SHRP2 SOLUTIONS
TOOLS FOR THE ROAD AHEAD

SHRP2 MILESTONES

Transportation Projects Powered by SHRP2

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SHRP2 SOLUTIONS

The second Strategic Highway Research Program (SHRP2) is providing transportation agencies with new and innovative ways to improve safety, rebuild aging infrastructure, and increase mobility for the traveling public. This news brief highlights significant project developments, case studies, and best practices from around the country. There are 350 SHRP2 projects underway across all 50 states, the District of Columbia, and Puerto Rico.

SHRP2 in 2016: Round 7 Products & Webinars!

As the Federal Highway Administration (FHWA) and the American Association of State Highway and Transportation Officials (AASHTO) approach the mid-point of SHRP2 implementation, activities at the State, Federal, and local levels are in high gear and will continue at a furious pace. More than 50 workshops, peer exchanges, showcases, field demonstrations, training sessions, and other activities are already scheduled for 2016, with many more being planned as new products are introduced. Significant efforts to assess the performance, benefits, and value of these solutions will also continue.

Round 7 Opens April 1

The final round of the Implementation Assistance Program (IAP) will be offered from April 1 – 29, 2016, with informational webinars scheduled in March. Five new products will be available for technical and financial assistance along with ten already in implementation. Three utility products will be offered in a "bundle" for the first time to maximize their efficiencies and effectiveness. (A schedule of the product webinars is on page 2; and a list of the Round 7 financial and technical assistance offerings is available on page 12.)

SHRP2 Education Connection

Ten universities will advance work through the SHRP2 Education Connection in the year ahead, developing college-level curriculum that will prepare the transportation workforce of the future with the latest in SHRP2 tools, processes, and innovative state-of-the-practice solutions. From January 10 – 14, 2016, these institutions showcased the SHRP2 Solutions at the Transportation Research Board (TRB) 95th Annual Meeting, in Washington, DC. In the coming months the work of these universities will be featured in *SHRP2 Milestones,* updating progress and results.

SHRP2 Implementation Assistance Program: Round 7 Webinars

The following SHRP2 Solutions are available through the 2016 FHWA/AASHTO Implementation Assistance Program (IAP). This will be the last opportunity to take advantage of the IAP's financial and technical assistance to implement SHRP2 products.

REGISTRATION PROCESS: The Federal Highway Administration uses a registration system for webinars. In this system, external users (those without an @dot.gov e-mail address) must request an account before they can register for webinars. If you are an external user, your first step is to request an account. Within two business days, you will receive e-mails with your temporary password and approval information. You will then be able to register for the webinars below. Plan to attend the following Round 7 webinars to learn more about SHRP2 implementation opportunities.

INFORMATIONAL WEBINARS: MARCH 8 – 22, 2016
APPLICATION PERIOD: APRIL 1 – 29, 2016

CAPACITY

PlanWorks (C01)

Systematic web-based resource that supports collaborative decision making to deliver projects that meet environmental, community, and mobility needs.
Thursday, March 17; 11:00 a.m. - 12:30 p.m. EDT Register today!

RENEWAL

Utility Bundle (R01A/R01B/R15B)

Products to identify, record, and retrieve utility locations throughout the design process to aid in reducing costly relocations.
Tuesday, March 8; 2:00 p.m. - 3:30 p.m. EDT Register today!

Structures Solutions

Featuring four SHRP2 structural solutions: *Nondestructive Testing for Concrete Bridge Decks* (R06A), *Nondestructive Testing for Tunnel Linings* (R06G), *Service Life Design for Bridges* (R19A), and *Service Limit State Design for Bridges* (R19B).
Wednesday, March 9; 11:00 a.m. - 12:30 p.m. EDT Register today!

Railroad-DOT Mitigation Strategies (R16)

A collection of resources and practices developed through collaboration and partnering between transportation agencies and railroads to improve coordination and expedite projects.
Tuesday, March 15; 11:00 a.m. - 12:30 p.m. EDT Register today!

Pavement Solutions

Featuring three SHRP2 pavement solutions: *Techniques to Fingerprint Construction Materials* (R06B), *Advanced Methods to Identify Pavement Delamination* (R06D), and G*uidelines for the Preservation of High-Traffic-Volume Roadways (R26).*
Tuesday, March 22; 2:00 p.m. - 3:30 p.m. EDT Register today!

RELIABILITY

Reliability Data and Analysis Tools (L02/L07/L08/C11/L05)

Tools to help transportation planners and engineers improve monitoring and analysis of data to achieve more consistent, predictable highway travel.
Tuesday, March 15; 2:00 p.m. - 3:30 p.m. EDT Register today!

Reliability in Simulation and Planning Models (L04)

Guidelines for incorporating reliability performance measures into travel models.
Wednesday, March 16; 11:00 a.m. - 12:30 p.m. EDT Register today!

Regional Operations Forum (L36)

Regional training program to advance transportation systems management and operations.
Monday, March 21; 2:00 p.m. - 3:30 p.m. EDT Register today!

Capacity Bringing greater collaboration to road building.

PlanWorks: Better Planning. Better Projects. (C01)

Under PlanWorks, site visitors can find a decision guide, assessments, application, and a library that were developed to aid collaborative decision making in transportation planning and project development.

Transportation agencies are responsible for being stewards of environmental and community concerns, while delivering transportation projects in ways that support a community's vision. Integrating economic, environmental, and community needs can be time-consuming and requires effective and collaborative decision making in order to keep projects on schedule. To support the decision-making process, transportation practitioners need a systematic decision support tool that integrates the community's needs into planning, design, and development of transportation projects.

PlanWorks is a web-based resource that supports collaborative decision making in transportation planning and project delivery. Available online, *PlanWorks* is organized around four primary components:

- The **Decision Guide** describes the 44 common decision points and opportunities for collaboration in the transportation planning and environmental review process.
- **Assessments** help identify barriers to developing successful projects and plans, and strategies for overcoming them, as well as opportunities to work together, improve interagency cooperation, and expedite project delivery.
- **Applications** provide specific information and approaches for how certain topics (e.g., performance measures, visioning, and freight) can be considered in the collaborative decision-making framework.
- The **Library** contains relevant case studies and reports of successful interagency cooperation in the transportation planning and environmental review process.

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Learn more about
PlanWorks

Renewal Championing predictable travel times

Nondestructive Testing for Tunnel Linings (R06G)

Nondestructive testing technologies to pinpoint defects in or behind tunnel linings.

Nondestructive testing (NDT) methods are automated, quantitative, and rapid; they provide substantially more complete coverage than conventional visual inspections. SHRP2 has evaluated all the best NDT technologies for their use in tunnel lining assessments. Ground-penetrating radar (GPR), infrared thermography analysis, and impact echo technology were determined to be the most appropriate. These technologies enable inspectors to drive through the tunnel and conduct the inspection without closing lanes.

The web-based, open-source NDToolbox helps identify and characterize testing technologies that are available to locate the primary deficiencies in tunnel linings. With the toolbox, users can explore different NDT technologies and examine their use in detecting deterioration for conditions relevant to the project.

The NDToolbox describes the technology and the physical principle behind it, applications, performance, limitations, equipment, test procedures and protocols, and sample results. It also provides recommendations regarding the best technologies for a particular deterioration detection application. The accompanying user's manual was developed for selecting NDT technologies that can detect defects behind or within tunnel linings. The manual includes more in-depth information on equipment, test procedures, inspector's training requirements, data management procedures, data analysis procedures, limitations, and interpretation guidelines.

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Learn more about
Utility Bundle on GoSHRP2

Utility Bundle (R01A/R01B/R15B)

Products to identify, record, and retrieve utility locations throughout the design process to aid in reducing costly relocations.

When it comes to designing and implementing transportation projects, utility conflicts identified at the end of the design period or during construction can extend construction time, pose safety concerns, and increase costs. The SHRP2 *Utility Bundle* is a related group of SHRP2 products that addresses elements of utility locating techniques and technologies, and the storage and retrieval of this critical data. The *Utility Bundle* is composed of three SHRP2 utility solutions:

- *3D Utility Location Data Repository* (R01A): 3D modeling helps agencies design optimum transportation solutions.
- *Utility Locating Technologies* (R01B): Advancing technologies to help agencies detect subsurface utilities.
- *Identifying and Managing Utility Conflicts* (R15B): Improving cooperation among highway agencies and utilities for faster project delivery.

3D Utility Location Data Repository (R01A)

The SHRP2's 3D storage and retrieval data model will accommodate large volumes of utility data, interface with existing design software, and provide a method for organizing the data so that it can reliably be used throughout the project design phase, during construction, and on future projects. The data stored will include the horizontal and vertical location of the utilities, as well as attribute data that is needed to effectively coordinate with utility owners.

The attribute data about each utility enables more efficient and productive coordination with utility owners. Knowing the location and depth of utilities enables designers to change designs to avoid costly utility relocation and delays in project delivery. During construction, contractors can pull up mapping systems that accurately display the location and depth of the utilities, so the utilities can be avoided and delays prevented. The ability to store data in a single platform can minimize the cost of data collection on future projects as well.

Utility Locating Technologies (R01B)

There are two advanced utility locating technologies that are available for agencies. The first is Multi-Channel Ground Penetrating Radar (MCGPR). Due to attenuation of MCGPR signals in clay or otherwise conductive soils, only a portion of the United States is suitable for effective MCGPR work according to the Natural Resources Conservation Service (NRCS) of the United States Department of Agriculture. See the NRCS soil suitability for GPR, and please note that actual site conditions in built-environments may vary from the NRCS maps. The second utility technology is Time Domain Electromagnetic Induction, which can work in highly conductive soils and identify metal utilities or utilities that are installed with a metal tracer wire.

Knowing the location, depth, and important attributes of utilities enables more efficient and productive coordination with utility owners during the design process helps minimize utility conflicts, and can save lives, money, and time through the sustainable application of Subsurface Utility Engineering technologies.

Identifying and Managing Utility Conflicts (R15B)

The Utility Conflict Matrix (UCM) and its companion report, *Identification of Utility Conflicts and Solutions*, provide concepts and procedures to identify and resolve utility conflicts that public agencies and utilities can use to help improve the highway project development process.

Additionally, a one-day training course has been developed to help agencies incorporate the UCM in existing business practices so that utility conflicts are identified throughout the design process.

The UCMs are designed to help agencies and utility companies identify the best and most cost-effective solutions. The SHRP2 UCM is also scalable to support a range of project sizes and conditions, in varying levels of project design. The standalone UCM, data model, and database are available on the TRB website along with a companion research report featuring best practices from State departments of transportation, as well as case studies.

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Learn more about

Railroad-DOT Mitigation Strategies on GoSHRP2

Railroad-DOT Mitigation Strategies (R16)

This SHRP2 Solution offers a suite of best practices, model agreements, and sample contracts that improve communication and project coordination among public agencies and railroads.

By using these tools, you can:

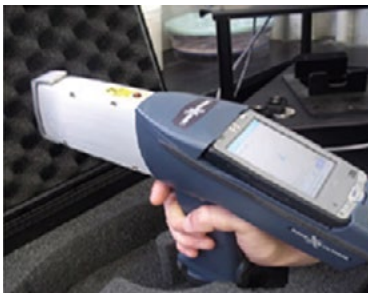
- **Improve Communication.** Public transportation agencies and railroads can identify and circumvent sources of conflict.
- **Expedite Project Delivery.** Memorandums of understanding developed for project and program needs can expedite delivery.
- **Reduce Project Costs.** Fewer delays waiting for reviews and agreements equals fewer project cost increases.

The challenge facing public transportation agencies and railroads is how to ease the project agreement process in a time of rapid highway construction. The interaction between both industries occurs thousands of times each year in the construction of highway projects in the proximity of railways. With each interaction, railroads must carefully review the safety, engineering, and operational impacts during construction and for decades to come. Although most reviews proceed smoothly, both the highway agencies and railroads agree that delays and setbacks in project development and construction occur. Delays waiting for railroads' reviews and agreements can cause increased project costs for highway agencies, and extended disruption to users.

The collection of model agreements, sample contracts, training materials, and standardized best practices developed through SHRP2 will enable public agencies and railroads to identify and find solutions to sources of conflicts and delays. These tools reflect research that takes into account both the railroad and public agency perspectives, processes, funding and budgets, and acknowledge best practices.

The report, *Strategies for Improving the Project Agreement Process Between Highway Agencies and Railroads*, outlines recommended practices and offers model agreements that can be modified to meet the legal and contractual requirements of individual transportation agencies and railroads to expedite negotiations. The implementation of this product consists of the following set of resources and strategies:

- **Best practices and streamlined processes**
  - Institutional arrangements.
  - Innovative partnering techniques.
  - Approaches to ensure collaboration.
- **Standardized Model Agreements**
  - Partnering Memorandum of Understanding.
  - Master Project Agreement.
  - Preliminary Engineering Agreement.
  - Resurfacing Agreements.
  - Highway Overpass Agreement.
  - Warning Devices Agreement as well as other agreements.



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Learn more about
Techniques to Fingerprint Construction Materials on GoSHRP2

Techniques to Fingerprint Construction Materials (R06B)

Procedures and equipment to identify various construction materials in the laboratory and with portable devices.

Quality assurance operations during construction are important aspects for ensuring that all contract requirements are met and that projects are built to last. However, verifying that construction materials meet project specifications can be a labor intensive and expensive operation, with test results often delayed and some materials only receiving minimal testing. This could potentially impact product quality and long-term performance. Field methods to quickly analyze construction materials such as paints, additives to asphalt, and reclaimed asphalt pavement (RAP) are beneficial to enhancing quality assurance. *Techniques to Fingerprint Construction Materials* evaluated portable spectroscopy technologies that can be used during construction to verify the chemical compounds or presence of certain additives or contaminants in some commonly used construction materials. The SHRP2 effort evaluated an array of spectroscopy technologies in their ability for in situ analysis of commonly used construction materials in the field.

Two technologies that show promise are the hand-held X-Ray Florescence (XRF) instrument and the compact Fourier Transform Infrared Spectroscopy (FTIR) unit. The SHRP2 Solution provides a rapid method for inspectors to use XRF to test pavement markings and epoxy coatings real-time in the field by determining their metal contents. The Solution also provides a method for using FTIR, working in the attenuated total reflectance mode, to assess the degree of oxidation in RAP, as well as a method for fingerprinting chemical admixtures in freshly mixed Portland concrete cement. The methods described above include generic testing procedures with sampling and data analysis guidelines, as well as proposed standards of practice that can be considered by AASHTO. The SHRP2 Solution also provides a summary of portable spectroscopy technologies and their potential for identifying and quantifying additives and contaminants in common construction materials, such as using the FTIR for the identification of polymer-additives in asphalt.

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Learn more about
Guidelines for the Preservation of High-Traffic-Volume Roadways on GoSHRP2

Guidelines for the Preservation of High-Traffic-Volume Roadways (R26)

Your guide to selecting the most-affordable options for extending pavement life.

A comprehensive SHRP2 report shows that many conventional techniques—and some new ones as well—can be used to extend the life of high-traffic-volume roads and avoid disruptive and costly major rehabilitation and reconstruction projects. Derived from an extensive literature review and a detailed survey of transportation agencies, the report documents successful current practices and provides selection matrices to help match specific high-volume-traffic situations with the best available treatments.

Guidelines for the Preservation of High-Traffic-Volume Roadways and its companion guidelines clarify key factors that affect preservation treatment decisions, including traffic levels, pavement conditions, climate conditions, available work hours, and treatment performance and cost. Preliminary and final feasibility matrices for hot mix asphalt and Portland Cement Concrete-surfaced pavements allow engineers to quickly identify a particular treatment type (such as crack fill) and see whether it is recommended for particular distress types and severity levels. Example decision matrices simplify the complex factors involved and give steps for weighing technical inputs. Appendices summarize treatments and give examples of how the matrices have guided treatment selection.

By helping engineers to more quickly and confidently select the right treatment at the right time for a given pavement, the guides can help transportation agencies embrace preservation as a key strategy in maintaining pavements, thereby saving scarce transportation dollars. And by focusing on more than 20 treatments that have proven cost-effective, these documents also help save money by reducing the risk of choosing preservation. Follow-on benefits include reducing congestion and increasing worker and driver safety.

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Learn more about
Advanced Methods to Identify Pavement Delamination on GoSHRP2

Advanced Methods to Identify Pavement Delamination (R06D)

Tools to detect subsurface delamination in asphalt pavements.

Developed through the SHRP2, three new technologies make advances in the detection of subsurface discontinuity of asphalt pavement. Ground-penetrating radar (GPR) uses a lane-width multi-antenna array with a frequency sweep that can be operated at speeds up to 40 miles per hour. Multiple pairs of hardware reduce the number of passes required to cover the lane width. The GPR also has an automated test frequency (every six inches) that accelerates the ability to acquire data. The impact echo (IE), combined with seismic analysis of surface waves (SASW) system completes data collection in less than one percent of the time required by manual point testing. The software uses real-time display to monitor the quality of the data collection. The IE software can provide immediate results in identifying suspect pavement variations, which significantly reduces the time and safety issues associated with current manual testing of a surveyed grid within a lane closure.

Highway agencies might consider use of the GPR and the IE/SASW, or both, for identifying project-level pavement delamination and debonding. While these technologies are currently available, highway agencies play a vital role in further developing them into readily implementable products. Proof of concept pilot projects are needed to not only validate the results, but also to encourage equipment manufacturers to advance the technology, hardware, and data analysis software; the ultimate goal being real-time reliable results that would be valuable not only for project-level quality control and forensics, but also network-level pavement assessment.

The GPR and the IE/SASW can be valuable project-level tools used independently or in a series to assist the engineer in identifying pavement discontinuity. Enhanced GPR technology is a significant step forward. This technology, which comes with a lane-width, multi-antenna array to provide an accurate full-lane measurement, is an improvement over the current one- and two-antenna systems, which need several passes across a lane to obtain a complete measurement. This equals time savings and improved safety. As the NDT industry continues to improve both hardware and software, these NDT tools should become more effective tools for pavement evaluation.

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Learn more about
Nondestructive Testing for Concrete Bridge Decks on GoSHRP2

Nondestructive Testing for Concrete Bridge Decks (R06A)

Recommended technologies to detect deterioration of concrete bridge decks.

The number of concrete bridge decks in poor structural condition is one of the biggest problems affecting bridges in the United States. Evaluating bridge deck conditions becomes increasingly critical as highway agencies work to optimize the effective timing, scope, and approaches for preventive maintenance, repair, and replacement. Normal chain dragging, hammer sounding, and visual methods of identifying concrete bridge deck deficiencies do not accurately and safely provide the needed information to adequately maintain concrete bridge decks. Nondestructive testing (NDT) techniques have the potential to quickly and reliably provide the needed information about under-the-surface conditions of bridge decks, but independent evaluations are needed to determine their best use and to validate their effectiveness under a variety of conditions.

The web-based, open-source NDToolbox helps identify and characterize testing technologies that are available to locate the primary deficiencies in concrete bridge decks. With the toolbox, users can explore different NDT technologies and examine their use in detecting deterioration for conditions relevant to the project. The NDToolbox describes the technology and the physical principle behind it, applications, performance, limitations, equipment, test procedures and protocols, and sample results. It also provides recommendations regarding the best technologies for a particular deterioration detection application.

The accompanying report identifies the four most common types of deterioration affecting concrete bridge decks, and the corresponding NDT techniques that are best suited to locating and identifying the deterioration. Based on their overall value in detecting and characterizing deterioration in concrete decks, the top technologies were ground-penetrating radar, impact echo, and ultrasonic surface waves. The report

and web tool provide clear information about the advantages and limitations of each technology. However, the ultimate decision about which equipment to acquire and which technology to use is dependent on the type of deterioration that is of highest concern to the agency, and whether the evaluation is being done for network-level condition monitoring or for project-level maintenance or rehabilitation.

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Learn more about
Service Life Design for Bridges on GoSHRP2

Service Life Design for Bridges (R19A)

Guidance, training, and technical assistance promoting service life design concepts and methods.

Because of deterioration, individual bridge components and systems such as bearings, decks, joints, columns, and girders require frequent and costly inspections, maintenance, and repairs that are often difficult to conduct. These activities cause lane closures that create congestion and impact safety for road workers and motorists. Bridge engineers need improved design options so they can deliver bridges that are operational for 100 years or more.

The *Design Guide for Bridges for Service Life* is a comprehensive reference document that complements AASHTO specifications and equips bridge engineers with the tools to develop specific solutions for given conditions and constraints. It represents a new approach to designing for service life that results in longer-lasting bridge components and systems that are both easier to inspect and better suited to their environments. The guide focuses on typical bridges with one or multiple spans and a maximum single span length of 300 feet. It addresses design, fabrication, construction, operation, maintenance, repair, and replacement issues applicable to both new and existing bridges. It includes standard plans, model specifications for design and construction, and fault tree flow charts.

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Learn more about
Service Limit State Design for Bridges on GoSHRP2

Service Limit State Design for Bridges (R19B)

Toolkit to perform state- or site-specific calibrations for service limit state design for bridges.

Bridge components deteriorate at different rates, which can lead to unanticipated bridge closings. Under the current system, bridge components are planned based on "ultimate limit state performance," which does not take into account service limit states focused on longevity-driven and durable design. SHRP2's *Service Limit State Design for Bridges* toolkit offers a quantitative framework to assess service limit states more accurately. The toolkit provides actual performance data, component-based distress models, and specific guidance for common bridge elements, as well as:

- A framework for calibrating service limit state specifications.
- Service limit state load and resistance factors.
- Bridge design procedures and model specifications for service limit states.
- Tools required for future service limit state improvements.
- Model specification changes that include designing for durability.

The toolkit contains databases, software tools used in the calibration (such as Monte Carlo spreadsheets), and instructions for developing new or revised spreadsheets and deterioration models. The framework will calibrate the following AASHTO service limit state design elements:

- Live load deflections.
- Bearing movements.
- Settlement of foundations and retaining structures.
- Permanent deformations of compact steel components.
- Fatigue of structural steel and the steel reinforcement in concrete (complementary research being conducted through the National Cooperative Highway Research Program 12-83).
- Slip-critical bolted connections.
- Concrete approaches.

Improved service limit state design can increase the service life of bridge components and give designers the option to select bridge components based on expected maintenance time and difficulty of replacement.

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Learn more about
Regional Operations Forum on GoSHRP2

Watch the *Regional Operations Forum* presentation from the 2014 ITE Technical Conference and Exhibit presented by Kathleen Frankle, Program Manager, University of Maryland-College Park.

Regional Operations Forum (L36)

Regional training program to advance transportation systems management and operations.

Transportation leaders are seeking ways to deliver a transportation system that supports reliable trips for drivers. Although many new strategies and technologies for operating transportation systems are emerging that can help transportation agencies improve travel-time reliability and safety, many are not yet routinely incorporated into practices, business processes, and decision making. Some agencies may experience success with certain approaches, but those successes and associated lessons learned are not regularly transferred to other agencies. Development of expertise through training and peer exchange is needed.

A new total-immersion forum now offers transportation agency leaders and practitioners the opportunity to learn about leading approaches related to operations and reliability and how to take advantage of the many advances being made in operations. This curriculum through the *Regional Operations Forum* for regional training allows managers and program leaders at public agencies to build expertise in the emerging field of transportation systems management and operations (TSM&O).

The FHWA is exploring additional formats for the *Regional Operations Forum* to meet user needs, and working with AASHTO and the National Operations Center of Excellence on follow-up activities. The FHWA also plans to work with states to identify ways that the forum can be used to catalyze further development of a state's own TSM&O training efforts and programs.

Through this Round 7 offering under the Implementation Assistance Program, state agencies will use the curriculum and materials from the *Regional Operations Forum* to establish or advance a TSM&O training program within the state. The intent in the Round 7 offering is to move beyond a one-time training and for state DOTs to adopt the long-term benefits of the forum building and contributing to future efforts. The aim of the *Regional Operations Forum* is to mainstream TSM&O into the cultures of the state and partners by transitioning the state of the art closer to the state of the practice.

The curriculum is designed to help those with TSM&O expertise as well as participants whose expertise is outside the TSM&O field. The in-person, immersion approach to the forum allows participants to focus on the material with fewer distractions and develop a strong peer network. Topics such as the principles of building TSM&O capability within organizations, performance measurement, goods movement, workforce development, and building a business case for TSM&O are covered. The forum also covers core TSM&O topics such as traffic incident management and traveler information, as well as emerging topics such as corridor management and connected vehicles. The forum contains presentation material, discussion to foster peer exchange, and group exercises to apply the knowledge. By conducting the forum on a regional basis, neighboring states or jurisdictions can emphasize the topics and issues that are most pertinent to the interests and capabilities of the specific region and develop a peer network that can work together on common issues in the future.

Incorporating the lessons learned through the *Regional Operations Forum* into practice assists agencies to strengthen TSM&O programs at the state and regional level – and provides the next generation of leadership with the necessary skills for advancing TSM&O. The curriculum transmits the latest strategies and technologies to transportation agency managers and leaders, helping agencies immediately to enhance their transportation systems management and operations. That, in turn, results in the economic, environmental, and safety benefits generated by more reliable travel times.

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Learn more about
Reliability Data and Analysis Tools on GoSHRP2

Reliability Data and Analysis Tools (L02/L07/L08/C11/L05)

Tools to help transportation planners and engineers improve monitoring and analysis of data to achieve more consistent, predictable highway travel.

SHRP2 research within the Reliability focus area produced a bundle of five analytical products that aid in diagnosing the nature of travel-time reliability problems, identifying possible corrective actions, and analyzing the probable effect on travel-time reliability of implementing those actions. The following SHRP2 products are included in the *Reliability Data and Analysis Tools* bundle:

- *Guide to Establish Monitoring Programs for Travel-Time Reliability* (L02).
- *Reliability by Design* (L07).
- *Incorporating Travel-Time Reliability into the Highway Capacity Manual* (L08).
- *Tools for Assessing Wider Economic Benefits of Transportation* (C11).
- *Handbook for Incorporating Reliability Performance Measures into Transportation Planning and Programming (L05).*

***Guide to Establish Monitoring Programs for Travel-Time Reliability* (L02)**
This guide provides agencies with methods for designing programs to monitor travel-time reliability and helps them establish a baseline of system data to help measure current performance and identify areas for improvement. It serves as a guidebook for designing, building, operating, and maintaining these systems and addresses freeways, toll roads, and urban arterials, providing direction on technical, analytical, economic, and institutional implementation issues. More information about this product is also available in a recorded SHRP2 Tuesdays webinar.

***Reliability by Design* (L07)**
This is a spreadsheet-based treatment analysis tool and design guidebook that helps agencies estimate the effectiveness and comparative economic benefits of freeway design treatments at specific locations. Pilot testing this product requires substantial calibration using locality-specific traffic, weather, and incident data. More information about this product is also available in a recorded SHRP2 Tuesdays webinar.

***Incorporating Travel-Time Reliability into the Highway Capacity Manual* (L08)**
This product provides reliability assessment methods based on the Highway Capacity Manual (HCM) freeway and urban street facility procedures and computational engines. The methods generate scenarios (such as weather, incidents and work zones) to consider the underlying causes of travel time variations. Learn more about this product by reviewing the proposed HCM chapters and a recorded SHRP2 Tuesdays webinar.

***Tools for Assessing Wider Economic Benefits of Transportation* (C11)**
This spreadsheet-based analysis tool, developed under the Capacity focus area, provides sketch-level estimates of travel-time reliability benefits. The tool takes information on the type of highway, projected traffic volume, speed, number of travel lanes, and capacity. It estimates benefits using generalized relationships from other SHRP2 studies. Learn more about this product by reviewing the project report, by exploring the tools available on the EconWorks website, or by viewing a recorded SHRP2 Tuesdays webinar about this product.

***Handbook for Incorporating Reliability Performance Measures into Transportation Planning and Programming* (L05)**
This handbook provides an overview of procedural and technical approaches to integrate mobility and reliability performance measures and strategies into State DOT and MPO transportation planning and programming processes. The guidebook and technical reference help agencies understand how to develop reliability-related policy; how to evaluate reliability in approaches to making investment choices; and how to communicate the importance of reliability to institutional partners. More information about this product is also available in a recorded SHRP2 Tuesdays webinar.

Watch the Reliability Analysis Tools presentation from the 2014 ITE Technical Conference and Exhibit presented by Stephen J. Andrle, Deputy Director, SHRP2, Transportation Research Board.

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Learn more about
Reliability in Simulation and Planning Models on GoSHRP2

Reliability in Simulation and Planning Models (L04)

Guidelines for incorporating reliability performance measures into travel models.

The SHRP2 Reliability focus area identified seven sources of nonrecurring congestion: incidents, weather, work zones, special events, traffic control devices not working properly, unusual fluctuations in demand, and bottlenecks that can exacerbate these sources of unreliability. These nonrecurring sources of congestion can affect supply, demand, or both. These supply and demand factors influence the travel time for origin–destination pairs across the network and, in turn, the distribution of travel time from which various reliability measures can be derived.

The *Reliability in Simulation and Planning Models* SHRP2 Solution is designed to assist State DOTs, MPOs, and other transportation agencies in moving reliability into their business practices. This SHRP2 product offers application guidelines for incorporating reliability into micro- and/or meso-simulation models that identify key steps for integrating demand and network models. This project adds a distinguishing classification that recognizes systematic variation factors and those that vary randomly (loosely corresponds to recurrent and non-recurrent congestion) for both travel demand and network supply. The variability in system performance that is at the center of interest has both systematic causes, which can be modeled and predicted, as well as causes that can only be modeled as random variables and which occur according to some probabilistic mechanism.

The new methods are useful for project evaluation and many types of planning. Three main components provide the capability to produce reliability performance measures as output from operational planning and simulation models:

1. The Scenario Manager, which captures exogenous or external sources of travel-time variation (i.e. outside unreliability sources), such as special events, adverse weather, work zone and travel demand variation.

2. Reliability-integrated simulation tools that model sources of unreliability endogenously (i.e., within the model), including user heterogeneity (diversity), flow breakdown, accidents and so forth.

3. A vehicle Trajectory Processor, which extracts reliability information from the simulation output, namely vehicle trajectories.

The Scenario Manager is a preprocessor that produces randomized input into simulation models, and the Trajectory Processor is a post-processor that portrays the variability in travel-time and reliability performance metrics from origins to destinations and for segments and links. Such tools are integrated into an agency's business processes to improve its capability to analyze and improve travel-time reliability.

The *Reliability in Simulation and Planning Models* solution has closed an important gap in the underlying conceptual foundations of travel modeling and traffic simulation, and can provide a practical means of generating realistic reliability measures using network simulation models in a variety of application contexts.

Round 7 Implementation Assistance Opportunities

The chart below lists the implementation assistance opportunities for Round 7 of the Implementation Assistance Program, which willl be open from April 1 – 29, 2016. All assistance opportunities include technical assistance support.

SHRP2 SOLUTION	TYPE OF ASSISTANCE	NUMBER AVAILABLE	AMOUNT OF ASSISTANCE (PER OPPORTUNITY)	ELIGIBLE AGENCIES
CAPACITY ASSISTANCE OPPORTUNITIES				
PlanWorks (C01)	User Incentive	5 – 8	$50,000 – $100,000	State DOTs and MPOs
RELIABILITY ASSISTANCE OPPORTUNITIES				
Reliability Data and Analysis Tools (L02/L07/L08/C11/L05)	Lead Adopter	5 – 10	$50,000 – $100,000	State DOTs and MPOs
Regional Operations Forum (L36)	Lead Adopter	4 – 8	$25,000 – 100,000	State DOTs
Reliability in Simulation and Planning Models (L04)	Proof of Concept	2	Up to $200,000	State DOTs and MPOs
RENEWAL ASSISTANCE OPPORTUNITIES				
Nondestructive Testing for Concrete Bridge Decks (R06A)	User Incentive	Up to 8	Up to $30,000	State DOTs, MPOs, local and tribal agencies.*
Nondestructive Testing for Tunnel Linings (R06G)	User Incentive	Up to 8	Up to $30,000	State DOTs, MPOs, local and tribal agencies.*
Service Life Design for Bridges (R19A)	Lead Adopter	Up to 5	Up to $100,000	State DOTs, MPOs, local and tribal agencies.*
Service Limit State Design for Bridges (R19B)	User Incentive	Up to 8	Technical assistance only	State DOTs, MPOs, local and tribal agencies.*
Utility Bundle (R01A/R01B/R15B)	Lead Adopter	Up to 15	R01B: Up to $100,000 R15B: Up to $100,000 R01A: Up to $150,000	State DOTs, MPOs, local and tribal agencies.*
Railroad-DOT Mitigation Strategies (R16)	Lead Adopter	Up to 8	$75,000	State DOTs, MPOs, and local agencies.
	User Incentive	Up to 12	$25,000 in technical assistance only	
Techniques to Fingerprint Construction Materials (R06B)	Proof of Concept	Up to 3**	Up to $250,000 plus equipment	State DOTs
Advanced Methods to Identify Pavement Delamination (R06D)	Proof of Concept	Up to 4***	Up to $250,000	State DOTs
Guidelines for the Preservation of High-Traffic-Volume Roadways (R26)	User Incentive	Up to 8	Up to $100,000 in technical assistance only	State DOTs, State Tollway and Thruway authorities, local agencies, tribal agencies.*

* Local agencies must coordinate application submittals with their state DOTs.

** Up to 3 agencies participating, with 2 advancing X-Ray Florescence, 1 advancing Fourier Transform Infrared Spectroscopy, or combination of both for materials included as part of study or other material(s).

*** Up to 4 agencies participating with 2 advancing ground penetrating radar, 2 advancing impact echo/seismic analysis of surface waves, or combination of both for project level analysis of pavement delamination, as part of study or other material(s).

About SHRP2

SHRP2 is a partnership of the Federal Highway Administration (FHWA), American Association of State Highway and Transportation Officials (AASHTO), and the Transportation Research Board (TRB). TRB completed the research, and now FHWA and AASHTO are jointly implementing the resulting SHRP2 Solutions that will help the transportation community enhance productivity, boost efficiency, increase safety, and improve the reliability of the Nation's highway system. If you would like additional information of have questions about SHRP2, please contact Carin Michel, FHWA SHRP2 Implementation Manager, at GoSHRP2@dot.gov, (410) 962-2530, or Pam Hutton, AASHTO SHRP2 Implementation Manager at phutton@aashto.org, (303) 263-1212. Visit the GoSHRP2 website for additional *SHRP2 Milestones* and updates.

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