance times and average incident clearance times. As of January 2019, Maine's statewide crash report includes a check box for recording secondary crashes.

In **Oregon**, ODOT created a Transportation Systems Management and Operations Program Performance Management Plan for TIM that outlines goals, core performance measures, action items, and communication. ODOT is developing a training program to improve TIM data collection and support performance measurement. ODOT leverages traffic operations center data with integrated CAD data from the Oregon State Police and public safety answering points in three counties and uses a business analytics service for TIM performance analytics and dashboarding. Using the data, Oregon created a **TIM Performance Measures report**, which encouraged the police to improve roadway and incident clearance times.

PennDOT built the Traffic Operations Analytics tool to integrate agency and partner incident data spread over multiple platforms and began quarterly TIM performance reporting to leadership and district TIM stakeholders. PennDOT developed a Traffic Alerts application to provide TMCs with real-time incident alerts using data from the INRIX traffic intelligence network, PennDOT's Road Condition Reporting and Crash Reporting Systems, Waze alerts, maintenance records, and road weather information systems. PennDOT's traffic operations staff and TMCs continue to modify their processes to improve performance. The Pennsylvania Turnpike initiated an

Using Data to Improve Traffic Incident Management

enterprise business intelligence effort that automates identification of incomplete TIM data, applies the right data to calculate metrics, and shares data through quarterly performance reports.

All **TxDOT** TMCs now have the capability to collect road clearance time, incident clearance time, and secondary crash data. Integration of safety service patrol data into TMC systems in Houston resulted in a threefold increase in incident data, and TMC-CAD integration in Austin generated a tenfold increase in incidents recorded. Concerted efforts among TMC operators resulted in significant improvements in recording incident timestamps for time of first awareness of an incident, road clearance time, and incident clearance time as well as secondary crashes. TxDOT created TIM performance dashboards for its six TMCs.

To quantify TIM benefits, a multidisciplinary team in **Utah** investigated availability of data from UDOT and the Utah Highway Patrol (UHP) for TIM performance analysis and developed a framework for additional data collection and interagency data sharing. Data from various sources, including road clearance time collected through the UHP CAD system, were compiled and integrated over a 6-month period. Analyses were conducted to calculate estimated response times, roadway clearance times, and incident clearance times and estimate excess travel time and cost. Utah plans to expand the pilot study and is looking into developing a TIM performance dashboard.

Virginia focused on improving consistency in TIM data collection through increased awareness and training efforts. VDOT expanded data collection to include arterials, improved data quality, and promoted consistent reporting practices by integrating traffic operations centers with public safety answering points. After initiating a statewide ATMS, VDOT is expanding the system to connect more regional traffic operations centers and implementing enhanced reporting tools. VDOT also expanded analysis and reporting TIM performance measures from annual or ad hoc reports to regular monthly and quarterly reports by major corridors. For example, while state-wide only 16 percent of delay on interstates is from incidents, 51 percent of delay on I-81 is from incidents, consequently the I-81 Corridor Improvement Plan focuses more significantly on incident management strategies.

In **Washington, D.C.**, the District Department of Transportation (DDOT) has hired a full-time data analyst whose work includes identifying, analyzing, and assessing additional use cases for data relevant to TIM, and making that information widely accessible across the department. DDOT is also hiring two program analysts to assess and act on data-driven results, especially as related to the TMC. With intern support, data dashboards have been developed or enhanced for decision makers to better track TIM improvements and personnel performance around response times and to optimize safety patrol service routing and traffic management center camera tours for faster response times. DDOT is scoping enhancements to its ATMS, including CAD, Waze, and social media integration, to improve situational awareness around TIM both for the TMC and the traveling public. CCTV cameras have been deployed along freeways and mobile CCTV cameras have been deployed on safety service patrol vehicles; the TMC is now actively using these to support incident management.

The **Wyoming Department of Transportation** (WYDOT) is growing their TIM program. WYDOT is sending officers to training on UAS operation to improve incident response. The Wyoming Highway Patrol (WHP) has created a new position as a liaison between the towing industry and the patrol. The goal in this is to have consistency in statewide towing operations.

WYDOT is deploying connected vehicle technology (CVT), including an application pioneered by the agency, to make traffic incident response faster. This application, known as "Distress Notification", allows a vehicle to broadcast their location and that they are in distress. Vehicles traveling in the opposite direction can pick up the signal and rebroadcast it to other similarly equipped vehicles. In essence, vehicles will be used as a communication mechanism to alert other vehicles in the traffic stream. In addition, vehicles will be used to deliver the location of the distressed vehicle to the TMC and WHP Dispatch through a network of roadside units.

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Watch the "Power of the STIC" video series to learn how the **national STIC network**, **local agencies**, **State transportation departments**, **academia**, and **industry** collaborate to accelerate innovation deployment.

STIC Overview | Local Public Agencies | DOTs | Academia | Industry

View the **"Mission Possible"** video for a brief overview of the 11 EDC-4 innovations.

See the **State Innovation Accomplishments map** for details on AID Demonstration and STIC Incentive projects, innovation deployment examples from articles and reports, and STIC network contacts.

ACRONYMS AND ABBREVIATIONS

1D	one-dimensional
2D	two-dimensional
3D	three-dimensional
AASHTO	American Association of State Highway and Transportation Officials
ADOT	Arizona Department of Transportation
AID Demonstration	Accelerated Innovation Deployment Demonstration
ALDOT	Alabama Department of Transportation
AOP	aquatic organism passage
ArDOT	Arkansas Department of Transportation
ATMS	advanced traffic management system
ATSPM	automated traffic signal performance measure
AZDPS	Arizona Department of Public Safety
CAD	computer-aided dispatch
Caltrans	California Department of Transportation
CDOT	Colorado Department of Transportation
CED	chronic environmental deficiency
CHANGE	collaborative hydraulics: advancing to the next generation of engineering
CMF	crash modification factor
CTDOT	Connecticut Department of Transportation
DDSA	data-driven safety analysis
DEC	Department of Environmental Conservation
DelDOT	Delaware Department of Transportation
DDOT	District Department of Transportation
DOT	department of transportation
DOT&PF	Alaska Department of Transportation and Public Facilities
EDC	Every Day Counts
EDC-4	Every Day Counts round four
FDOT	Florida Department of Transportation
FHWA	Federal Highway Administration
FLH	Federal Lands Highway
GDOT	Georgia Department of Transportation
GIS	geographic information system
GTFS	General Transit Feed Specification
HDOT	Hawaii Department of Transportation
HSIP	Highway Safety Improvement Program
HSM	Highway Safety Manual
IDOT	Illinois Department of Transportation
IMO	integrating mobile observations
INDOT	Indiana Department of Transportation
ITD	Idaho Transportation Department
KYTC	Kentucky Transportation Cabinet
Louisiana DOTD	Louisiana Department of Transportation and Development
LRSP	local road safety plan
LTAP	Local Technical Assistance Program
M2D2	Multimodal Development and Delivery

MaineDOT....Maine Department of Transportation
MassDOT .... Massachusetts Department of Transportation
MDOT.... Michigan Department of Transportation
MDT....Montana Department of Transportation
Maryland SHA....Maryland State Highway Administration
MiDOT....Mississippi Department of Transportation
MIRE .... Model Inventory of Roadway Elements
MnDOT ....Minnesota Department of Transportation
MoDOT ....Missouri Department of Transportation
MSAR .... Mobile Solution for Assessment and Reporting
NCDOT .... North Carolina Department of Transportation
NEPA.... National Environmental Policy Act
NEPA/404 ....National Environmental Policy Act and Clean Water Act Section 404
NJDOT....New Jersey Department of Transportation
NWS ....National Weather Service
NYSDOT .... New York State Department of Transportation
ODOT.... Ohio Department of Transportation
ODOT.... Oklahoma Department of Transportation
ODOT.... Oregon Department of Transportation
PBE ....prefabricated bridge element
PennDOT ....Pennsylvania Department of Transportation
PRHTA ....Puerto Rico Highway and Transportation Authority
RGP ....Regional General Permit
RIDOT.... Rhode Island Department of Transportation
RRFB .... rectangular rapid-flashing beacon
SCDOT ....South Carolina Department of Transportation
SDDOT ....South Dakota Department of Transportation
SMPDC ....Southern Maine Planning and Development Commission
SPF.... safety performance function
STEP ....safe transportation for every pedestrian
STIC ....State Transportation Innovation Council
TDOT ....Tennessee Department of Transportation
TIM....traffic incident management
TMC ....traffic management center
TxDOT.... Texas Department of Transportation
UDOT....Utah Department of Transportation
UHP ....Utah Highway Patrol
UHPC ....ultra-high performance concrete
USACE....U.S. Army Corps of Engineers
VIDPW....Virgin Islands Department of Public Works
VDOT ....Virginia Department of Transportation
VTrans .... Vermont Agency of Transportation
WisDOT ....Wisconsin Department of Transportation
WSDOT.... Washington State Department of Transportation
WVDOT.... West Virginia Department of Transportation
WYDOT .... Wyoming Department of Transportation

U.S. Department of Transportation
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