

**United States Department of Transportation
FY 2020 Annual Modal Research Plans**

Federal Highway Administration

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Executive Summary

The Federal Highway Administration (FHWA) addresses current issues and emerging challenges, creates efficiencies in the highway and transportation sector, and provides information to support policy decisions through its Research and Technology (R&T) programs. FHWA conducts advanced and applied research; coordinates and collaborates with other research organizations, both nationally and internationally, to leverage knowledge; and develops and delivers solutions to address highway transportation needs. FHWA is uniquely positioned to identify and address highway issues of national significance and build effective partnerships that leverage and maximize the value of the Federal investment in highway R&T activities.

FHWA's Office of Research, Development, and Technology (RD&T) is located at the Turner-Fairbank Highway Research Center (TFHRC), a Federally owned and operated national research facility in McLean, Virginia. The TFHRC houses more than 20 laboratories and support facilities and conducts exploratory and applied research. TFHRC staff administer the majority of FHWA's research and development (R&D) activities in the areas of infrastructure, operations, and safety. Research in the areas of Intelligent Transportation Systems (ITS), policy, innovative finance, planning, and the environment is primarily conducted or administered by FHWA offices located at U.S. Department of Transportation (USDOT) Headquarters

FHWA has a long history of strong partnerships and collaboration with the States, Federal agencies, academia, and private industry to coordinate efforts and leverage the unique capabilities of each to advance shared goals. FHWA's R&T program is coordinated with R&T activities conducted through the University Transportation Center research program, the Transportation Research Board's (TRB) National Cooperative Highway Research Program, and State-based R&T initiatives. In addition, FHWA develops joint strategies to address USDOT goals with modal stakeholders, including the Federal Transit Administration, the Federal Railroad Administration, the National Highway Traffic Safety Administration, the Federal Aviation Administration, and the Federal Motor Carrier Safety Administration. FHWA provides unique capabilities to support research that is of national significance but which other partner organizations and private industry are unable or unwilling to conduct. Working within this partnership framework, FHWA strategically identifies opportunities for collaboration, coordination, and independent research that advances the goals of the Agency and the Department. FHWA also works closely with the TRB-sponsored advisory group, the Research and Technology Coordinating Committee (RTCC), which consists of academic and industry specialists, to provide an outside perspective on the direction of the R&T program and identify future opportunities for coordination and collaboration. This independent evaluation and consultation provides valuable insight into opportunities for continuous improvement within the R&T program.

FHWA's core R&T program activities improve safety, reduce congestion, enhance infrastructure design and construction, and provide data and analyses to decision-makers throughout the transportation community.

- The Safety area addresses the contributing factors for deaths and injuries related to roadway design, construction, and maintenance, and develops robust data analysis tools that enable transportation professionals to match those contributing factors with cost-effective countermeasures. In Fiscal Year (FY) 2020, the FHWA Safety R&T program will invest in topics such as an integrated and holistic process for safety analysis that merges hotspot and systemic models for a balanced approach that ensures the best possible selection of safety improvements; an investigation of pedestrian-intersection treatments across several geographic locations; and human behavior studies of driver interactions with automated truck platooning.
- The Infrastructure area engages in forward-looking research that supports safety, durability, resilience, environmental sustainability, and asset management. FHWA infrastructure research outcomes stimulate economic growth, productivity, and competitiveness through contributions to improved mobility and accessibility. In FY20, work initiated through the Accelerated Implementation and Deployment of Pavement Technologies program will include development of technical guidance in several areas—including emerging asphalt performance tests, equipment certification for performance measurement, and improved pavement foundations—and work to advance continuous friction measurement and management to improve pavement safety. Construction and Project Management Program activities will include peer exchanges on the use of Unmanned Aerial Systems and activities to advance the application of Building Information Modeling in highway infrastructure engineering and management practice. Characterization of the durability of recycled materials used as backfills, updated guidance and training on slope management, and implementation of a geotechnical asset management framework will be among the activities initiated through the Geotechnical and Hydraulics program. Long-Term Infrastructure Performance Program activities in 2020 will include analysis to develop improved models to predict bridge deck performance, while Pavements and Materials program activities will include documentation of the business case for performance-related specification and validation of a potentially ground-breaking test method for detecting the potential for concrete deterioration due to alkali silica reactivity. In FY20, Structures program activities include the pursuit of innovative short-span bridge superstructures that take advantage of advance materials, deployment of the National Tunnel Inspection Standards, and investigation of the use of drones for bridge inspection. FY20 Transportation Performance Management, Asset Management, and Maintenance activities will include asset management case studies and technical guidance for several bridge preservation practices.
- The Operations area develops innovative technologies and processes that lead to system-wide improvements in how FHWA and its State and local partners manage and improve the efficiency and reliability of the National Highway System. In FY20, the FHWA Operations research area will work with Automated Driving Systems (ADS) stakeholders to identify alternative integration scenarios that will proactively

prepare the roadway environment for the deployment of ADS. These integration scenarios will increase the understanding of how both public and private entities can support the safe integration of ADS from organizational and technical perspectives. The program will also focus on Cooperative Automation that will address the ability of ADS to navigate challenging roadway environments such as adverse weather conditions, work zones, or traffic incidents. The Operations area will support effective mobility through research into how to best apply Transportation Systems Management and Operations (TSMO) strategies in rural areas, development of a TSMO strategy toolkit to assist practitioners in identifying appropriate TSMO solutions, and exploring the nexus between TSMO and safety to better understand how TSMO and safety strategies can work together. The Operations area will continue to support performance-based management of and investment in transportation through research and technical assistance on analytical tools, congestion and reliability performance management rules, a data framework supporting transportation management for non-recurring events, and evaluation of the results from funding alternatives grants. The Operations research programs will develop and issue a Notice of Proposed Amendments for a new edition of the Manual on Uniform Traffic Control Devices and manage the rulemaking process. The Operations area will also continue to support freight mobility to enhance the movement of goods and support economic competitiveness through efforts such as an analysis of urban and rural intermodal freight connectors, producing improved analytical tools, peer exchanges, and dissemination of best practices to State and local partners. For example, the Emergency Route Working Group required by the Fixing America's Surface Transportation (FAST) Act will provide recommendations that will inform some research programs. Additionally, the Office of Operations will develop an FHWA Truck Size and Weight Research Implementation proposal to include projects that are cross-cutting and impact multiple agencies and departments. Also, FHWA is finalizing research to update a 2015 Jason's Law truck parking survey/analysis of where truck parking shortages exist and tactics to address these shortages.

- The Policy area offers comprehensive quality data; evaluates the impacts of a broad range of policy options; and analyzes current and emerging issues that will affect the way transportation projects are regulated and permitted, and how transportation systems are constructed, operated, and maintained. The Foundations for Evidence-Based Policymaking Act of 2018 codifies the need for data to be more accessible both to the Department as well as the public. This increased access to data is intended to enable evidence-based policymaking and improve transparency. The FHWA will conduct an intermodal collaboration across the Department regarding all new projects funded in FY20 under the research plan. The effort will identify data collection partnership opportunities, application usages, and ways the data can achieve shared collection goals while supporting multiple users. The FHWA will also work with its partners in the other modes (NHTSA, FMCSA, FTA, FRA, and BTS) to

improve FHWA's data guidance related to data management plans, data discoverability, and technical assistance to project managers and awardees (State and local highway agencies). The FY20 Policy program will continue to explore alternative private sector data sources, improve a variety of data collection methods, take advantage of "big data" for integrated and linked data systems, and support research to identify policies to streamline the regulatory process. The Policy area will conduct important studies on topics such as policy alternatives and system impacts for emerging technologies including shared modes, on-demand transportation, connected and automated vehicles, alternative fuel vehicles, and multimodal corridor investments. Additionally, the Policy area will establish a framework and quantitative tools for assessing market viability and economic impacts of emerging transportation services, including shared mobility, at varying population densities, levels of access, and socio-economic characteristics, with an emphasis on underserved populations and rural transportation systems. The Policy area will conduct empirical policy simulation to assess macroeconomic impacts from highway investment, including economic output and employment. FY20 funding will support the development of updated versions of benefit-cost analysis models used to identify and prioritize potential future investments for Congressional reporting purposes.

- The Planning and Environment research area assesses new tools and processes that consider the complex relationships among individuals, communities, the economy, and the environment, to enable better decisions and lead to improved outcomes. New FY20 FHWA Planning and Environment R&T program activities will invest in topics to accelerate project delivery, including activities related to regulatory reform, rulemaking, guidance, "planning and environmental linkages," programmatic approaches, National Environmental Policy Act assignment program and audit support, "Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects," resource agency liaison program support, and the Environment Discipline Support System. Examples of tools FHWA will create in FY20 through interagency agreements include programmatic approaches to expedite permitting and regulatory review times and policy and guidance for stakeholder flexibilities. The Planning and Environment area will also continue to support the expansion of alternative fuels through a designation of alternative fuel corridors, technical assistance, training, and research.
- The Exploratory Advanced Research Program conducts longer-term, higher-risk research in all the research areas above. These research products have the potential for dramatic breakthroughs in transportation. The FY20 program will support research on the application of machine learning to support complex system control scenarios at multiple scales and across modes; new methods for measuring and forecasting the movement of goods across modes that take into account economic behavior in support of policy needs at multiple scales (i.e., national, State, and local);

and the application of machine learning to increase the reliability of and reduce the cost of analyzing sensor data.

The technology and innovation deployment efforts under the R&T program aim to accelerate the adoption of proven innovative practices and technologies as standard practices to significantly improve safety, system efficiency, infrastructure health, reliability and performance, and livable/sustainable communities.

- [Every Day Counts Program \(EDC\)](#): EDC identifies under-utilized, market-ready technologies with high pay-offs and accelerates their deployment and acceptance throughout the Nation.
- [Accelerated Innovation Deployment \(AID\) Demonstration Program](#): This program provides incentive funding for eligible entities to accelerate the implementation and adoption of innovation in highway transportation.
- [State Transportation Innovation Council \(STIC\) Incentive Program](#): This program offers technical assistance and up to \$100,000 per STIC per year to support the costs of standardizing innovative practices in a State Department of Transportation (DOT) or other public sector STIC stakeholder.
- [Accelerating Market Readiness \(AMR\)](#) program: This program provides funding to spur the advancement of emerging transformative innovations that have the potential to enhance roadway safety, shorten the project delivery process, and improve the performance of transportation infrastructure. Funding is available for testing and field evaluations, pilot demonstration projects, and documentation and dissemination of performance results to increase knowledge of the innovations.
- *Memorandum of Understanding (MOU) with American Association of State Highway Transportation Officials (AASHTO)*: The MOU supports a cooperative agreement between the AASHTO Innovation Initiative (AII) and the FHWA Center for Accelerating Innovation for AII to serve as AASHTO's point of contact for stakeholder engagement in EDC and to collaborate on the deployment of EDC and foster the EDC innovation pipeline. AII will support FHWA as technical peer evaluators on Accelerating Market Readiness proposals received from external sources.
- *Accelerated deployment of pavement technologies*: The FAST Act extends the designation of \$12 million per FY to promote, demonstrate, support, and document the application of innovative pavement technologies, practices, performance, and benefits.

Each USDOT modal administration is responsible for ITS requirements, guidance, and research relevant to that mode, and each uses a combination of mode-specific funding and dedicated ITS funding to accomplish that mission. Some Joint Program Office (JPO) funds

supplement modal research activities where additional revenues are needed to meet program objectives or to ensure synchronization with USDOT multimodal needs. ITS JPO also has a role in coordinating USDOT's overall ITS research program to ensure multimodal collaboration and avoid duplication of efforts. Staff from ITS JPO and modal agencies work jointly to accomplish the defined ITS research program and avoid duplication. The research programs and funding discussed in the FHWA Annual Modal Research Plan do not directly include the \$100 million dedicated to the ITS research program. However, the ITS research program provides \$21 million of the \$60 million annual Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) grant program funding in FY 2020. FHWA administers the ATCMTD program. In addition, FHWA's Connected and Automated Vehicle Research and TSMO Research areas may receive additional funding from the dedicated ITS research program to fully accomplish their objectives, but the funding totals shown in the following sections reflect only funding from FHWA's highway R&D and Technology and Innovation Deployment Program (TIDP) programs. Finally, FHWA administers the ITS JPO, providing staffing and administrative processes.

Chapter 1: Introduction/Agency-Wide Research Approach

Federal Role/Continued Relevance

The primary goal of the FHWA R&T program is to deliver R&D that directly supports the strategic goals of FHWA and the USDOT. FHWA's R&T program identifies and addresses issues of national significance that cannot or will not be addressed by other research sponsors, including issues that require higher-risk and/or longer-term research and areas of specific Federal responsibility. The FHWA R&T program is responsible for conducting R&T activities that produce a clear public benefit, support Federal stewardship roles, meet and address current and emerging needs, and ensure the coordination of highway R&T activities. Additionally, the FHWA R&T program delivers solutions needed to meet current and future challenges. In pursuit of these responsibilities, FHWA's role is to conduct research, in coordination with other research partners, that addresses market failures of national significance that may exist due to the level of risk, complexity, or a need for sustained investment. The FHWA R&T program also aims to maximize value and avoid duplication by focusing on innovations with broad applicability and leverage research investments with programs aimed at successful technology transfer. The FHWA R&T program also ensures that critical technical expertise is available in times of crisis or for sensitive matters. This includes an ability to provide technical support during natural disasters, participate in sensitive Federal investigations, and work with other Federal agencies on issues related to national security and defense.

The FHWA R&T program covers the entire innovation lifecycle, including agenda setting, conduct of R&D, technology testing and evaluation, and deployment and evaluation of market-ready technologies and innovations. This holistic approach to innovation allows FHWA and USDOT to serve as national leaders in transportation, thus providing the Agency and Department legitimacy in shaping the direction of innovation development in support of national interests. This credibility and influence ensure that, in working with partners, FHWA is pursuing a transportation future that is aligned with the strategic goals of USDOT and promoting the most safe and efficient transportation system for taxpayers. Without the FHWA R&T program, the Nation would lack the strategically aligned innovation development and deployment activities—not to mention the world-class technical expertise, relevancy, and strategic influence—to ensure that the public has access to the safest, most reliable, and most resilient infrastructure.

The FHWA R&T program is structured to adjust to year-to-year changes in priorities and emerging needs. In addition, FHWA's Office of RD&T utilizes long-range roadmap processes that support iterative technology and innovation development as well as transition steps that move lab-validated innovations to field testing and, eventually, to full deployment. The FHWA R&T roadmaps were updated in response to the release of the USDOT Strategic Plan. This Annual Modal Research Plan reflects those strategic adjustments in the FHWA R&T program investments for FY20 and FY21. The funding amounts allocated to the R&T program presented in this plan are the result of a cross-agency review of prioritized needs

that are responsive to FHWA and Departmental goals and ensure adequate investment and progress in meeting those goals.

Research Portfolio Information

FHWA R&D project data and published reports are transmitted to the [USDOT Research Hub](#) and the National Transportation Library Repository and Open Science Access Portal ([ROSA P](#)). This includes all data elements that currently make up a complete data entry in Research Hub. FHWA continues to work with the National Transportation Library to develop an ongoing process to continually feed and update data and to develop a new pilot process to publish FHWA RD&T documents directly into ROSA P. FHWA is also continuing its work with OST-R to provide real-time upload of project activity and to improve the ability to track views and downloads of projects by FHWA R&D program area and downloads of reports and data sets. In FY20, FHWA is moving forward with implementing its plan to fully transfer the FHWA research projects database to Research Hub.

Acquisition and Assistance

FHWA uses a broad array of acquisition and assistance mechanisms to support and stimulate highway-related research. FHWA's research funding is authorized by statute to allow discretion in the selection of contracts, grants, cooperative agreements, and interagency agreements where appropriate for the specific project. The selection of the appropriate acquisition or assistance vehicle is made by a warranted Contracting Officer in FHWA's Office of Acquisition and Grants Management in consultation with the requiring program office. This decision is made at the earliest stage of the planning process and helps shape important factors such as the degree of control FHWA may have in the direction of the project, rights in ownership of research results, potential leveraging of non-Federal funds, and the marketplace of interested vendors or recipients.

Acquisition—Contracts and Purchase Orders

Acquisition encompasses the mechanisms used to acquire supplies or services primarily through the issuance of contracts and purchase orders that are for the direct benefit of the Government. The term "contract" applies to awards made for supplies or services valued above the Federal Acquisition Regulation's Simplified Acquisition Threshold (currently \$150,000). Simplified acquisition procedures, which are quicker and more streamlined, may be used for needs under \$150,000. An acquisition award under \$150,000 using simplified acquisition procedures is referred to as a purchase order; within the FHWA research program, purchase orders are most commonly used to acquire supplies necessary for laboratory operation.

FHWA strives to utilize the most efficient and effective methods to support research activities with contracts that offer economical best value for the taxpayers while engaging myriad highly sophisticated private sector organizations, ranging from small disadvantaged business enterprises to Fortune 500 corporations and universities. The FHWA research program has highly diverse needs. Examples of common research-funded

contracts include: the procurement of scientific, engineering, and testing equipment for nondestructive evaluation of highway structures; engineering and professional services to operate the TFHRC laboratories; studies to investigate connected and automated vehicle technology, improve the longevity of pavements and bridges, and enhance the safety of guardrails and other roadway devices; training for State DOT officials; and technology transfer to share research results with States, localities, and industry. Contract types range from short-term firm fixed price awards and cost reimbursement studies with uncertain outcomes to multi-year indefinite delivery indefinite quantity awards that allow expeditious ordering of goods and services. Additionally, solicitation methods such as Broad Agency Announcements (BAA) enable industry to propose unique and innovative solutions to address problem statements and allow FHWA to make multiple awards from a single announcement, using both acquisition and assistance award types. The Exploratory Advanced Research Program is a key example where BAAs have yielded highly successful results.

Assistance—Grants and Cooperative Agreements

Assistance describes the process by which the Government provides support to accomplish a public purpose that is authorized by Federal statute, such as the highway R&D program. The instruments used to carry out assistance are grants and cooperative agreements. The majority of FHWA's research grants and cooperative agreements require a minimum non-Federal matching contribution, typically 20 to 50 percent, as required by the specific legislative authority for the program. Grants and cooperative agreements are similar and are governed by the same regulations found in [2 CFR Part 200](#). The distinction between the two is the degree of Federal involvement in how the specific award is carried out. Grants are used when no substantial Government involvement is envisioned in the technical direction of the award. Cooperative agreements are used when FHWA contemplates substantial technical involvement during performance with the recipient. Cooperative agreements constitute the majority of the assistance activity within the FHWA research program.

Typical recipients of FHWA grants and cooperative agreements are universities and non-profit organizations such as AASHTO and the National Academy of Sciences.

Interagency Agreements and Intra-Agency Agreements (IAA)

Interagency agreements and IAAs are awards between FHWA and another Federal entity. An interagency agreement is used if the partner agency is outside USDOT. IAA is the term when the partner agency is another USDOT operating administration. FHWA's research program both receives funds to conduct work for other agencies and sends funding to other agencies to participate in collaborative research of interest to both partnering agencies. Aside from the Volpe Center, nearly all FHWA research-funded IAAs are awarded under the authority of the Economy Act, which requires a determination that it is more efficient and economical to conduct the work with the specific partnering agency versus contracting with the private sector. IAAs with Volpe are not subject to the Economy Act as the Volpe Center has specific authority to perform research for USDOT operating administrations.

Technology Transfer

FHWA has embraced a culture of innovation and actively supports and advances innovation across the entire breadth of its activities. FHWA has woven innovation into its business practices, from the development of innovative technologies at its world-class TFHRC; to the Office of Innovative Program Delivery that works across FHWA and with partners to identify and focus innovations for implementation; to its field structure in the Office of Technical Services and its Division Offices that provide technical assistance to State and local partners to deploy the innovations; to its Federal Lands Highway program that works with Federal partners (e.g., the National Park Service) to deploy innovations on transportation assets on Federal lands. The innovation lifecycle is tracked across these different components through multi-year roadmaps to promote parallel development and deployment tracks and to ensure a comprehensive view of what is needed to advance innovation. This promotes cost-effectiveness and timeliness in the innovation development and deployment process, thereby ensuring that FHWA is continually serving as a good steward of taxpayer funds. Across the Agency, FHWA has the organizational capacity to advance innovation through two primary methods: 1) the identification and development of innovative technologies and practices and 2) the implementation of innovation at the Federal, State, and local levels.

FHWA has traditionally used a multi-prong approach to deploying new and proven technologies and transportation-related innovations and processes. This includes direct technical and financial assistance; training; peer exchanges; collaboration with industry groups to disseminate knowledge and information; and evaluation of deployment methods to determine effectiveness, assess needed improvements, and document outcomes.

Key deployment and technology transfer (T2) stakeholders include State DOTs, Federal Land Management agencies, local agencies and industry groups. Additionally, the Local and Tribal Technical Assistance Program centers play a critical role in technology transfer activities. These stakeholders are often the intended audience for the FHWA R&D programs' research outputs.

In the early stages, as an innovation or technology moves from research to development, FHWA will seek out willing State and local transportation agencies to pilot new technologies or be early adopters. The pilot States and other early adopters often receive financial and technical assistance to mitigate the increased risk of using new technologies or initiatives or to offset unprogrammed costs.

As the innovation or technology becomes more mature and is ready for more widespread use, training aids are developed for delivery and early adopters often become "lead" States. Lead States share best practices, challenges, and successes and encourage others to adopt the innovation. Peer exchanges and pooled funds are extremely effective ways for States or other transportation agencies to directly share knowledge and information and transfer technology.

FHWA strongly encourages the use of market-ready technologies and innovations. Specific programs provide resources that enable States and local agencies to accelerate the speed with which innovative technologies and practices enter into standard practice. Resource Center technical specialists, program office subject matter specialists, and field office personnel encourage the use of these technologies during regular office visits and in program discussions with stakeholders. State and local agencies are key motivators in encouraging the use of these technologies by their peers as they are best positioned to discuss how these innovations addressed their transportation issues and provided benefits and efficiencies.

Lastly, a robust evaluation program is critical to sharing results and quantifying the overall benefits gained by Federal, State, and local transportation agencies and the traveling public. FHWA's evaluation programs include both output and outcome measures. Output measures are key to describing the overall saturation of a technology or innovation. Outcome measures assist with measuring the overall performance of the program and help refine and improve technology transfer efforts.

The primary funding source for technology transfer activities is the TIDP, authorized under [23 U.S. Code § 503\(c\)](#). TIDP funds efforts to accelerate the implementation and delivery of new innovations and technologies that result from highway R&D to benefit all aspects of highway transportation and eligible activities, including:

- Deploying research results and products developed under the highway R&D program.
- Establishing and carrying out demonstration programs.
- Providing technical assistance and training to researchers and developers.
- Developing improved tools and methods to accelerate adoption of proven innovative practices and technologies as standard practices.
- Implementing the Future Strategic Highway Research Program findings and results.

The FHWA R&D program submits information on technology transfer activities through OST-R to support the Department of Commerce Federal Laboratory Technology Transfer Fiscal Year Summary Report to the President and the Congress in accordance with [15 U.S. Code § 3710\(g\)\(2\)](#).

Evaluation/Performance Measurement

The purpose of the FHWA R&T program is to identify and address issues of national significance that cannot or will not be pursued by other research sponsors, including needs that require higher-risk and/or longer-term distinctive areas of research. In this role, FHWA shapes and executes a national R&D, deployment, and training program that produces and delivers the solutions needed to meet current challenges, assesses future needs, and respond to those needs proactively and effectively. FHWA relies on both internal measures of performance as well as input and feedback from its partners to ensure that R&T investments are addressing priority needs and producing the desired results.

The R&T Program Evaluation effort is able to show the value of select innovations and technologies developed or deployed through the FHWA R&T program. However, due to the extended interval between development of innovations and sufficient deployment to provide data for evaluations and the inability to separate out the individual effects of a given product or innovation relative to impact of others that are addressing the same goals, it is not always possible to evaluate the individual contribution of a given technology or innovation on a holistic level or within a short timeframe. As such, FHWA considers and measures the performance of the R&T program from many levels, including the identification of research priorities, effective project management, targeted deployment, and end-state evaluations of deployed innovations and technologies.

Selecting the Right Research

The FHWA R&T program's research activities are closely aligned with FHWA's industry and Governmental partners through active coordination with appropriate organizations including TRB and AASHTO, as well as coordination through the FHWA Division Offices, which work directly with the State DOTs to identify emerging needs. These partnerships have existed for decades and have built-in structures that allow for insight and coordination of each organizations' research efforts. In particular, the R&T program leverages relationships with the AASTHO Special Committee on Research and Innovation, other AASHTO Committees, the RTCC, and TRB committees to ensure that research priorities are aligned with State, local, and industry partners. Feedback received through these relationships help guide the research direction of the Agency to ensure that FHWA is addressing existing needs as well as longer-range requirements.

In addition, FHWA has developed several tools and datasets to support robust analyses to establish performance baselines, conduct modeling and simulation of proposed innovations, and assess the aggregate impacts of innovations over time. These tools and datasets are typically developed in cooperation with State and local DOTs and are available for use by researchers in the Government, academia, and industry, both nationally and internationally. FHWA, other USDOT modes, and partner organizations use these data and tools to track the long-term performance of the highway system. By providing a holistic view of the highway system, FHWA and its partners can identify where the greatest improvements have been made and where research is still required and invest accordingly.

Monitoring and Evaluating Project Performance

Once research priorities are identified, the R&T program conducts individual research projects, which employ a variety of methods to quantify the potential impact of innovative products, procedures, and concepts throughout the project lifecycle. These assessments may be produced through simulation and modeling, laboratory testing, or piloting innovations in a controlled environment. In many cases, FHWA will partner with one or more public agencies to conduct pilots on public roads. These efforts provide estimates, with varying degrees of reliability, regarding the potential impact of the innovation.

Research results and deliverables from the FHWA highway R&D program may be integrated into and disseminated through FHWA technical guidance; presented in the form of draft standards to organizations such as AASHTO for possible adoption; or handed off to other FHWA deployment programs, the FHWA Resource Center, and Local and Tribal Technical Assistance Programs for implementation and end-user outreach.

Technology and Innovation Deployment

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 advanced through the program, and some have adopted more than 30. Many of these innovations are now considered mainstream practices across the country. The State Innovations Accomplishment Map, available at https://www.fhwa.dot.gov/innovation/stic/state_innovation.cfm, illustrates State-by-State participation. FHWA compiles a semi-annual report on the state of practice of the current round of EDC innovations, which illustrates the progress made in advancing the technologies and practices; the innovation implementation stage in each State; and the number of States that have demonstrated, assessed, or institutionalized each innovation. This implementation stage is compared to the baseline at the beginning of each EDC round and the goal set for the innovation by each State.

R&T Program Evaluation

While individual research programs aim to contribute to the overall performance of the highway system, whether through enhanced infrastructure performance, reduced congestion, or lives saved, the overall measurement of the effectiveness of research programs, and even specific projects, in relation to these goals, is challenging. To address this issue, in 2014 the FHWA initiated the R&T Program Evaluation effort, with the goal of examining the impact of select projects within the FHWA R&T portfolio. In addition to quantifying the effects of these innovations and technologies, the program also explores why these programs were successful as well as what can be improved. Based on these results, FHWA ultimately works in consultation with the RTCC to identify where process improvement and strategic investment opportunities exist within the FHWA R&T program.

Further, FHWA works closely with State and local DOTs to track progress from deployment of innovative products, technologies, and processes. These reports are posted on FHWA websites and presented to stakeholders. Results and lessons learned from technology

transfer activities, and the interaction with stakeholders during and after the deployment, inform further lessons learned reporting, dissemination programs, and follow-on research.

FHWA reports a number different metrics as a measure of performance of the R&T program. These metrics include:

- Number of research projects completed;
- Number of research projects published;
- Percent of Every Day Counts (EDC) Round 5 innovations that met their goals;
- Percent of State and Federal Transportation Innovation Councils that have a Functioning-to-Sustained maturity level for a formal innovation process and a communication plan; and
- Number of States and local agencies that have used a federal innovative finance tool in the current year.

Chapter 2. High Priority Project Descriptions

New High-Priority Projects for Fiscal 2020

Research Project Name/Topic Area	NextGen National Household Travel Survey
Total Funding in FY20	\$2,620,000
Period of Performance	1/1/2020 to 3/1/2021
AMRP Program	Highway & Transportation Data
U.S. DOT Strategic Goal	Safety, Infrastructure, & Innovation

What are the anticipated outcomes of this project?

Building upon the success of the 2017 National Household Travel Survey (NHTS), the NextGen NHTS will offer the latest data and information on American travel behavior. The NextGen NHTS will fill a national data gap on travel behavior, provide critical data and information for national program and policy scenario analysis, and offer State DOTs and MPOs the necessary data to carry out planning, design, operations, and maintenance of their transportation programs.

The 2020 NextGen R&D effort consists of two key components. The first will develop and deploy effective data collection and processing methods resulting in a delivery of (a) 2020 national multimodal travel behavior data – trip rates per household and per person by a host of social, economic, geographical, and demographic dimensions, and (b) methodologies which can be used by all other interested parties. The second component will develop and deploy transparent approaches to derive and deliver (a) national passenger travel origin destination data and (b) national truck origin destination data by focusing on both private passive and publicly available data.

The 2020 NextGen NHTS supports the U.S. DOT’s Strategic Goals in areas of a) Safety by offering data to improve safety exposure information and travel behavior, b) Infrastructure by providing data to identify system reliability, improve the experience of traveling public, and support economic competitiveness, and C) Innovation by sharing new and effective data collection methods with state and local agencies and private sectors. The NextGen NHTS is aligned and integrated with the U.S. DOT’s research priorities in areas of “Improving the Mobility of Freight”, “Feasibility of Micro-Transit”, and “Improving Mobility for Underserved Communities” through its latest and relevant data, information, and methodologies.

What specific problems will be solved with this research?

The NextGen NHTS is to solve two challenges. The first challenge is to develop an affordable and efficient travel behavior data collection method which can provide quality reliable travel behavior data in a timely manner. The second challenge is to develop and deploy big data and big data analytics in partnership with private businesses to accomplish an integrated multimodal national travel demand database.

Will non-government groups serve as partners in this research? (Yes/No) If yes, what was their role/contribution?

Yes - The non-government groups will participate in the program by (a) contributing financially to the program, (b) providing technical inputs and reviews, (c) offering data for testing, and (d) carrying out the research work. Currently, the AAA Foundation for Traffic Safety has committed to provide financial support to the NextGen NHTS pooled fund study. The Metropolitan Washington Council of Governments, Atlanta Regional Commission, Arizona DOT, Georgia DOT, Michigan DOT, New York DOT, Ohio DOT, Oklahoma DOT, Oregon DOT, Virginia DOT, and Tennessee DOT, have also committed their financial participation. Over a dozen other State DOTs and MPOs have expressed interest in participating in the pooled fund study beyond FY20.

Total cost for the FY20 program is estimated to be \$21 million, with approximately \$4.1 million from FHWA, while the remaining \$16.9 million will come from private entities, State DOTs, and MPOs.

Who are the beneficiaries of this research and how will they benefit?

The U.S. Department of Transportation, the Federal Highway Administration, all State DOTs, Metropolitan Planning Organizations, transportation related research and development entities, and private businesses engaged in transportation and hospitality industry (e.g., intercity travel providers, transportation, tourism, hotels and restaurant).

Why do we need to make this investment in research? Why should this research be funded by the government and not the private sector?

The main reason that the government investment is required in this area is due to the very limited data in the market place. In the past two years, private businesses have engaged in the R&D effort. Unfortunately, the data quality and maturity can't meet the needs right now. In addition, the limited available private data is more focused on large urban areas.

Research Project Name/Topic Area	Safety study on Pedestrian Activated Beacons Crossing embedded LED sign
Total Funding in FY20	\$300,000
Period of Performance	2020 - 2022
AMRP Program	Safety Design
U.S. DOT Strategic Goal	Safety

What are the anticipated outcomes of this project?

According to NHTSA FARS data, there were 5,977 pedestrian fatalities in 2017, representing roughly 16 percent of all traffic related fatalities in the United States. Furthermore, approximately 27 percent of pedestrian fatalities occurred at or were related to an intersection. Tens of thousands of pedestrians are also injured each year, making pedestrian safety at intersections a priority of the FHWA Safety program.

The aim of this project is to study the safety of Pedestrian Activated Beacons Crossing embedded LED sign to identify medium to low-cost pedestrian safety engineering countermeasures techniques applied at intersections, both controlled and uncontrolled, that will help achieve the FHWA goal to improve pedestrian safety at intersection.

LEDs can be embedded in standard highway warning and regulatory signs to outline either the sign itself or the words and symbols on the sign. The LEDs may be set to flash or operate in steady mode. LEDs may be illuminated 24 hours a day, or be activated by vehicles or pedestrians. Due to the low power requirements of LEDs, signs with embedded LEDs can typically be powered using stand-alone solar panel units.

This treatment is applicable for regulatory and warning signs at unsignalized intersections with the intended purpose of improving the visual conspicuity of the signs. Typical locations where LED-embedded signs can be implemented include:

- Locations with sight visibility limitations (horizontal curves, dusk/dawn glare, etc.);
- Locations with documented problems of drivers failing to recognize an intersection; and
- At STOP signs – this treatment may help to increase the rate of vehicles stopping and to avoid drivers failing to detect the STOP sign

This proposed project will involve the engineering countermeasures for this sign to development of an evaluation plan, collection of before and after installation data, and statistical analysis to assess effectiveness. This research project is aligned with the Safety DOT Strategic Goal by focusing on solutions to reduce the number of pedestrian fatalities and serious injury. Eventual application of the products of this research will support systemic safety improvements by focusing on high risk locations where pedestrians interact with vehicles. This research also supports the DOT Research Priority Area of Improving Mobility for Underserved Communities, where the risk to pedestrians is substantial compared to other locations.

What specific problems will be solved with this research?

Candidate engineering countermeasures for research that are considered traffic control devices must be allowed by the Manual on Uniform Traffic Control Devices (MUTCD), which includes devices that are covered by current official experimentations or interim approvals. The Contractor, in consultation with selected local jurisdictions, will be responsible for evaluating whether this Pedestrian Activated Beacon Crossing Embedded LED sign can be proven to improve pedestrian safety.

The Contractor will work with the FHWA to develop engineering countermeasure and identify the research sites. The study approach should strive to achieve geographic diversity, using sites and data from multiple regions of the United States to the greatest extent possible given project resources.

The study will investigate the quantitative effectiveness of embedded LED units, and their ability to improve driver compliance with regulatory signs through improved conspicuity. The study will also consider other factors that may describe the signs' crash reduction properties by articulating how they enhance visibility and recognition of regulatory and warning signs to drivers, especially under low-light or low-visibility conditions.

Will non-government groups serve as partners in this research? (Yes/No) If yes, what was their role/contribution?

This project will feature a Technical Advisory Panel (TAP) that should be comprised of three to five members. Members of this informal panel will likely be requested from among the members of the National Committee on Uniform Traffic Control Devices (NCUTCD) which includes individuals representing Federal, State, Local Governments, academia, non-profit organizations, or private industry. The TAP will participate in meetings, provide input, and review documents for the project.

Who are the beneficiaries of this research and how will they benefit?

The project will feature a plan that details how the information obtained in tasks one to four will be transmitted to facility planners and designers. The marketing plan shall discuss how practitioners can utilize the design and operational information and discuss the safety impact. In addition to the final report and technical brief(s), the plan shall address what other recommended end products could be developed such as journal articles, brochures, and presentations.

Why do we need to make this investment in research? Why should this research be funded by the government and not the private sector?

Traffic safety countermeasures that protect pedestrians is an activity that the government pursues to support the general welfare of the public. A wide variety of treatments and countermeasures have been conceived and implemented across the country in recent years. Some of them, such as the Rectangular Rapid Flashing Beacon (RRFB) can enhance safety by reducing crashes between vehicles and pedestrians at unsignalized intersections and mid-block pedestrian crossings by increasing driver awareness of potential pedestrian conflicts.

FHWA continues to look for effective low-cost countermeasure to serve as alternatives to traffic signals that are shown to significantly increase driver yielding behavior at crosswalks when supplementing standard pedestrian crossing warning signs and markings.

These signs and markings are used to reduce the incidence of multiple-threat crashes at crosswalks on multi-lane roads (i.e., crashes where a vehicle in one lane stops to allow a pedestrian to cross the street while a vehicle in an adjacent lane, traveling in the same direction, strikes the pedestrian), but alone they only have a small effect on overall driver yielding rates.

Research Project Name/Topic Area	Cooperative-ADS Prototype development supporting TSMO
Total Funding in FY20	\$1,000,000 (\$500K FFHWA, \$500K ITS JPO)
Period of Performance	08/01/2020 to 07/31/2022
AMRP Program	Connected and Automated Vehicles
U.S. DOT Strategic Goal	Innovation

What are the anticipated outcomes of this project?

As part of the CARMA platform suite of projects, this effort will develop a prototype application for Cooperative Automation in a Work Zone to advance the platform functionality beyond the proof-of-concept technology readiness level. To achieve this end goal, FHWA will conduct tests and evaluations of the prototype application on a closed course and open roads to validate functionality and assess impacts on safety and operational efficiency.

This project will directly support the U.S. DOT Strategic Goal for Innovation. This project will develop a prototype application for Cooperative Automation in work zones as part of a broader effort to demonstrate the capability of Cooperative-ADS to improve the safety and efficiency of Automated Driving Systems (ADS) operations under difficult and hazardous conditions. The project is part of the CARMASM program, using open source software to encourage collaborative development of these capabilities by academia, industry, and government.

What specific problems will be solved with this research?

This project will support improvements in safety by developing and testing concepts for shared maneuvers to improve Automated Driving Systems (ADS) operations under hazardous conditions such as work zones. To achieve this, FHWA will leverage advances by State and local DOTs and industry to extend the emerging capabilities of automated vehicles to improve safety and mobility in ways that benefit the public.

Will non-government groups serve as partners in this research? (Yes/No) If yes, what was their role/contribution?

Yes. The project falls within the CARMA program, which is based on an open source platform with collaborative development through GitHub. The project will be advanced through efforts of academia, industry, and government for continuous development and improvement of functionality.

Who are the beneficiaries of this research and how will they benefit?

The public will benefit from accelerated development and deployment of cooperative automation, which is anticipated to result in increased safety and operational efficiency of the Nation's roads. To achieve this goal, however, ADS technologies must be able to successfully and safely address difficult TSMO scenarios, such as work zones. Therefore, research efforts led by FHWA will ensure that these critical gaps are addressed and that the underlying technology is available for safe deployment.

Infrastructure owners and operators and industry will benefit by providing measurable benefits of cooperative automation to support investment decisions.

Why do we need to make this investment in research? Why should this research be funded by the government and not the private sector?

The research supports the government function of determining appropriate road network investments.

The research also addresses a market-failure in the development of cooperative automation. Without government leadership, a nationally interoperable system of road infrastructure to support cooperative automation will not be developed to enable improved ADS operations.

Research Project Name/Topic Area	Innovative Short Span Bridge Superstructures
Total Funding in FY20	\$100,000
Period of Performance	FY20
AMRP Program	Structures
U.S. DOT Strategic Goal	Infrastructure & Innovation

What are the anticipated outcomes of this project?

This project will deliver innovative short-span bridge superstructures concepts that are immediately implementable by bridge owners interested in moving away from poorly performing existing solutions.

In the near term, this research will contribute to achievement of the Department’s Innovation goal through development of innovative new design alternatives for highway owners to consider when replacing highway bridges. In the longer term, it will contribute to the Department’s Infrastructure goal and State of Good Repair priority through the resulting opportunities for bridge owners to maximize the return on their infrastructure construction investments. The outcome of this work will be applicable to bridges throughout the nation, including those in rural communities.

What specific problems will be solved with this research?

The large majority of bridges in the U.S. are short span. As these bridges deteriorate, replacement eventually becomes a necessity. Replacement in-kind is simplest but does not address performance deficiencies such as antiquated structural designs that rely on antiquated materials. This project will offer more durable, better performing superstructures that can easily be implemented within existing bridge configurations.

Will non-government groups serve as partners in this research? (Yes/No) If yes, what was their role/contribution?

Yes. Non-governmental groups, such as steel and concrete bridge fabricators, will serve as sounding boards for concepts that surface early in the project.

Who are the beneficiaries of this research and how will they benefit?

State DOTs and their stakeholders are the primary beneficiaries. They will reap long-term benefits from a better performing infrastructure network that requires less maintenance.

Why do we need to make this investment in research? Why should this research be funded by the government and not the private sector?

Solutions in this space must be embraced by bridge owners, namely State DOTs. State DOTs are hesitant to deploy privately developed solutions given that these solutions are perceived as being anti-competitive; DOTs do not want to lock themselves into the use of a proprietary structural system. FHWA can develop new solutions in the public space, making the solutions available to anyone involved in design, construction, and procurement.

Research Project Name/Topic Area	Validation of chemical and physical Alkali Silica Reactive (ASR) tests and development of ASR mitigation strategies
Total Funding in FY20	\$1,000,000
Period of Performance	2020-2021
AMRP Program	Pavement & Materials R&D
U.S. DOT Strategic Goal	Infrastructure & Innovation

What are the anticipated outcomes of this project?

This project is expected to confirm (or refute) that improved test methods do, in fact, yield reliable findings concerning the likelihood that a given concrete mixture will develop Alkali Silica Reactive (ASR), and identify strategies for mitigating ASR in mixtures found to be likely to develop ASR.

This project will contribute to achievement of the Department’s Innovation goal by further advancing a game-changing test method and mitigation strategies to guard against a very prevalent and costly cause of deterioration in concrete pavements, bridges and other structures. In the longer term, it will contribute to achievement of the Department’s Infrastructure goal and State of Good Repair priority, through improved infrastructure durability that will contribute to improved mobility. The outcome of this work will be applicable to infrastructure throughout the nation, including that in rural communities.

What specific problems will be solved with this research?

ASR is an insidious cause of concrete deterioration, in which the product of a chemical reaction between the alkali component of Portland cement and silica present in some aggregates expands when exposed to water, causing the concrete to crack, shortening the service life. The existing standard tests, (ASTM 1260 and ASTM 1293) are both unreliable, and slow to yield results. A test method that yields reliable results more quickly, and strategies for modifying ASR-prone mixes to mitigate ASR potential are needed.

Will non-government groups serve as partners in this research? (Yes/No) If yes, what is their role/contribution?

Yes, the Massachusetts Department of Transportation, Oregon State University, University of Texas and the Federal Aviation Administration are participating by conducting some of the tests and providing samples of materials for which ASR susceptibility has been established via field exposure sites.

Who are the beneficiaries of this research and how will they benefit?

This research has the potential to benefit anyone who builds or uses infrastructure constructed with concrete, through improved material durability. In particular, it will benefit Federal, State and local government agencies that invest in concrete infrastructure for transportation facilities and other infrastructure.

Why do we need to make this investment in research? Why should this research be funded by the government and not the private sector?

The Federal government, through the FHWA, USDOT, and other Federal agencies, invests enormous sums of money in construction, maintenance and preservation of concrete infrastructure. This research is needed to improve the durability of that infrastructure, thereby reducing life-cycle infrastructure costs. The required research does not offer the profit potential needed to motivate private sector investment.

Research Project Name/Topic Area	Curbside Management
Total Funding in FY20	\$380,000
Period of Performance	15 months July 2019 -October 2020
AMRP Program	Multimodal Connectivity
U.S. DOT Strategic Goal	Innovation

What are the anticipated outcomes of this project?

The objective of this task order is to develop resources on curb space management that will allow communities to make informed decisions on how to best manage their curbs. A curbside management tool will be developed to allow jurisdictions to assess, prioritize, and optimize their curb uses, with a suggested weighting based on importance. Case studies will be presented to support examples of best practices used to determine the weighting of the inputs in the Tool. This will directly support the U.S. DOT Strategic Goal for Innovation by providing new tools and methodologies that address changing curbside access needs and evolving technological impacts. The demands for curb space are changing with the evolution of transportation options, shipping demands, and increased urban densities. This project will consider these evolving needs and provide innovative solutions for managing these competing demands.

What specific problems will be solved with this research?

The tools, case studies and pilot projects developed in this activity will help local jurisdictions to assess the built infrastructure including parking and other street-side resources they have and the mobility services using them. In the near term, the products will give the jurisdictions tools and guidance to assess their assets, evaluate changes to more effectively use those assets. In the long term, this work can help the jurisdictions to develop strategies to address the identified conflict points and to pursue desired curb usage and policies.

Will non-government groups serve as partners in this research? (Yes/No) If yes, what was their role/contribution?

Yes - Both government and non-government partners will serve on a Technical Advisory Committee (TAC). The TAC shall provide input on deliverables and findings.

Who are the beneficiaries of this research and how will they benefit?

Local agencies and municipalities with control of the curb, will be provided guidance and resources to help them manage the access and usage by various multimodal mobility options. The research will assess their curb usage and receive recommendations on management techniques based on their existing/planned conditions.

Why do we need to make this investment in research? Why should this research be funded by the government and not the private sector?

Street and roadway infrastructure funded through local, State, and Federal sources, represents a tremendous investment and asset to public agency owners. Increasingly demand for curb access has increased significantly due to the emergence of new mobility services such as shared use mobility, ride-sourcing, and “Mobility on Demand” applications, and increasing freight delivery demand. These factors are leading to increased congestion, safety concerns, and having damaging economic and environmental impacts.

There is a growing need to better tie the land-use decisions of the adjacent ROW of transportation facilities to the expected uses. This investment will help to reduce conflicts, increase safety, and increase efficiency of the mobility options using the curb. This project will balance public goals and objectives while recognizing the importance of enhancing opportunities for private sector mobility innovations.

Completed High-Priority Projects from Fiscal 2018-2019

Research Project Name/Topic Area	Automation in Highway Construction
Total Funding Amount	\$293,512
Period of Performance	2014-2018
AMRP Program	Construction and Project Management

What were the outcomes of this project?

Coordinated planning for automation in highway construction layout provides the potential to add significant value across project delivery, especially in construction. The digital data migration in and out of the construction phase is one limiting factor to fully exploiting automation's potential benefits. The challenge of digital data management is to optimize the collection and creation of data such that they are available in the right resolution and format when needed. The Federal Highway Administration conducted research to document gaps for implementing automation in highway construction and to develop guidance for State transportation departments to assist them in implementing and using automation to improve project delivery. The report describes a snapshot in time through investigative case studies of four States (FL, IA, NY, WI) for automation technology implementation. It presents an overview of enabling technologies and policies for automation in highway construction as well as implementation strategies, design procedures, and practical guidelines to properly generate three-dimensional (3D) models for uses in construction and other phases of highway project delivery. Its implementation is an ongoing process in almost every State transportation department across the United States. As capabilities continue to advance nationally, so will additional opportunities presented by automation. Finally, this research highlights the need to quantify the benefits, costs, and return on investment on a variety of automation technologies that will bring new data requirements and products. At the same time, outreach initiatives are currently deploying some of the more mature automation technology uses, such as post-construction survey.

What specific problems that were solved with this research?

While 3D design practices are common in State transportation departments, automation technology requires added detail in 3D design models to output data in a portable and durable format; and requires additional data organization and data description. This report provides the accuracies needed for both survey control and topographic survey information. It describes how construction specifications can incorporate practices to manage the use of automation technology to adapt to project characteristics and evolving technologies. It also describes how consistency in 3D data and survey methods provides for automated inspection tasks, especially acceptance and measurement processes; can enhance transparency, make inspectors available to observe construction, and enhance project safety.

The research developed automation technology guidelines from the case studies and primarily from two states (WI, OR) who are actively developing automation technology specifications for a coordinated planning and use of automation in highway construction

from project scoping through construction acceptance. The States allowed the researchers to develop a recommended guide as detail in this document to add significant value across project delivery, but especially in construction and beyond e-Construction, new data sources for asset management decision making, and the incorporation of schedule and cost information into 3D models. The products of these efforts will likely provide information that helps implementing agencies to focus their efforts and investments for supporting automation in highway construction.

Did non-government groups serve as partners in this research? (Yes/No) If yes, what was their role/contribution?

Yes, WSP Inc. the prime contractors and their subcontractors conducted the research.

Who are the beneficiaries of this research and how will they benefit?

All local and state transportation agencies. Primarily the Highway Design and Construction Engineers will benefit by effectively adopting automation in highway construction into their agencies practices. These improvements should increase productivity, quality of construction, and accelerate project delivery.

Research Project Name/Topic Area	National Highway Freight Network webtool
Total Funding Amount	\$75,000
Period of Performance	Summer 2018- Summer 2019
AMRP Program	Freight Infrastructure Needs Identification and Analysis Program Area in the Freight Management and Operations Program.

What were the outcomes of this project?
FHWA updated the Geographic Information System (GIS) of the National Highway Freight Network (NHFN), which offers a more user-friendly method to manipulate and understand the NHFN data. The webtool offers the ability to manipulate underlying Highway Performance Monitoring System (HPMS) data linked to the NHFN network. This new data visualization also provides the ability to zoom to specific components of the NHFN in local areas and to create and print maps.
What specific problems that were solved with this research?
Customer feedback regarding the NHFN requested more frequent updates and a user-friendly visualization method. The creation of the webtool allows for a visualization of new component data on the NHFN and for users to further explore connections between the NHFN and HPMS data. The NHFN is a fluid and dynamic network and the webtool allows for more frequent updates of the underlying GIS data to more accurately reflect all components of the NHFN.
Did non-government groups serve as partners in this research? (Yes/No) If yes, what was their role/contribution?
No
Who are the beneficiaries of this research and how will they benefit?
The primary beneficiaries are our direct customers – State DOTs, MPOs, cities, other federal partners. They primarily benefit by having a more update to date NHFN product to use for their analysis such as State DOTs when they create State Freight Plans. The link to the HPMS data is also a new opportunity that will allow partners to make performance based connections regarding NHFN components. The webtool also allows for ease of display for our customers leadership and customizable maps to be created to fit individual needs.

Research Project Name/Topic Area	Value Capture: Capitalizing on the Value Created by Transportation
Total Funding Amount	\$ 1,100,000
Period of Performance	2019
AMRP Program	Resiliency / Every Day Counts

What were the outcomes of this project?

Through the development and outreach efforts of this project, public investment in transportation assets that improve access and increase opportunity benefits adjacent property owners through greater land value and other economic impacts are more accessible to State and local DOTs. This includes many techniques that are available to the public sector to share in a portion of this increased land value to build, maintain, or reinvest in the transportation system. This project resulted in numerous resources and outreach efforts to support value capture as an option for State and local DOTs. Introductory webinars were held in 2018 and presentations were provided at each of the Every Day Counts (EDC) summits. The program also completed a Value Capture Implementation Manual and conducts a series of webinars on value capture techniques.

What specific problems that were solved with this research?

Value Capture can provide a sustained revenue source that can support operations and maintenance or, in some cases, the financing of the original transportation improvement. Value capture also promotes equity by reinforcing the “beneficiary pays” principle of economics. When private landowners benefit from a public investment, value capture provides a way for a portion of the gain to directly support the public investment that enabled their benefit. Finally, when value is captured from land but not the improvements (e.g, buildings) made to it, it supports denser development near highways. Landowners would pay the same land tax regardless of land use, so they are incentivized to develop or sell the land close to transportation. This can help limit sprawl.

Did non-government groups serve as partners in this research? (Yes/No) If yes, what was their role/contribution?

Yes - State and local partners are assisting in research and develop implementation manual including sharing their experiences implementing value capture techniques.

Who are the beneficiaries of this research and how will they benefit?

Well-functioning infrastructure enhances the value of property adjacent to the infrastructure. And while the public generally bears the cost of providing infrastructure, private property value increases are a windfall to property owners. Value Capture reclaims a portion of the increased in property value from publicly provided infrastructure, or recovers a portion of the cost or impact imposed on public infrastructure from private development. Value capture is applicable in a broad range of settings, including urban, rural, and suburban.

Chapter 3 - FY 2020 Program Descriptions FY 2020 RD&T Program Funding Details

RD&T Program Name	FY 2020 Enacted (\$000)	FY 2020 Basic (\$000)	FY 2020 Applied (\$000)	FY 2020 Development ¹ (\$000)	FY 2020 Technology ² (\$000)
Accelerated Implementation and Deployment of Pavement Technologies	10,872	0	0	0	10,872
Construction and Project Management	1,767	0	362	272	1,133
Geotechnical and Hydraulics	3,533	0	2,672	227	634
Long-Term Infrastructure Performance Program	7,248	0	6,161	1,087	0
Pavements and Materials	4,485	0	3,624	861	0
Structures	5,391	0	2,446	1,540	1,405
Transportation Performance Management, Asset Management, and Maintenance	1,640	0	0	0	1,640
Safety Program Delivery	2,265	0	0	2,265	0
Safety Design and Operations	3,887	0	0	3,887	0
Safety Data and Analysis	3,551	0	0	2,781	770
Human Factors Analytics	1,422	0	0	1,422	0
Transportation Systems Management and Operations	5,372	0	5,372	0	0
Connected and Automated Vehicles	5,255	0	5,255	0	0
Managing Disruptions to Operations	2,537	0	2,537	0	0
Freight Management and Operations	3,080	0	3,080	0	0

¹ Development is defined as the systematic application of knowledge or understanding, directed toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.

² Technology is defined as activities that demonstrate, pilot, or evaluate an R&D output and/or facilitate the transfer of an R&D output to an adoption-ready state. Technology deployment is the final phase of the technology transfer process.

Truck Size and Weight	997	0	997	0	0
Accelerating Project Delivery	2,718	0	2,356	0	362
Performance-Based Planning	1,903	0	1,450	272	181
Modeling and Analysis Tools	1,903	0	770	363	770
Resiliency	1,178	0	544	362	272
Planning for Bicycle and Pedestrian Safety, Connectivity, and Multimodal Mobility, including for Underserved Communities	1,178	0	906	272	0
Policy Analysis and Global Outreach	4,222	0	3,221	512	489
Highway and Transportation Data	5,834	0	2,583	1,224	2,027
Every Day Counts	5,889	0	0	0	5,889
State Transportation Innovation Council	5,074	0	0	0	5,074
Accelerated Innovation Deployment	5,889	0	0	0	5,889
Accelerating Market Readiness	2,265	0	0	0	2,265
Innovative Program Delivery	806	0	172	91	543
Research Infrastructure, Technology Transfer, and Partnerships	12,684	0	8,453	0	4,231
Small Business Innovation Research	1,812	0	1,676	136	0
Exploratory Advanced Research	4,294	0	4,294	0	0
Advanced Transp. and Congestion Management Program	35,334	0	0	35,334	0
Surface Transp. Funding Alternatives	18,120	0	0	0	18,120
<i>Facilities and Maintenance</i>	<i>6,070</i>	<i>0</i>	<i>2,023</i>	<i>2,023</i>	<i>2,024</i>
Totals	180,475	0	60,954	54,931	64,590

FY 2020 RD&T Program Budget Request by DOT Strategic Goal

RD&T Program Name	FY 2020 Enacted (\$000)	Safety (\$000)	Infra-structure (\$000)	Innovation (\$000)	Account-ability (\$000)
Accelerated Implementation and Deployment of Pavement Technologies	10,872	0	3,624	7,248	0
Construction and Project Management	1,767	0	367	1,133	267
Geotechnical and Hydraulics	3,533	1,631	1,631	271	0
Long-Term Infrastructure Performance Program	7,248	0	7,248	0	0
Pavements and Materials	4,485	317	3,941	0	227
Structures	5,391	0	5,391	0	0
Transportation Performance Management, Asset Management, and Maintenance	1,640	0	0	0	1,640
Safety Program Delivery	2,265	2,265	0	0	0
Safety Design and Operations	3,887	3,887	0	0	0
Safety Data and Analysis	3,551	3,551	0	0	0
Human Factors Analytics	1,422	1,422	0	0	0
Transportation Systems Management and Operations	5,372	0	5,372	0	0
Connected and Automated Vehicles	5,255	0	0	5,255	0
Managing Disruptions to Operations	2,537	843	843	851	0
Freight Management and Operations	3,080	181	2,355	544	0
Truck Size and Weight	997	272	544	181	0

Accelerating Project Delivery	2,718	0	1,178	1,087	453
Performance-Based Planning	1,903	272	997	453	181
Modeling and Analysis Tools	1,903	0	906	815	182
Resiliency	1,178	0	634	544	0
Planning for Bicycle and Pedestrian Safety,	1,178	453	453	272	0
Policy Analysis and Global Outreach	4,222	154	1,391	1,594	1,083
Highway and Transportation Data	5,834	1,544	1,639	800	1,851
Every Day Counts	5,889	1,540	1,359	2,718	272
State Transportation Innovation Council	5,074	1,087	1,268	2,537	182
Accelerated Innovation Deployment	5,889	1,540	1,359	2,718	272
Accelerating Market Readiness	2,265	362	453	1,359	91
Innovative Program Delivery	806	0	403	403	0
Research Infrastructure, Technology Transfer, and Partnerships	12,684	3,171	3,171	3,171	3,171
Small Business Innovation Research	1,812	453	453	453	453
Exploratory Advanced Research	4,294	0	0	4,294	0
Advanced Transp. and Congestion Management Program	35,334	0	35,334	0	0
Surface Transp. Funding Alternatives	18,120	0	0	18,120	0
<i>Facilities and Maintenance</i>	<i>6,070</i>	<i>1,518</i>	<i>1,518</i>	<i>1,517</i>	<i>1,517</i>
Totals	180,475	26,463	83,832	58,338	11,842

Accelerated Implementation and Deployment of Pavement Technologies \$10,872,000

Program Description/Activities/Objectives:

Program Description

Together, the Pavement & Materials Research and Development (R&D) Program, the Long-Term Pavement Performance (LTPP) research, and the Accelerated Implementation and Deployment of Pavement Technologies (AIDPT) Program provide a coordinated and cohesive approach to research, development, technology and deployment activities focused on providing tools, technologies and guidance, and supporting updated policies, to improve the safety, durability, sustainability and cost-effectiveness of highway pavements, and the materials from which highway infrastructure is constructed. The AIDPT program serves as the implementation and deployment mechanism for innovations coming out of the Pavement & Materials and LTPP research. Activities in the AIDPT program include advancement of performance engineered mix design for both asphalt and concrete pavements. Providing guidance and tools to optimize mixture designs for States environmental conditions, materials availability, durability requirements is a high priority program area.

Program Objectives

FHWA's AIDPT Program seeks to accelerate the adoption of innovative pavement technologies, with a focus on advancing performance-related tests and specifications. There are many performance tests being developed. FHWA will seek to provide guidance on the multitude of tests to assist States as they move towards performance specifications. Also, new in FY 2020 will be the support of implementation of Continuous Friction Measurement (SCRIM) to support improved pavement management systems. Implementation activities include providing education and guidance on the use of new tests, demonstration and shadow projects (where new technologies are used side-by-side with existing technologies), and other information sharing opportunities such as peer exchanges and workshops.

Key FY20 FHWA AIDPT R&T Program Activities.

Activity	Period of Performance	Partners/Notes
Deployment and Implementation of Performance Engineered Mixtures for Concrete Mixes*	2017-2023	Participation in national pooled fund TPF-5(368); technical guidance and implementation support through concrete cooperative agreement (awarded 11/2018)

Activity	Period of Performance	Partners/Notes
Deployment and Implementation of Performance Engineered Mixtures for Asphalt*	2017-2023	Participation in national pooled fund TPF-5(178); technical guidance through asphalt cooperative agreement (awarded anticipated 7/2020)
Technical guidance on the use of recycled materials and industrial byproducts in pavements	2018-2023	Technical guidance and implementation support through concrete cooperative agreement
Guidance on emerging asphalt performance tests	2020-2025	States and asphalt industry
Deploy and deliver workshops and supporting materials to advance “best practices” pavement technology	2016-2024	Technical guidance and implementation support through a concrete cooperative agreement; State DOT, industry outreach through stakeholder forums
Stakeholder Technical Working Groups to gather feedback on technical topics	2020-2024	State DOTs, industry associations, academia specializing the technical program areas
Mobile Concrete Testing Trailer to deploy Performance Engineered Mix Design for concrete, deploy new test and technologies, and provide national leadership for concrete pavements	2019-2025	Deploy research, new tests, and implementation of performance engineered concrete mixes
Mobile Asphalt Testing Trailer to deploy Performance Engineered Mix Design for asphalt, deploy new tests and technologies, and provide national leadership for asphalt pavements	2019-2025	Deploy research, new tests, and implementation of performance engineered asphalt mixes
Provide technical guidance to support implementation of improved pavement management systems and pavement performance measures	2018-2023	Technical guidance and implementation support

Activity	Period of Performance	Partners/Notes
Technical guidance to support implementation of pavement performance measures with equipment certification guidelines	2020-2022	Participation in national pooled fund TPF-5(299);
Continuous friction measurement (SCRIM) to support implementation of improved pavement management systems	2020-2025	Demonstration projects, implementation support
Pavement sustainability technical support and resources	2017-2022	Deploy research and implementation support for life cycle cost analysis; develop resources such TechBriefs and webinars
Guidance on pavement foundations to improve the pavement design process	2020-2025	Develop improved guidance for durable long-lasting pavements
Pavement preservation technical support and resources	2018-2023	Technical guidance and implementation support
Development of statistical evaluation tool for Quality Assurance (SpecRisk)	2020-2025	Develop and deploy tool to asses risk level
Non-destructive pavement evaluation (GPR, MIRA, IR, ICC) activities	2020-2025	Demonstrate tools; equipment loan

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes. The AIDPT program is authorized in section 503(c)(3) of title 23, United States Code, which requires the Secretary to establish and implement a program under the technology and innovation deployment program to promote, implement, deploy, demonstrate, showcase, support, and document the application of innovative pavement technologies, practices, performance, and benefits. The program, as defined in the FAST Act, will “promote, implement, deploy, demonstrate, showcase, support, and document the application of innovate pavement technologies, practices, performance, and benefits.”

Program Alignment with Strategic Goals:

DOT Strategic Goal
Infrastructure
Innovation

FHWA's AIDPT Program primarily supports the Department's Infrastructure and Innovation goals while also contributing to the Safety Strategic Goal. Specific contributions are as follows.

Infrastructure: The AIDPT Program supports the Infrastructure goal through technology transfer, training and technical support addressing the areas of pavement performance, life cycle cost analysis and preservation for pavements.

Innovation: The AIDPT Program supports the Department's Innovation Goal by accelerating the deployment of innovative pavement technologies. For example, non-destructive testing tools for pavement evaluation can be used for Quality Control or Acceptance. These tools save time and money and increases worker safety. This innovation is now available for demonstrations and for loan through the AIDPT program.

Safety: The AIDPT Program will contribute directly to highway safety and the Department's Systematic Safety Approach by supporting activities to better analyze pavement surface condition and characteristics such as pavement friction and faulting.

USDOT Research Priorities:

FHWA's AIDPT Program directly addresses performance-based regulations and safety. In support of recent performance management and asset management regulations, the Program sponsors . implementation activities that provide education and guidance to stakeholders on the pavement related portions of the regulations such as the collection of pavement condition data and host sharing opportunities such as peer exchanges and workshops. New in FY 2020 will be the support of implementation of Continuous Friction Measurement (SCRIM) to support the implementation of improved pavement management systems by incorporating data for safety considerations in the decision-making process. This effort will provide guidance on the use of new tests and demonstration and shadow projects (where new technologies are used side-by-side with existing technologies). Also, the AIDPT Program seeks to accelerate the adoption of innovative pavement technologies, with a focus on advancing performance-related tests and specifications. There are many performance tests being developed. FHWA will seek to provide guidance on the multitude of tests to assist States as they move towards performance specifications. Performance specifications will better provide a process for optimizing pavement performance goals and environmental conditions while allowing for contractor innovation and allowing for contractor innovation and properly assigned risk and reward.

Research Collaboration Partners:

FHWA AIDPT program staff regularly engage with key stakeholders in both formal and informal settings to gather input concerning challenges and opportunities that might be addressed through the program, as well as information on work undertaken by other

organizations both nationally, and internationally. Stakeholders include representatives of individual state highway agencies, pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB), industry organizations such as the American Concrete Pavement Association (ACPA) and the National Asphalt Pavement Association (NAPA), standard-setting organizations such as the American Concrete Institute (ACI) and ASTM International, and university faculty engaged in related work.

Formal interactions with AASHTO, TRB, and industry organizations generally occur at regular intervals (at least annually, and as often as quarterly), but are not formally tracked or measured. Ad hoc interactions in the form of technical assistance requests are logged on an internal SharePoint site.

FHWA has several technical working groups and expert task groups as a means of gathering stakeholder input on feedback on technical topics specific to pavements and materials. The groups are composed of a mix of representatives from State Departments of Transportation and other public agencies, related industry groups (such as asphalt and concrete paving industries, contractors, etc.), and academia.

The input obtained through these interactions is considered by program staff as they identify and formulate a program of initiatives that, in accordance with 23 USC 503(c)(3),

- the deployment of new, cost-effective designs, materials, recycled materials, and practices to extend the pavement life and performance and to improve user satisfaction;
- the reduction of initial costs and lifecycle costs of pavements, including the costs of new construction, replacement, maintenance, and rehabilitation;
- the deployment of accelerated construction techniques to increase safety and reduce construction time and traffic disruption and congestion;
- the deployment of engineering design criteria and specifications for new and efficient practices, products, and materials for use in highway pavements;
- the deployment of new nondestructive and real-time pavement evaluation technologies and construction techniques; and
- effective technology transfer and information dissemination to accelerate implementation of new technologies and to improve life, performance, cost effectiveness, safety, and user satisfaction.

Program partners (both government and non-government), benefits derived from partnerships, and partner contributions are summarized in the table below.

Benefits of Partnership and Partner Contributions to FHWA AIDPT.

Partner Organization	Benefits of Partnership and Partner Contributions								
	User Perspective on Needs	Industry Perspective	Standard Setting	Field Trials	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Donation of Material or Services	Funding
AASHTO Committee on Materials and Pavements	X		X		X				
State Departments of Transportation	X			X	X				X
National Institute of Standards and Technology (NIST)						X	X		
National Asphalt Pavement Association		X						X	
American Concrete Pavement Association		X							
ASTM International			X						
Pavement Preservation Expert Task Group³	X	X				X			
Asphalt Expert Task Group⁴	X	X				X			

³ The Pavement Preservation Expert Task Group provides a forum for State highway agency representatives, academia, and industry stakeholders to discuss experiences and best practices for implementing pavement preservation techniques. This group will also develop a roadmap of research needs in this area.

⁴ The existing Asphalt Expert Task Group will be restructured to meet current Agency goals and direction, and will focus on implementation of technologies and innovations to improve pavement performance and advance performance related specifications specifically for asphalt pavements.

³ A Concrete Expert Task Group will be created to balance industry and technical input to concrete pavement technologies and innovations. This group will also focus on the implementation of technologies and innovations to improve pavement performance and performance related specifications specifically for concrete pavements.

Concrete Expert Task Group³	X	X				X			
Sustainable Pavements Technical Working Group⁵	X	X				X			

⁵ The Sustainable Pavements Technical Working Group consists of technical experts from State DOTs, industry, and academia that provide technical assessments and input regarding the sustainability considerations for pavements and materials related to the FHWA Sustainable Pavements Program.

Construction and Project Management \$1,767,000

Program Description/Activities/Objectives:

Program Description

FHWA's Construction and Project Management Research and Technology (R&T) Program is a coordinated and cohesive program of research, development and technology activities focused on providing tools, technologies and guidance, and supporting updated policies, to improve highway construction and project management practices. Activities include research and development to advance technologies and practices that accelerate highway construction, improve infrastructure quality (and therefore durability), improve project efficiencies, and ensure effective management of construction projects.

Program Objectives

In FY19, the FHWA Construction and Project Management will complete the development of a roadmap to guide the advancement of Building Information Management (BIM) for Infrastructure. This will allow for the strategic use of resources to support research and deployment activities. Another product will be guidelines on the quality assurance for accelerated bridge construction. A web-based and instructor-led training courses on bridge construction inspection will be completed.

Key FY20 FHWA Construction and Project Management R&T Program Activities.

Activity	Period of Performance	Partners/Notes
Unmanned Aerial Systems Peer Exchanges	FY20-21	
Development of State of the Art Report on Partial Depth Precast Concrete Deck Panels	FY20-21	
Quality Assurance Guidelines for Bridge Construction	FY20-21	
Continued support of the Transportation Construction Management Pooled Fund Program	FY12-20	Participating States: CO, GA, IA, MN, MS, MT, OR, and TX https://www.pooledfund.org/Details/Study/489
Major Project Cost Estimating and Performance Data Analysis	FY20-21	
Implementation of improvement actions stemming from the 2019 Major Projects Program Assessment	FY20-21	
Update NHI course on Utility Coordination for Highway Projects	FY20-21	

Activity	Period of Performance	Partners/Notes
BIM Implementation/R&D activities based on BIM for Infrastructure Roadmap priority activities	FY20-21	

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes. The program is authorized in sections 502 and 503 of title 23, United States Code, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas to improve highway safety, improve infrastructure integrity, strengthen transportation planning and environmental decision-making, reducing congestion, and enhancing freight productivity, among others.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Infrastructure
Innovation
Accountability

FHWA’s Construction and Project Management R & T Program supports the Department’s Infrastructure, Innovation and Accountability Strategic Goals. Specific contributions are as follows.

Infrastructure: The Construction and Project Management R&T Program will contribute to achievement of the Department’s Life Cycle and Preventive Maintenance objective through development of quality assurance guidelines for bridge construction. It will contribute to achievement of the Economic Competitiveness and Workforce objective through development of training on utility coordination. The program will contribute to the State of Good Repair/Risk-Based Asset Management strategy through advancement of BIM for infrastructure, so that data developed through design and construction processes becomes part of the asset management process.

Innovation: The Construction and Project Management R&T Program will support the Department’s Innovation Goal by advancing innovative highway construction and project management practices. For example, the program will pursue work to advance application of BIM in the highway industry. Peer exchanges to promote and support effective application of unmanned aerial systems to support highway construction will contribute to the State of Good Repair/Advanced Inspection Tools strategy.

Accountability: The Construction and Project Management R&T Program will contribute to Mission Efficiency and Support through efforts to improve major project cost estimating and program management improvement initiatives.

This program impacts and is of benefit to highway construction projects throughout the nation, including those in rural communities.

USDOT Research Priorities:

Performance-Based Regulations and Safety: FHWA’s Construction and Project Management R&T program supports achievement of infrastructure performance targets required under performance based regulations.

Mobility of freight: FHWA’s Construction and Project Management R&T program serves to increase infrastructure durability, which creates a more reliable transportation system.

Research Collaboration Partners:

FHWA Construction and Project Management R&T program staff regularly engage with key stakeholders in both formal and informal settings to gather input concerning challenges and opportunities that might be addressed through the program, as well as information on work undertaken by other organizations both nationally, and internationally. Stakeholders include representatives of individual State DOTs, pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB), industry organizations such as the Associated General Contractors (AGC) and the American Road and Transportation Builders Association (ARTBA), standard-setting organizations such as AASHTO, and university faculty engaged in related work.

Formal interactions with AASHTO, TRB, and industry organizations generally occur at regular intervals (at least annually, and as often as quarterly), but are not formally tracked or measured. Ad hoc interactions in the form of technical assistance requests are logged on an internal SharePoint site.

The input obtained through these interactions is considered by program staff as they identify and formulate a program of research and technology initiatives that, in accordance with 23 USC 502(a)(3),

- Is of national significance;
- Delivers a clear public benefit and occurs where private sector investment is less than optimal;
- Supports a Federal stewardship role in assuring that State and local governments use national resources efficiently;
- Meets and addresses current or emerging needs;
- Addresses current gaps in research;
- Presents the best means to align resources with multiyear plans and priorities; or
- Presents the best means to support Federal policy goals compared to other policy alternatives.

Program partners (both government and non-government), benefits derived from partnerships, and partner contributions are summarized below.

Benefits of Partnership and Partner Contributions to FHWA Construction and Project Management R&T Program.

Partner Organization	User Perspective on Needs	Industry Perspective	Standard Setting	Field Trials	Deployment	Specialized Expertise or	Funding
AASHTO Committee on Construction	X				X		
State Departments of Transportation	X			X	X		X
Associated General Contractors (AGC)		X					
American Road and Transportation Builders Association (ARTBA)		X					
International Intelligent Construction Technologies Group (IICTG)		X			X		
AASHTO Joint Committee on Electronic Engineering Data	X	X	X				
International Highway Engineering Exchange Program (IHEEP)	X	X			X		
FAA			X			X	

Geotechnical and Hydraulics Research & Technology

\$3,533,000

Program Description/Activities/Objectives:

Program Description

The Geotechnical and Hydraulics Research and Technology (R&T) Program provides a coordinated and cohesive approach to research, development and technology activities to improve the geotechnical and hydraulic performance (safety, efficiency, durability, resiliency and cost-effectiveness) of the highway and transportation system.

The composition and focus of the Geotechnical and Hydraulics R&T Program (Program) reflects how our nation's transportation system spans and includes widespread and diverse geological, riverine, and coastal environments and features. The Program aligns with needs and requirements associated with public safety, statutory and regulatory requirements, and other elements of transportation. The Program has historically been successful in using our funding in producing actionable, relevant, forward thinking, and cost-effective products and outcomes that benefit the transportation community.

Functional areas addressed in the Program include Earth and Rock Works; Earth Retaining Structures; Geohazards; Ground Improvement; Structural Foundations; Subsurface Investigations; Hydrology (including floodplains), Highway Drainage, Bridges and Culverts; Scour; and Coastal Engineering. This multi-faceted Program yields an effective, crosscutting approach to addressing the hydraulic and geotechnical challenges of highway infrastructure.

Program Objectives

FHWA's Geotechnical and Hydraulics R&T Programs seeks to drive innovation in geotechnical and hydraulic engineering practice to ensure and enhance the safety and resiliency of highway infrastructure. Within the functional areas of both disciplines the Program Objectives are to engage in activities that:

- (1) lead research in areas of new or compelling needs of the transportation system,
- (2) enhance the efforts of other research, as appropriate, and
- (3) adapt innovation to suit our transportation systems.

In FY20, the Geotechnical and Hydraulics R & T Programs will deliver improved guidance on abutment and embankment scour protection design and detail how scour is aligned with the AASHTO LRFD Bridge Design Specifications. The Program also expects to examine and develop tools to evaluate the erosion resistance of subsurface layers. Other products are also expected, including recommended LRFD resistance factors for large-diameter open-end pipe piles. These accomplishments will lead to more safe, reliable, and cost-effective bridge designs.

Key FY20 FHWA Geotechnical and Hydraulics R&T Program Activities.

To support Program objectives, we provide key FY2020 activities in the table below. These activities are not all inclusive; the Program approaches include the flexibility to respond to new or changing priorities and needs as they arise.

Activity	Period of Performance	Partners/Notes
Evaluate Long Term Data on GRS-IBS In-Service Performance	2012 - 2022	State and local transportation agencies (e.g. MA, UT, MN, NY, OH)
Advanced Geotechnical Modeling	2018 - 2021	
Evaluate Geosynthetics for Use in Pavement Design	2019 - 2024	State and local transportation agencies
Geotechnical Aspects of Pavements	2020-2025	State agencies
Assessing the condition of pavement structures using NDE technologies	2020-2025	State DOTs, industry
Assessment of Corrosion for Buried Metallic Foundations and Elements	2019 - 2024	NASEM, NSF, industry, professional organizations, other government entities
Durability of recycled materials used as backfills	2020 - 2023	State DOTs, industry
Correlation between soil erosion resistance and lab/in-situ testing	2020 - 2025	State DOTs, academia
Profiling Bridge Approach Transitions	2020 - 2023	State and local transportation agencies
Update GEC-11 - Design and Construction of MSE Walls and RSS	2019 - 2020	State DOTs, industry, academia
Update and Deploy Guidance and Training on Slope Management Protocol	2020 - 2023	State and local agencies
Archival, Management, and Communication of Geotechnical Data	2018 - 2021	State and local agencies, industry, academia
Implementation of Geotechnical Asset Management Framework	2020 - 2025	State and local agencies, industry, academia
Deploy Guidance and Develop Training on MSE Wall Management Protocol	2020 - 2022	State and local agencies, industry, academia
Develop design specifications for pavement hydraulics and highway drainage to mitigate hydroplaning	2017 - 2023	State transportation agencies, Department of Energy/Argonne National Lab (DOE/ANL)
Develop solutions and design guidelines for hydrological (changes in rain fall and flood frequency) impacts on highway infrastructure	2016 - 2022	State transportation agencies, National Oceanic and Atmospheric Administration (NOAA), United States Geological Survey (USGS)
Develop solutions to key challenges associated with flow modeling for bridge and culvert hydraulics	2019 - 2023	State transportation agencies, DOE/ANL
Develop the next generation design tools for bridge scour, stream stability and scour protection/countermeasures	2019 - 2024	State transportation agencies, DOE/ANL, USGS

Activity	Period of Performance	Partners/Notes
Develop design specifications for coastal highways and bridges impacted by extreme events	2018 - 2023	State transportation agencies, DOE/ANL

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes. Portions of the Program directly support the requirements and auspices of Title 23, United States Code (USC) §144. “National bridge and tunnel inventory and inspection standards.” Additionally, the May 1977 EO 11988 “Floodplain Management” serves as impetus for other Program functional areas.

USC sections 502 and 503 provide important Program authorizations, including requiring the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas. 23 USC §503(b)(2)(C)((xii) authorizes research and technology activities that include “(xii) hydraulic, geotechnical, ... aspects of infrastructure.”.

The Program seeks to align with the following 23 USC §503 Objectives:

#	§503 Objectives	Citation
0-1	<i>Improving Highway Safety</i>	§503(b)(2)
0-2	Reduce the number of fatalities and serious injuries on public roads	§503(b)(2)(B)(ii)
0-3	<i>Improving Infrastructure Integrity</i>	§503(b)(3)
0-4	Reduce the number of fatalities attributable to infrastructure design characteristics and work zones	§503(b)(3)(B)(i)
0-5	Improve the safety and security of highway infrastructure	§503(b)(3)(B)(ii)
0-6	Improve the ability of transportation agencies to deliver projects that meet expectations for timeliness, quality, and cost	§503(b)(3)(B)(vi)
0-7	Improve highway condition and performance through increased use of design, materials, construction, and maintenance innovations	§503(b)(3)(B)(vi)
0-8	Reduce the environmental impacts of highway infrastructure through innovations in design, construction, operation, preservation, and maintenance	§503(b)(3)(B)(vii)
0-9	Study vulnerabilities of the transportation system to ... extreme events and methods to reduce those vulnerabilities.	§503(b)(3)(B)(viii)
0-10	<i>Strengthening Transportation Planning and Environmental Decision-making</i>	§503(b)(4)
0-11	Minimize the cost of highway infrastructure and operations	§503(b)(4)(B)(i)
0-12	Reduce the potential impact of highway infrastructure and operations on the environment	§503(b)(4)(B)(ii)
0-13	Advance improvements in environmental analyses and processes ... for transportation decision-making	§503(b)(4)(B)(iii)
0-14	Improve construction techniques	§503(b)(4)(B)(iv)
0-15	Accelerate construction to reduce congestion and related emissions	§503(b)(4)(B)(v)
0-16	Reduce the impact of highway runoff on the environment	§503(b)(4)(B)(vi)

Knowing and understanding the Program’s statutory (and regulatory) requirements and authorities assures we remain focused on efforts and outcomes support those objectives⁶. Finally, the Program has or shares responsibility for the following elements and requirements contained within the March 22, 2018 Transportation Appropriation Bill, including producing a report on Resilient Infrastructure (Senate report page 53) and supporting Geosynthetic Reinforced Soil-Integrated Bridge Systems (Senate report page 54).

⁶ As appropriate, we will relate any activities or examples to these objectives by using a “O-n” nomenclature. For example, O-9 would indicate support of the §503(b)(3)(B)(viii) objective.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation

The Program aligns with and supports the Department’s Safety, Infrastructure and Innovation Strategic Goals. The contributions of the Program support the National Highway System as well as the local and rural road systems. The following sections provides some specific contributions for these goals and topics.

Safety: The Program contributes directly to highway safety through research of the interactions of water sheet flow, pavement systems, and vehicle stability (Hydroplaning) with a goal of improving driver and vehicle safety and stability. Additionally, the Program focuses on means to predict, prevent, and mitigate scour, which has been a primary cause of bridge failure, and works to mitigate geohazards and to develop protocols for the inventory and evaluation of embankments, slopes, walls, rock cuts, bridge foundations, bridge approaches, etc. necessary for life cycle assessments to equip transportation agencies to better manage these assets to ensure serviceability and safety.

Infrastructure: The Program contributes to the Department’s Life Cycle and Preventative Maintenance goal and to Infrastructure System Resilience and Risk-Based Asset Management through a variety research and development efforts. For example, the Program is leading the next generation of science and engineering research related to scour resistant bridge foundation design. The Program recognizes that current scour prediction approaches are potentially too conservative under certain site conditions, increasing construction cost and time. The Program applies geotechnical and hydraulic engineering principles to develop more accurate prediction tools, taking advantage of erosion resistant soils below riverbeds to reduce foundation depth (e.g. using in-situ erosion testing). The proposed guidance developed through research will result in safe and more economical design, especially relevant as many aging bridge foundations have exceeded their design service life and may require replacement in the near future.

Innovation: The Program supports the Department’s Innovation Goal by undertaking research and development in technologies and tools that provide more reliable and cost-effective project designs. The Program supports use of advanced geotechnical exploration techniques for cost effective project delivery and improved risk management.

The Program also continues to advance best practice technologies to address a significant number of construction claims in highway projects by maintaining the Geo-Construction Information and Technology Selection Management System

“[GeoTechTools](#)”; used throughout the project delivery process to identify appropriate geotechnical solutions to promote improved infrastructure performance. The Program takes advantage of using supercomputing clusters at the Department of Energy’s (DOE’s)/Argonne National Laboratories (ANL) / Transportation Research Analysis and Computing Center (TRACC) to more effectively and efficiently conduct research studies. Computer modeling reduces the need for expensive physical experimental work and permits more efficient management of research projects.

USDOT Research Priorities:

Performance Based Regulations and Safety: The FHWA Geotechnical and Hydraulics Research Program addresses Performance Based Regulations and Safety priority by providing tools and guidance to support highway agency efforts to ensure the integrity of bridge foundations.

Improving Mobility of Freight: The program supports Improving Mobility of Freight by providing tools and guidance to support highway agency efforts provide durable infrastructure, thereby reducing the frequency of highway workzones.

Research Collaboration Partners:

FHWA Geotechnical and Hydraulics R&T Program staff regularly engage with key stakeholders in both formal and informal settings to gather input concerning challenges and opportunities that might be addressed through the program, as well as information on work undertaken by other organizations both nationally, and internationally. Stakeholders include representatives of individual highway agencies, pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB), industry organizations such as the American Society of Civil Engineers, the Geo-Institute of ASCE, the Deep Foundations Institute, the International Association of Foundation Drilling, the Geosynthetic Materials Association, ASTM International, and university faculty engaged in related work.

The Program functional areas also interact with other Federal entities; we have both formal and informal engagement and collaboration activities. For example, engaging in collaborative efforts with the U.S. Geologic Survey, National Oceanic and Atmospheric Administration, and U.S. Army Corps of Engineers.

Formal interactions with AASHTO, TRB, and industry organizations generally occur at regular intervals (at least annually, and as often as quarterly), but are not formally tracked or measured. Ad hoc interactions in the form of technical assistance requests are logged on an internal SharePoint site.

The input obtained through these interactions is considered by program staff as they identify and formulate a program of research and technology initiatives that, in accordance with 23 USC 502(a)(3):

- Is of national significance;

- Delivers a clear public benefit and occurs where private sector investment is less than optimal;
- Supports a Federal stewardship role in assuring that State and local governments use national resources efficiently;
- Meets and addresses current or emerging needs;
- Addresses current gaps in research;
- Presents the best means to align resources with multiyear plans and priorities; or
- Presents the best means to support Federal policy goals compared to other policy alternatives.

In the table below, the Program summarizes partners (both government and non-government), benefits derived from partnerships, and partner contributions.

Benefits of Partnership and Partner Contributions to FHWA Geotechnical and Hydraulics R&T

Partner Organization	User Perspective on Needs	Industry Perspective	Standard Setting	Field Trials	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Donation of Material or Services	Funding
Government									
State Departments of Transportation	X			X	X				X
Local Public Agencies (LPA) and Metropolitan Planning Organizations (MPO)	X			X	X				X
AASHTO Committee on Bridges and Structures	X		X		X				
AASHTO Committee on Hydraulics and Hydrology	X		X		X	X			
US Army Corps of Engineers (USACE)	X		X	X		X			X
Department of Energy (DOE)/ Argonne National Lab (ANL)	X					X	X		
Department of Interior (DOI)/ US Geological Survey (USGS)	X			X		X	X		

Partner Organization	User Perspective on Needs	Industry Perspective	Standard Setting	Field Trials	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Donation of Material or Services	Funding
Department of Commerce (DOC)/ National Oceanic and Atmospheric Administration (NOAA)	X			X		X	X		
Federal Aviation Administration (FAA)	X		X		X	X	X	X	
Federal Railroad Administration (FRA)	X	X	X		X	X	X	X	
Professional Organizations									
American Society of Civil Engineers		X			X		X	X	
Geo-Institute		X		X	X	X	X	X	
Deep Foundations Institute (DFI)		X		X	X	X	X	X	
The International Association of Foundation Drilling (IAFD)		X		X	X	X	X	X	
ASTM International			X						
Industry									
National Concrete Masonry Association (NCMA)		X		X	X	X	X		
Geosynthetic Materials Association (GMA)		X		X	X	X	X		
Academia									
United States University Council for Geotechnical Education and Research (USUGER)		X		X		X	X	X	
Other									
Transportation Research Board (TRB)					X	X			
National Academies of Sciences, Engineering, and Medicine (NASEM)		X			X	X	X		
National Science Foundations	X		X	X		X	X		X
International Programs	X		X	X	X	X	X		

Long-Term Infrastructure Performance \$7,248,000

Program Description/Activities/Objectives:

Program Description

The Long-Term Infrastructure Performance (LTIP) Programs include the Long-Term Pavement Performance (LTPP) Program and the Long-Term Bridge Performance (LTBP) Program. These programs, conducted in collaboration with the State DOT infrastructure owners, provide for characterization and monitoring of in-service highway pavement test sections (LTPP) and bridges (LTBP) to assemble the data needed to improve infrastructure design and advance the understanding of highway infrastructure performance necessary to effectively manage transportation assets. The collected data are disseminated to the public through web-based portals. FHWA's investment in obtaining and disseminating the data is leveraged by both public and private sector research organizations that apply the data to address a variety of infrastructure performance needs of local, State, regional, and national interest.

Historically, LTPP and LTBP have been managed and pursued as independent research efforts. In 2017, in recognition of opportunities for synergy and improved efficiency, FHWA transitioned to an integrated approach to managing the two programs.

Program Objectives

FHWA's LTIP Programs seek to advance understanding of how and why highway pavements and bridges perform as they do, in support of improved design and the Performance-Based Infrastructure Investments called for as part of the Department's Economic Competitiveness strategy. In 2020 the LTIP programs will continue collection, processing and analysis of pavement and bridge data required to achieve these objectives. The LTPP InfoPave and LTBP InfoBridge web portals will be updated with data collected through the summer of 2019. New analysis projects will be undertaken to develop bridge performance models and address to-be-selected objectives identified in the [LTPP Data Analysis Plan](#).

Key FY20 Long-Term Infrastructure Performance Program Activities.

Activity	Period of Performance	Partners/Notes
2020 LTPP Data Collection	2020 - 2021	State Transportation Agencies (Pavement Owners)
2020 LTPP Program Support	2020 - 2021	
2020 LTPP Data Analysis	2020 - 2022	Specific project to be selected from LTPP Data Analysis Plan .
2020 LTBP Data Collection	2020 - 2021	State Transportation Agencies (Bridge Owners)
2020 LTPP Program Support	2020 - 2021	

Activity	Period of Performance	Partners/Notes
2020 LTBP Data Analysis	2020 – 2022	New bridge deck performance model(s)
2020 LTIP Stakeholder Engagement	2020-2021	
Infrastructure Research Engineering Services and Data Management.	2020-2021	

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes. The program is authorized in sections 502 and 503 of title 23, United States Code, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas to improve highway safety, improve infrastructure integrity, strengthen transportation planning and environmental decision-making, reducing congestion, and enhancing freight productivity, among others. Both long-term research programs were provided for through previous highway authorization legislation (LTPP was authorized by the 1987 Surface Transportation and Uniform Relocation Assistance Act and LTBP was authorized by the 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)) and were intended to span multiple decades. As these programs continue to develop, they are supporting the implementation of the Transportation Performance Management (TPM) requirements that were included in the last two bills: MAP-21 and FAST-Act.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Infrastructure

The Program primarily supports the Department’s Infrastructure Strategic Goal. Activities under this program also support aspects of the Department’s Safety and Innovation goals.

The following sections provides some specific contributions for these goals. For each section, we may provide examples that provide context of our approaches and contributions or relate the sections or examples to associated statutory objectives.

Infrastructure: The LTIP Programs is aligned with the State of Good Repair/Risk-based Asset Management and Economic Competitiveness/Performance-Based Infrastructure Investment strategies in support of the Department’s Life Cycle and Preventive Maintenance objective by enabling more effective management of infrastructure performance.

Safety: The LTIP Programs contribute indirectly to highway safety and the Department's Systematic Safety Approach through contributions to improved design and more effective infrastructure management, resulting in reduced risk of failure and work zone exposure.

Innovation: The LTIP Programs supports the Department's Innovation Goal through development of innovations needed to support data collection that have broader applicability, and by providing data to support development of improved design procedures and other solutions to pavement and bridge engineering challenges.

These programs impact and are of benefit to highway pavements and bridges throughout the nation, including those in rural communities.

USDOT Research Priorities:

Performance Based Regulations and Safety: The Long-Term Infrastructure Performance Programs address the Department's Performance Based Regulations by supporting the development of knowledge, tools and guidance to support and enable effective management of highway infrastructure performance.

Research Collaboration Partners:

The individual State DOTs owners of the pavements and bridges under study are actively engaged in supporting data collection efforts. Due to the importance of their active engagement, FHWA contracts with the TRB for a Federal Advisory Committee Act (FACA) compliant Long-Term Infrastructure Performance Committee that provides consensus stakeholder advice on the conduct of the program via letter reports addressed to the Administrator. In addition, FHWA LTIP Program staff regularly engage with stakeholders in both formal and informal settings to gather input concerning challenges and opportunities that might be addressed through the program, as well as information on related work undertaken by other organizations both nationally, and internationally. Each of the two programs has implemented a state coordinators group to manage and strengthen the partnership between the FHWA and the state DOTs. Other stakeholders include the American Association of State Highway and Transportation Officials (AASHTO) and its Committees on Materials and Pavements (LTPP) and Bridges and Structures (LTBP), the Transportation Research Board (TRB), industry organizations such as the National Asphalt Pavement Association and the American Concrete Paving Association, Institute of Steel Construction, National Concrete Bridge Council (NCBC), and university faculty engaged in related work.

Formal interactions with AASHTO, TRB, and industry organizations generally occur at regular intervals (at least annually), but are not formally tracked or measured. Ad hoc interactions in the form of technical assistance requests are logged on an internal SharePoint site.

The input obtained through these interactions is considered by program staff as they identify and formulate a program of research and technology initiatives that, in accordance with 23 USC 502(a)(3),

- Is of national significance;

- Delivers a clear public benefit and occurs where private sector investment is less than optimal;
- Supports a Federal stewardship role in assuring that State and local governments use national resources efficiently;
- Meets and addresses current or emerging needs;
- Addresses current gaps in research;
- Presents the best means to align resources with multiyear plans and priorities; or
- Presents the best means to support Federal policy goals compared to other policy alternatives.

Benefits of Partnership and Partner Contributions to FHWA Long-Term Infrastructure Performance

Partner Organization	User Perspective on Needs	Consensus Stakeholders Advice	Industry Perspective	Standard Setting	Field Trials	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Donation of Material or Services	Funding
State Departments of Transportation	X	X		X	X	X	X	X	X	X
AASHTO Special Committee on Research and Innovation	X						X			
AASHTO Committee on Materials and Pavements	X	X		X		X		X		
AASHTO Committee on Bridges and Structures	X	X		X		X		X		
Universities			X				X	X		
University Transportation Centers			X				X	X		
National Academy of Sciences (TRB)	X	X	X				X	X		
Industry Associations*.	X		X	X		X	X	X		

Pavement & Materials Research & Technology

\$4,485,000

Program Description/Activities/Objectives:

Together, the Pavement & Materials Research and Development (R&D) Program and the Accelerated Implementation and Deployment of Pavement Technologies (AIDPT) Program provide a coordinated and cohesive approach to research, development and technology activities focused on providing tools, technologies and guidance, and supporting updated policies, to improve the safety, durability, sustainability and cost-effectiveness of highway pavements, and the materials from which highway infrastructure is constructed. This work is aligned with the DOT State of Good Repair/Advanced Materials, Designs and Technologies strategy. Activities in the Pavement & Materials Research & Development Program include research and development of material test methods and specifications to improve the durability of both virgin and recycled materials used in highway construction, with a focus on advancing performance-related specifications that provide a fair and rational basis for linking payment to the expected performance of the as-constructed product, while giving contractors the freedom to innovate. Activities also include the development of methods and best practices to encourage effective decision making in the assessment and management of pavements.

Program Objectives

FHWA's Pavement & Materials R&D Program seeks to drive innovation in pavement materials, design, construction, evaluation and management practices, with a focus on advancing performance-related specifications. Performance Related Specifications (PRS) compare design expectations to what was constructed, and pay for the product accordingly. Over the last 30 years FHWA, State DOTs, and the pavement industry have performed a significant amount of research to improve pavement evaluation tests and models that now make it viable to move PRS to implementation. PRS provides predictive pavement performance tool that enable defensible and rational mechanisms for acceptance and payment and allows for greater risk sharing between contractor and owner agency. At the same time, PRS provide contractors the flexibility to select materials, techniques, and procedures to improve the quality, economy, or both, of the end product. Furthermore, PRS links material design, construction, quality, payment, and long-term pavement performance. PRS provides tools to the industry for "raising the bar" on performance for longer lasting, durable, and innovative pavements while shifting some of the risk and rewards for performance.

In support of this effort to improve pavement performance, the program is developing guidance, tools, and specifications to enable agencies to best utilize local materials (aggregates, binder supplies, etc.) to achieve more durable pavements. In FY 20 tests will be advanced to ensure the consistency of materials used in delivering asphalt pavements and the durability of concrete pavements. A potentially revolutionary chemical method as well as modifications to existing physical tests for determining the Alkali Silica Reactive

(ASR)⁷ resistance of concrete will be delivered. These advances offer more accurate screening of ASR susceptibility of materials in a much shorter time. In addition, refinements to the Superpave Binder Purchase Specification will be made to screen incompatible asphalt blends that are prone to premature failures, and a test method for characterizing the consistency of RAP will be submitted to AASHTO.

In FY20, the Pavement & Materials R&D program will deliver methods for highway agencies to assess flooded pavements in terms of pavement structural damage and when it is safe to open flooded roads to different types of traffic. Another accomplishment will be guidance for how to effectively perform utility cuts and more importantly, how to repair those cuts so as to minimize disruption to the surrounding pavement. In FY20, the initial demonstration of technologies to determine pavement friction and macrotexture and to assess pavement structural capacity at highway speed will be completed. Follow up with State agencies who would like to further investigate these technologies is being conducted by pooled fund projects.

Key FY20 FHWA Pavement & Materials R&D Program Activities.

Activity	Period of Performance	Partners/Notes
Business case for performance related specifications	2020-2021	
Relationship of mix gradation to macrotexture/safety	2020-2021	
Validation and Proof Testing of Mechanistic-Empirical Based Approach for National Level Pavement Performance Analysis	2020-2022	
Validating NDE for Density Assessment	2020-2022	
Improvements to Software Supporting Performance-Related Specifications for Pavements	2020-2021	
Validation of chemical and physical Alkali Silica Reactive (ASR) tests and development of ASR mitigation strategies	2020-2021	FAA, Massachusetts DOT
Development of Local/Regional Aggregate Performance Specifications & Tests	2019-2022	
Assessment and validation of concrete durability testing procedures in support of AASHTO PP-84	2019-2022	

⁷ ASR is a chemical reaction that can occur in some concrete mixtures. When exposed to moisture, the reaction product expands, causing deterioration of the concrete.

Performance Related Specifications for Asphalt Pavements	2020-2022	
Evaluation of the Use of RAP and RAS: Effects of Binder Content, Grade and Consistency on Mix Performance	2020-2022	
Development of a Refined Superpave Binder Purchase Specification	2020-2022	
Evaluation of durability of dilute epoxy asphalt mix	2020-2022	

In addition to the role of conducting research and development, through the Pavement & Materials R&D Program, FHWA provides technical assistance in support of infrastructure forensic investigations undertaken by the National Transportation Safety Board (NTSB), the Inspector General, State Departments of Transportation, FHWA Division Offices and Federal Lands, and others. Examples of forensic activities include: investigations of premature failures, assistance in fraud cases, and assistance in identifying reasons for low pavement friction that have resulted in crashes.

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes. The program is authorized in sections 502 and 503 of title 23, United States Code, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas to improve highway safety, improve infrastructure integrity, strengthen transportation planning and environmental decision-making, reducing congestion, and enhancing freight productivity, among others.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Accountability

FHWA’s Pavement & Materials R&D Program primarily supports the Department’s Safety, Infrastructure and Accountability Strategic Goals and contributes to the Innovation Goal as well. Specific contributions are as follows.

Safety: The Pavement & Materials R&D Program will contribute directly to highway safety and the Department’s Systematic Safety Approach through work to advance friction management. Indirect contributions will be made through durability improvements that reduce the frequency and duration of construction work zones for maintenance and repair.

Infrastructure: The Pavement & Materials R&D Program is aligned with the State of Good Repair/Advanced Materials, Designs and Technologies strategy and supports the Life Cycle and Preventive Maintenance objective by providing best practices, developing recommendations and demonstrating analysis methodologies for identifying an optimized sequence of treatment actions that considers both structural and functional condition over the life cycle. Additionally, by developing pavement performance related specifications, the program enables Federal-aid recipient to better ensure that they are paying for quality pavement construction that require less frequent repairs due to increased design durability.

Innovation: The Pavement & Materials R&D Program supports the Department's Innovation Goal by undertaking research and development in the advancement and development of fundamental tests and protocols for improved selection and prediction of materials performance. Activities also advance the development of rapid tests for evaluation of infrastructure materials.

Accountability: The Pavement & Materials R&D Program will contribute to the Department's Accountability Goal by establishing the business case for performance related specifications that put the emphasis on performance characteristics, while giving contractors latitude to innovate.

This program impacts and is of benefit to highway infrastructure throughout the nation, including that in rural communities, and the nation's freight infrastructure.

USDOT Research Priorities:

Performance Based Regulations and Safety: The FHWA Pavement & Materials R&D Program addresses the Departments Performance Based Regulations and Safety Priority by providing tools and guidance to support highway agency efforts provide safe and durable highway pavements and effectively manage their condition.

Improving Mobility of Freight: Through better pavement performance, the frequency of highway work zones is reduced, which in-turn improves system reliability and the mobility of freight and people.

Research Collaboration Partners:

FHWA Pavement & Materials R&D program staff regularly engage with key stakeholders in both formal and informal settings to gather input concerning challenges and opportunities that might be addressed through the program, as well as information on work undertaken by other organizations both nationally, and internationally. Stakeholders include representatives of individual highway agencies, pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB), industry organizations such as the American Concrete Pavement Association (ACPA) and the National Asphalt Pavement Association (NAPA), standard-setting organizations such

as the American Concrete Institute (ACI) and ASTM International, and university faculty engaged in related work.

Formal interactions with AASHTO, TRB, and industry organizations generally occur at regular intervals (at least annually, and as often as quarterly), but are not formally tracked or measured. Ad hoc interactions in the form of technical assistance requests are logged on an internal SharePoint site.

The input obtained through these interactions is considered by program staff as they identify and formulate a program of research and technology initiatives that, in accordance with 23 USC 502(a)(3):

- Is of national significance;
- Delivers a clear public benefit and occurs where private sector investment is less than optimal;
- Supports a Federal stewardship role in assuring that State and local governments use national resources efficiently;
- Meets and addresses current or emerging needs;
- Addresses current gaps in research;
- Presents the best means to align resources with multiyear plans and priorities; or
- Presents the best means to support Federal policy goals compared to other policy alternatives.

Program partners (both government and non-government), benefits derived from partnerships, and partner contributions are summarized in the table below.

Benefits of Partnership and Partner Contributions to FHWA Pavement & Materials R&D

Partner Organization	User Perspective on Needs	Industry Perspective	Standard Setting	Field Trials	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Donation of Material or Services	Funding
AASHTO Committee on Materials and Pavements	X		X		X				
State Departments of Transportation	X			X	X	X		X	X
National Institute of Standards and Technology (NIST)						X	X		
National Asphalt Pavement Association		X						X	
American Concrete Pavement Association		X							
ASTM International			X						

Universities				X	X	X	X		
Sustainable Pavements Working Group⁴	x	x				X			
Federal Aviation Administration						X (ASR)			

Structures

\$5,391,000

Program Description/Activities/Objectives:

Program Description

The Structures Research and Technology (R&T) Program is a coordinated and cohesive program of research, development and technology activities focused on providing tools, technologies and guidance, and supporting updated policies, to improve the safety, structural integrity, longevity, construction processes and cost-effectiveness of highway bridges, tunnels and other structures.

Program Objectives

FHWA's Structures R & T Program seeks to drive innovation in structural design, construction, inspection, evaluation, and maintenance through the development of best practice guidance and novel solutions to engineering challenges in bridges, tunnels, and ancillary structures, as well as training and technology transfer initiatives directed toward ensuring the safety of the Nation's bridges and structures, and promoting effective management of that infrastructure. The program addresses "weak links" in relevant technologies that cannot or will not be addressed by other organizations, due to lack of capabilities and/or the absence of profit potential required to motivate private investment. Consistent with the Department' State of Good Repair strategy, the over-arching objectives guiding FHWA's Structures R&T Program are to:

- Achieve and sustain a state of good repair of bridges, tunnels, and other structures.
- Implement and enhance the effectiveness of transportation performance management.
- Deliver projects faster and more efficiently.
- Improve the sustainability and resilience of highway infrastructure.

Program activities include work addressing Advanced Materials, Designs and Technologies, Risk-Based Asset Management, Infrastructure System Resilience, and Advanced Inspection Tools.

In FY20, the Structures R&T program will deliver advancements that support the safe and efficient operation of highway structures. The cause of the Florida International University pedestrian bridge collapse will be released and recommended changes to practice that addressing critical associated needs in bridge design and construction will be produced. A framework for the structural design of ultra-high performance concrete bridges will be delivered to AASHTO, allowing the community to begin crafting and vetting the needed formal guidance. The pavement and tunnel modules of the non-destructive evaluation web manual will be released. Training material on proper design and installation of high strength bolting for steel structures, as well as updated training and reference materials and guidance on safety inspections, assessments, preservation and management of

highway bridges and tunnels will be delivered. Tools for risk assessment and management for seismic designs will also be developed.

Key FY20 FHWA Structures R&T Program Activities.

Activity	Period of Performance	Partners/Notes
Flexural Behavior of Ultra-High Performance Concrete	FY20-FY21	
Rehabilitation of Deteriorated Bridge Decks with Ultra-High Performance Concrete Overlays	FY20-FY21	
Interface Shear Resistance of Conventional and Novel Concretes	FY20-FY21	
Refinement and Delivery of a Standardized Test Method for Tensile Response of Strain-Hardening Fiber Reinforced Concretes	FY20-FY21	
Development of a Standardized Test Method for Durability of Ultra-High Performance Concrete	FY20	
Innovative Short-Span Concrete Bridge Superstructures	FY20-FY21	
Use of Toughened Epoxies to Fill Gaps Between Plates for Steel Bridge Construction	FY20-FY21	
Qualification of Homopolar Generator Welds	FY20-FY21	
Stress Corrosion Cracking of Stainless Steel Reinforcing Bars	FY20-FY21	
Corrosion of Metalizing Over Variable Surface Cleanliness	FY20-FY21	
Galvanic Corrosion Study Between 50W and A1010 Steels	FY20-FY21	
Assessment of Commercial Chloride Diffusion Sensors	FY20-FY21	
Integration of NDE into Bridge Management Systems	FY20-FY21	
Application of Infrared Thermography for Tunnel Liner Assessment	FY20-FY21	
Field Validation of Magnetic NDE Methods for Internal Post-Tensioning Tendons	FY20-FY21	
DFS Area Bridge/Tunnel Inspection Program Peer Exchanges	FY20-FY21	
NHI Training course updates, per current BIRM updates	FY20-FY21	
Support contract Bridge Preservation Expert Task Group	FY20-FY21	Selected State Departments of Transportation

Activity	Period of Performance	Partners/Notes
Regional bridge preservation partnership support and participation	FY20-FY21	Selected State Departments of Transportation
Bridge preservation peer exchanges	FY20-FY21	
Bridge Preservation Portal	FY20-FY21	
Multi-Hazard Resilience Stakeholder Panel--Consolidated Panel for all bridge resilience-related subjects	FY20-FY21	
Risk assessment and decision-making tool evaluation and development--assist State DOTs in Risk Management Planning	FY20-FY21	
Implementation and Accelerated Deployment of Fixed Fire Suppression System Technology in High Risk Tunnels	FY20-FY21	
Develop design aid charts and tables for selecting preliminary physical security protection measures for bridges.	FY20-FY21	
Develop contract specification language and detailed descriptions for selected security protection measures for bridges.	FY20-FY21	
Support Strut-and-Tie Concrete Design Concept Through Training Course Delivery	FY20	
Develop and deploy a guide framework for bridge load rating, posting and permitting	FY20-FY21	
NTIS Deployment	FY20	
Bridge management systems workshop delivery	FY20-FY21	
BrM software annual license fee	FY20-FY21	
Validation and testing protocol development for Shape Memory Alloy, Engineered Cementitious Concrete, Re-centering Detailings	FY20-FY21	
Multi-Hazard Bridge Design--Risk Evaluation and Risk Management through LRFD Calibration	FY20-FY21	
Develop criteria, guidelines, and recommendations for the integrated design of emergency ventilation system and fixed firefighting systems using synthesis, computer simulation, model scale testing, and full-scale testing.	FY20-FY21	
Develop criteria, guidelines, and recommendations for the design of precast concrete tunneling segments using synthesis, computer simulation, model scale testing, and full-scale testing.	FY20-FY21	

Activity	Period of Performance	Partners/Notes
Vulnerability of critical bridge components accessible by UAS threats.	FY20-FY21	
Numerical FE crash simulations of TL-5 & TL-6 barriers to verify correct impact forces for MASH implementation	FY20-FY21	
Refresh Steel Bolted Splice Training Course	FY20-FY21	
VBI Update - Mobile Platform Compatibility/Device Purchase	FY20	
Drone Research for Bridge Inspection	FY20-FY21	
Advance bridge load rating practices and technologies	FY20-FY21	

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes. The program is authorized in sections 502 and 503 of title 23, United States Code, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas to improve highway safety, improve infrastructure integrity, strengthen transportation planning and environmental decision-making, reducing congestion, and enhancing freight productivity, among others. Additionally, this program supports implementation of other statutory mandates, specifically, Transportation Performance Management, and the National Bridge and Tunnel Inspection requirements (23 CFR 650).

Program Alignment with Strategic Goals:

DOT Strategic Goal
Infrastructure

FHWA’s Structures R & T Program primarily supports the Department’s Infrastructure Strategic Goal. The Structures Program also makes valuable contributions to the Safety and Innovation Goals. Specific contributions are as follows.

Infrastructure: The Structures R&T Program will support the Life Cycle and Preventative Maintenance Objective by providing test methods, and guidance to support infrastructure owners in effective design, construction and management of highway bridges, tunnels and other structures. The program addresses the Department’s Economic Competitiveness and Workforce objective through training to ensure that personnel responsible for bridge and tunnel inspection have the knowledge and skills required to effectively and efficiently carry out this vitally important responsibility. The program is aligned with the State of Good Repair Strategy, and will

include activities addressing Advanced Materials, Designs and Technologies, Risk-Based Asset Management, Infrastructure System Resilience, and Advanced Inspection Tools.

Safety: The Structures R&T Program will contribute directly to highway safety by providing tools, technologies, guidance and training to support infrastructure owners in ensuring that highway bridges, tunnels and other structures are designed, constructed, inspected, evaluated, and maintained to safely carry traffic loads and withstand the forces of nature.

Innovation: The Structures R&T Program contributes to Development of Innovation by undertaking research and development in structural design, construction, and maintenance to develop innovative solutions to highway structural engineering challenges. Ultimately, the resulting innovations will improve the state of the practice and result in resilient and adaptable systems to mitigate the impact of hurricanes, floods, and other extreme events on bridges and other structures. Additionally, the Program contributes to Deployment of Innovation through training and technology transfer initiatives.

This program impacts and is of benefit to highway structures throughout the nation, including those in rural communities and the nation's freight infrastructure.

USDOT Research Priorities:

Performance-Based Regulations: The Structures R&T Program contributes to the success of performance-based regulations by providing bridge owners with guidance, training, tools and technologies to more effectively manage the performance of highway bridges.

Research Collaboration Partners:

FHWA Structures R&T program staff regularly engage with key stakeholders in both formal and informal settings to gather input concerning challenges and opportunities that might be addressed through the program, as well as information on work undertaken by other organizations both nationally, and internationally. Stakeholders include representatives of individual highway agencies, pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB), industry organizations such as the Precast/Prestressed Concrete Institute, and the National Steel Bridge Alliance, standard-setting organizations such as the American Concrete Institute (ACI) and ASTM International, and university faculty engaged in related work.

Formal interactions with AASHTO, TRB, and industry organizations generally occur at regular intervals (at least annually, and as often as quarterly), but are not formally tracked or measured. Ad hoc interactions in the form of technical assistance requests are logged on an internal SharePoint site.

The input obtained through these interactions is considered by program staff as they identify and formulate a program of research and technology initiatives that, in accordance with 23 USC 502(a)(3):

- Is of national significance;
- Delivers a clear public benefit and occurs where private sector investment is less than optimal;
- Supports a Federal stewardship role in assuring that State and local governments use national resources efficiently;
- Meets and addresses current or emerging needs;
- Addresses current gaps in research;
- Presents the best means to align resources with multiyear plans and priorities; or
- Presents the best means to support Federal policy goals compared to other policy alternatives.

Program partners (both government and non-government), benefits derived from partnerships, and partner contributions are summarized in the table below.

Benefits of Partnership and Partner Contributions to FHWA Structures Program.

Partner Organization	User Perspective on Needs	Industry Perspective	Standard Setting	Field Trials	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Donation of Material or Services	Funding
AASHTO Committee on Bridges and Structures	X				X				
State Departments of Transportation	X			X	X			X	X
National Institute of Standards and Technology (NIST)						X	X		
Precast/Prestressed Institute		X						X	
American Concrete Institute		X							
ASTM International			X						
Canadian Standards Association			X						
Research Council on Structural Connections (RCSC)			X						

Transportation Performance Management, Asset Management and Maintenance

\$1,640,000

Program Description/Activities/Objectives:

Program Description

The Transportation Performance Management and Asset Management and Maintenance (TPM, AM & M) Research and Technology (R&T) Program is a coordinated and cohesive program of research, development and technology deployment activities focused on providing tools, innovations, technologies and on developing guidance and policies to advance the effective management of highway infrastructure and system performance. Research development and deployment activities include: identification and advancement of specific strategies to enhance TPM; the improvement of AM, preservation and maintenance practices and the development and deployment of TPM, AM and Maintenance training, technology transfer and support initiatives.

Program Objectives

FHWA’s TPM Program is guided by the TPM Implementation Plan, which is publicly available on FHWA’s [TPM website](#). The Plan lays out the implementation activities that will be accomplished in 2018-2022. Investing in these activities will support State DOTs, MPOs, and industry to implement effective practices to manage the performance and condition of the highway system. In 2020, FHWA’s TPM Program will accomplish the activities outlined in the TPM Implementation Plan and will deliver to State DOTs and MPOs a range of technical assistance resources such as training, guidance, best practices, peer exchanges, etc.

Key FY20 program activities are listed below.

Activity	Period of Performance	Partners/Notes
Develop Guidance Documents to Promote Bridge Preservation	FY20-21	AASHTO TSP2 Bridge Preservation Partnerships, AASHTO Technical Committee on Bridge Preservation T-9
Develop a Case Study on Measuring Effectiveness of Preservation	FY20-21	AASHTO TSP2 Bridge Preservation Partnerships, AASHTO Technical Committee on Bridge Preservation T-9
Conduct Two Bridge Preservation Peer Exchanges	FY20-21	
Conduct Asset Management Peer Exchanges	FY20-21	
Develop Asset Management Case Studies with webinars	FY20-21	

Key BIM Research Activities identified in the BIM Roadmap	FY20-21	
TPM Capacity building Pooled-fund Study & conference support	FY20-21	AASHTO Performance-based Capacity Building Pooled Fund Study
TPM Training and Technical Assistance Delivery	FY20-21	FHWA Resource Center and NHI
TPM Training and Educational Resource Development	FY20-21	
Pilot study to evaluate promising technologies to identify occupancy factors for corridors	FY20-21	
Develop Asset Management Guidance Documents & Workshops	FY2021	
Support for Bridge Preservation Expert Task Group	FY20-21	AASHTO T-9, TRB, Academia, Industry, States

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes - The program is authorized in sections 502 and 503 of title 23, United States Code, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas to improve highway safety, improve infrastructure integrity, strengthen transportation planning and environmental decision-making, reducing congestion, and enhancing freight productivity, among others. In particular, this program supports implementation of other statutory mandates, specifically, TPM, AM, and pavement and bridge preservation and maintenance [23 USC 150 and 23 USC 119 implemented through 23 CFR 490 and 23 CFR 515].

Program Alignment with Strategic Goals:

DOT Strategic Goal
Accountability

FHWA’s TPM, AM & M R & T Program primarily supports USDOT Accountability goal. However, the program also makes significant contributions toward all the USDOT Strategic Goals through the efficient investment of Federal transportation funds across national transportation goals; the increase in accountability and transparency of the Federal-aid highway program; and the improvement of program and project decision-making through performance-based planning and programming. Specific contributions are as follows.

Safety: The TPM, AM & M R&T Program will contribute directly to highway safety and the Department's Systematic Safety Approach by providing tools, technologies, training and guidance to support infrastructure owners in effectively managing highway bridges, tunnels and other structures, so that such infrastructure is resilient and can safely carry traffic loads and withstand natural disasters. This also includes safety TPM data contributions to the overall Department's Data strategy.

Infrastructure: The TPM, AM & M R&T Program supports the Life Cycle and Preservation/Preventive Maintenance objective through research development and deployment strategies designed to foster more effective management of highway infrastructure assets. Focus areas include:

Advancing TPM practices; including the development of risk-based AM plans for developing investment strategies to achieve system performance effectiveness and State DOT targets for asset condition, while managing the risks, in a financially responsible manner, at a minimum practicable cost over the life cycle of its assets. A focus of State DOT AM plans is the State DOT's long-term state-of-good-repair (SOGR) objectives for the NHS. FHWA works with State DOTs and MPOs to increase the health and longevity of the Nation's highways by assessing vulnerabilities, considering communities and resilience in the transportation planning process, incorporating resilience in AM plans, and addressing resilience in project development and design.

Innovation: The TPM, AM & M Program supports the Department's Innovation Goal by undertaking research and development toward providing critical data needed for improved decision-making, developing analytic tools to address critical performance gaps, and providing for a greater level of transparency in communicating transportation performance. The TPM, AM & M R&T Program is also focused on advancing the use of Building Information Modeling (BIM) for highway infrastructure in order to enable a life cycle approach to leverage and integrate data as projects move from planning to design to construction and finally to operations and maintenance, after which the cycle begins again. Lastly, work will be conducted so that agencies can be prepared for autonomous vehicles from a design, maintenance and AM perspective.

This program impacts and is of benefit to the highway system in its entirety, including the portion serving rural communities.

USDOT Research Priorities:

FHWA's Transportation Performance Management, Asset Management and Maintenance R&T program supports achievement of safety, infrastructure, reliability, and freight performance targets required under Performance Based Regulations and Safety, and Improving the Mobility of Freight through data-driven management of the transportation system.

Research Collaboration Partners:

FHWA is committed to supporting effective implementation of TPM to ensure States and MPOs are using a performance-based approach in their transportation planning and programming,

setting meaningful targets for the TPM measures, and reporting at a level of detail needed for a national conversation on transportation performance. FHWA aims to provide State DOTs, MPOs, and other stakeholders with the information and resources they need to implement TPM and achieve a performance-based transportation system

The FHWA TPM and AM program conducted a national survey of State DOTs and metropolitan Planning Organizations to identify the areas of need for implementing TPM and AM. This input from stakeholders is being used to identify and develop technical assistance resources to help State DOTs in meeting the requirements for TPM and asset management.

Benefits of Partnership and Partner Contributions to FHWA TPM, Asset Management and Maintenance R&T Program.

Partner Organization	User Perspective on Needs	Industry Perspective	Standard Setting	Field Trials	Deployment	Specialized Expertise or	Funding
AASHTO TSP2 Bridge Preservation Partnerships, AASHTO Technical Committee on Bridge Preservation T-9	X	X	X		X		
State Departments of Transportation	X				X		X
AASHTO Performance-based capacity building pooled fund	X				X		X

Safety Program Delivery \$2,265,000

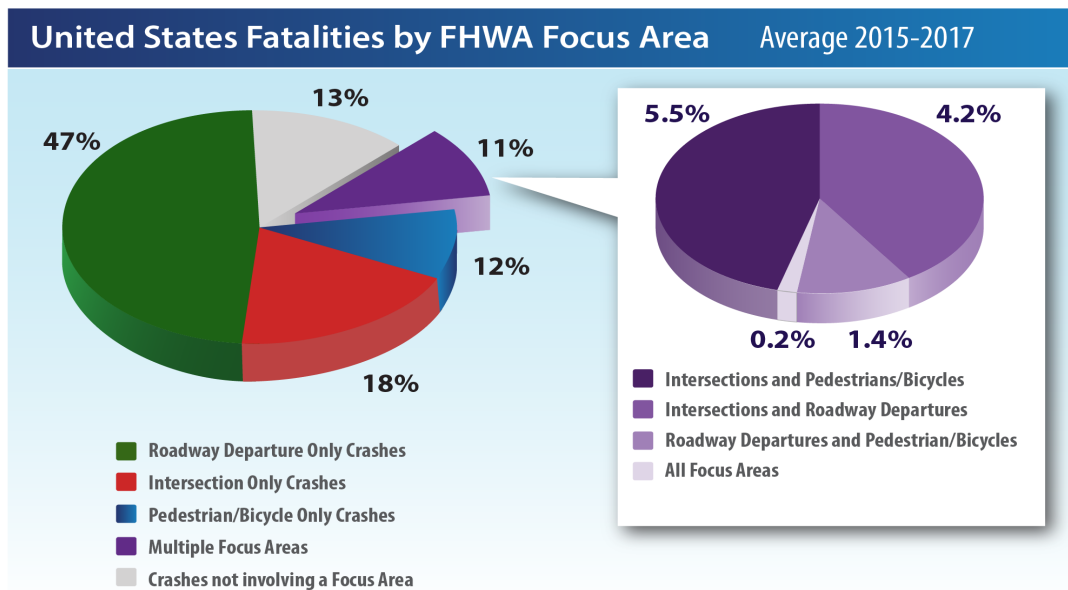
Program Description/Activities/Objectives:

Program Description

The FHWA Office of Safety, Office of Safety Research and Development and the Resource Center Safety and Design Technical Service Teams work alongside the safety specialists in the Division offices on a “Focused Approach to Safety.” This approach focuses our resources on activities that address the Nation’s most critical safety challenges by providing new tools and innovations, research, and training. This program emphasizes performance-based, data-driven solutions to assist our stakeholders in implementing the Highway Safety Improvement Program with our stakeholders. This approach increases awareness on critical severe crash types, leads to key safety infrastructure improvements, assists in prioritizing limited resources, and creates positive organizational changes in safety culture, policies, and procedures. The three critical areas identified as providing the greatest potential to reduce highway fatalities and serious injuries using infrastructure-oriented improvements are namely:

- Roadway departure,
- Intersection crashes, and
- Pedestrian/bicycle crashes.

These three focus areas encompass almost 90% of the traffic fatalities in the U.S.



NOTE: The totals in the pie charts do not exactly add up to 100% and 11% respectively due to rounding.

The Safety Program Delivery research focuses on reducing highway-related fatalities and serious injuries on the Nation’s roadways by:

- Implementing FHWA safety programs legislative requirements

- Informing Congress; State DOTs; other Federal, State, and local government agencies; Tribes; academia; and the public about how FHWA safety resources are invested and the safety improvements achieved from FHWA efforts.
- Strengthening States' abilities to implement a performance driven safety program by sharing information, training, and assistance
- Improving the technical capacity of transportation safety professionals at all levels of government to advance safety programs
- Creating practical applications of the Department's Safety Data Initiative to enhance our understanding of crash risk and our ability to mitigate such risks
- Fostering a safety culture not only thru technical assistance but thru marketing and communications programs; and
- Promoting an integrated, multidisciplinary (4E's) approach to safety in all phases of program and project development including transportation planning.
- Evaluation and assessment of road owners' capabilities which enable target training and technical assistance to fill gaps.

Through the Safety Program Delivery program, FHWA assists partners and stakeholders in making the best use of the programs and services available to them to optimize their safety investments and to maximize their safety contributions to realize the vision.

The Safety Program Delivery Research Program provides support for the \$2.6 billion Highway Safety Improvement Program (HSIP) -a core Federal-aid highway program with the purpose to achieve a significant reduction in fatalities and serious injuries on all public roads. The program assists states with the administration of the HSIP by providing needed information, training, policy guidance and technical assistance to FHWA's partners and the public on proven, efficient, cost-effective safety programs and activities; encouraging and supporting partnerships with private and public safety stakeholders; and continuously communicating the necessity and available tools to utilize a data-driven system approach to saving lives on all public roads.

Program Objectives

FHWA's Safety Program Delivery Program ensures that stakeholders have the tools and resources needed to address emerging and existing roadway safety issues. The program identifies the following objectives:

- Implement FHWA Safety Programs' Legislative Requirements.
- Strengthen States' abilities to implement a performance driven safety program by sharing information, training, and assistance
- Improve the technical capacity of transportation safety professionals at all levels of government to advance safety programs
- Evaluate the results of FHWA Safety Program Delivery implementation efforts

FY20 FHWA Program Delivery R&T Program Activity

Activity	Period of Performance	Partners/Notes
Implement FHWA Safety Programs' legislative requirements	2012-2022	<p>Communicate the laws, regulations and funding eligibility for the HSIP (23 USC 148 and 23 CFR 924).</p> <p>Ensure oversight and stewardship for the HSIP:</p> <ul style="list-style-type: none"> • Strategic Highway Safety Plan (SHSP) • State Highway Safety Improvement Program • Special Rules (High-Risk Rural Roads & Pedestrian and Older Driver) • Rail-Highway Grade Crossing Safety Improvement Program (23 USC 130 & 23 CFR 646 Subpart B) • Safety Performance Management (23 CFR 490 Subpart B) <p>Work alongside modal partners to communicate the laws, regulations, policy guidance and funding eligibility and provides stewardship for the following statutory programs:</p> <ul style="list-style-type: none"> • 402 Program (23CFR 1200.12) – NHTSA • Other Grant Programs 23 USC 406 & 408 • Penalty Transfers – NHTSA • Open Container Law (23 USC 154/23 CFR 1270) • Repeat Offender Law (23 USC 164/23 CFR 1275) • Other Penalty Transfers 23 USC 153, 158, 159, 161 • Driver Licenses for Drug Offenders Certification (23 USC 159 & 23 CFR 192) • Safety Incentives to Prevent Operation of Motor Vehicles by Intoxicated Persons (23 USC Sec. 163 & 23 CFR 1225) <p>Implement the Safety-Related Planning Regulations - 23 USC 134 and 135 and 23 CFR Part 450</p>

Activity	Period of Performance	Partners/Notes
Strengthen States' abilities to implement a performance driven safety program by sharing information, training, and assistance	2012-2022	<p>Provide technical assistance to stakeholders on policy and guidance. Communicate Federal safety policy and guidance through various communication forums such as fact sheets, webinars, meetings, and manuals.</p> <p>Assess 2018 State safety performance targets to determine which states met or made significant progress toward their safety targets.</p> <ul style="list-style-type: none"> • Notify States of FHWA's determinations • Work closely with States that did not meet their safety targets through the submission of a plan that will help them to meet future targets <p>Conduct an HSIP National Scan Tour in partnership with AASHTO to identify State HSIP processes and practices yielding noteworthy practices for all States.</p> <p>Publish and market the Highway-Rail Crossings Handbook, 3rd Edition.</p> <p>Support and educate the State Departments of Transportation, Metropolitan Planning Organizations, and other safety stakeholders on national safety goals, policies, and strategic plans.</p>
Improve the technical capacity of transportation safety professionals at all levels of government	2012-2022	<p>Supports State and local agencies with the implementation of the HSIP by coordinating regional safety peer exchanges to ensure safety practitioners have current technical expertise.</p> <p>Provides technical assistance to help State and local agencies effectively manage and administer the HSIP, Strategic Highway Safety Plan (SHSP), Safety Performance Management, High-Risk Rural Roads Program</p>

		<p>(HRRRP), and Railway-Highway Grade Crossing Safety Improvement Program (RHGCP) among others.</p> <p>Provide training and assistance with tools to support decisions using a data-driven approach in managing highway safety.</p> <p>Develop an SHSP capability maturity Model which will serve as a snapshot of current State practices relating to the development, implementation, and evaluation of SHSPs.</p> <p>Conduct SHSP Evaluation Process Model workshops for States and their partners as they begin their SHSP update cycle.</p> <p>Conduct marketing and outreach on the Roadway Safety Fundamentals textbook in an effort to improve technical capacity among practitioners and academia.</p> <p>Deliver the 2020 Roadway Safety Discipline Boot Camp to FHWA practitioners.</p>
<p>Evaluate the results of FHWA Safety Program Delivery implementation efforts</p>	<p>2012-2022</p>	<p>Performs program assessments, prepare annual reports, evaluate safety products and tool to identify gaps in existing safety efforts and opportunities for improvement.</p> <p>Identify enhancements to the HSIP online reporting tool to address user needs and requirements, ultimately yielding annual outputs and outcomes on the HSIP program.</p> <p>Develop the 2019 HSIP National Summary Report to determine the aggregate number and type of projects funded under the HSIP.</p> <p>Develop a program evaluation project that helps to determine how States are modifying or enhancing their safety efforts based upon FHWA’s safety program delivery efforts.</p>

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes, this program is authorized in sections 502 and 503 of title 23, United States Code, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas to improve highway safety, improve infrastructure integrity, strengthen transportation planning and environmental decision-making, reducing congestion, and enhancing freight productivity, among others.

The HSIP is legislated under Section 148 of Title 23, United States Code (23 U.S.C. 148) and regulated under Part 924 of Title 23, Code of Federal Regulations (23 CFR Part 924). This program also supports the implementation of other statutory mandates, such as National Performance Management Measures (23 CFR 490).

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety

FHWA’s Safety Program Delivery primarily supports the Department’s Safety goal. FHWA Safety Program Delivery secondarily addresses the Department’s Infrastructure, Innovation, and Accountability Goals;

Safety: The Safety Program Delivery research focuses on strengthening States’ abilities to implement a performance driven safety program by sharing information, training, and assistance. The program seeks to increase the technical capacity of transportation safety professionals at all levels of government to advance safety programs. The program fosters a safety culture not only thru technical assistance but thru marketing and communications programs. Through these various mechanisms, the Safety Program Delivery works to reduce roadway fatalities and serious injuries.

Infrastructure – The Safety Program Delivery research promotes an integrated, multidisciplinary (4E’s) approach to safety in all phases of program and project development including transportation planning. It includes evaluation and assessment of road owners’ capabilities which enable target training and technical assistance to fill gaps. It includes providing technical assistance and training to State DOTs to ensure effective, data-driven infrastructure safety projects that lead to alternative infrastructure designs. The Safety Program Delivery research program also supports efforts that reduce crashes thus improving the mobility of all road users on the nation’s roads.

Innovation – The Safety Program Delivery research promotes the development and use of innovative tools to support decisions using a data-driven approach in managing highway safety.

Accountability – The Safety Program Delivery research program includes evaluation of various safety programs such as the SHSP and HSIP as well as the tracking and support of Safety Transportation Performance Management. The program provides support for states in developing targets and assistance to states that fail to meet targets.

The Safety Program Delivery research program develops tools and technical assistance of great value to rural areas. Examples include high-risk rural roads technical assistance, marketing and communication materials specifically for local public agencies, working with local associations such as the National Association of County Engineers (NACE) to identify needs and provide technical assistance as well.

USDOT Research Priorities:

Safety Program Delivery addresses several of the DOT research priorities as outlined below.

Economic Impact of Regulatory Reform: Through the promotion of noteworthy practices and technical assistance this program supports the efforts to streamline regulatory oversight and compliance activities.

Economic Impact of Permitting Reform: This program supports the accelerated delivery of transportation projects by improving the technical capacity of transportation safety professionals at all levels of government to advance safety programs. In turn, this supports decision making on effective safety countermeasure implementation.

Performance-Based Regulations and Safety: Safety Program Delivery implements a strategic approach using system information to make investment and policy decisions to achieve national safety performance goals. The Safety Performance Management Final Rule supports the Highway Safety Improvement Program (HSIP) by establishing safety performance measure requirements to carry out the HSIP and to assess fatalities and serious injuries on all public roads. State Strategic Highway Safety Plans support the use of data-driven processes to guide safety programs and enable innovative approaches to improving safety outcomes.

Potential Impact of Value Capture: The analysis of safety countermeasures allows the benefits and costs of safety improvement alternatives to be determined, resulting in cost-effective decisions to improve infrastructure.

Improving the Mobility of Freight: Safety Program Delivery includes safety countermeasures that consider truck movements, such as safe roadside design for higher profile freight vehicles.

Improving Mobility for Underserved Communities: Safety Program Delivery focuses on both urban and rural communities, including tribal communities. It also includes all road users, including non-motorized road users and other vulnerable road users.

Cybersecurity: This program considers the data produced through connected and automated transportation technologies for their safety analytical value. This program collaborated with other programs to explore the potential and is considering new statistical methods.

Research Collaboration Partners:

FHWA's Safety Program Delivery Research Program is built upon focus areas identified from safety data provided by States, as well as stakeholder input and assessment of stakeholder capabilities. Our focused approach to safety research is directed at providing information to transportation practitioners, decision makers, and others to assist in preventing and reducing these severe crashes. We track input from partners through regular reporting and technical assistance.

FHWA gains input on research needs from our stakeholders using a multitude of vehicles including but not limited to:

- Peer exchanges provide opportunities to identify technical skill gaps in evaluating and deploying life-saving countermeasures and advancing the use of scientific methods and data-driven decisions.
- HSIP assessments are conducted regularly in the States and these evaluations identify opportunities to enhance HSIP implementation efforts thru research and technical assistance.
- HSIP reports, due annually facilitate the documentation of stakeholder input and are used to improve products, tools and grow existing services.
- Annual 23 USC Section 130(g) reports from each state documenting the progress being made to implement the railway-highway crossings program, the effectiveness of such improvements, an assessment of the costs of the various treatments employed, and subsequent crash experience at improved locations.
- Federal, state, regional, and local transportation agencies, academic institutions, foundations, or private firms proposed activities through a pooled fund study.
- State SHSP update cycles provide a forum for increased coordination and collaboration among a multi-disciplinary group of State safety stakeholders and FHWA. Update cycles identify needs and input on various program areas.

Coordinating across modes within DOT is vital to ensuring our roads are safe. FHWA works closely with FMCSA, NHTSA, FTA, and FRA to address multiple dimensions of roadway safety. FHWA concentrates on improvements to roadway infrastructure upon which vehicles and users operate. There are many places where the safety mission of other modes overlaps and require coordination to achieve success.

- The US DOT Safety Council serves to tackle the most critical transportation safety issues we face in a coordinated fashion.

- The DOT Traffic Records Coordinating Committee (TRCC) is an interagency group charged with coordinating the support and improvement of safety data collection, management, and analysis within DOT, among State and Federal partners, and across different State-level traffic records systems.
- The intermodal Managers' Safety Meeting, with senior managers from FHWA, NHTSA, FMCSA, FTA, and FRA meets regularly to discuss common issues and opportunities to coordinate strategies and program activities.

In addition, the FHWA Safety Delivery Program coordinates with other FHWA program offices (e.g., Planning, Policy, Infrastructure, Public Affairs) to advance safety program delivery initiatives.

Making dramatic improvements in national, State, and local safety performance depends upon building effective external partnerships with a wide range of safety stakeholders, including national safety organizations, State and local transportation professionals, and the private sector. To build effective national safety partnerships, FHWA actively engages in a broad range of external coordination. FHWA meets regularly to share information with a host of our safety partners. The purpose of these meetings is to strengthen FHWA's relationship with its safety partners to better leverage resources and be more aggressive in accomplishing our mutual safety goals. Discussions with these groups have provided valuable insights into FHWA's safety program research activities.

External Partners include but are not limited to:

- **American Association of State Highway and Transportation Officials** – Collaborates on research problem statements and various outreach projects, in addition to participating on various committees that focus on highway safety policy.
- **American Traffic Safety Services Association** - Represents the road safety, traffic safety, and highway safety industry and collaborates on Road to Zero (RTZ) initiatives.
- **American Road & Transportation Builders Association (ARTBA)** – partners with us on a variety of program activities including training on Safe Guardrail Installation & Maintenance and collaborates on RTZ initiatives.
- **Transportation Research Board** – The mission of the Transportation Research Board is to provide leadership in transportation innovation and progress through research and information exchange, conducted within a setting that is objective, interdisciplinary, and multimodal. FHWA coordinates on research problem statements and safety program staff participates on various safety-related research projects and committees.
- **National Association of County Engineers** – Collaborates on evaluating and deploying life-saving countermeasures and advancing the use of scientific methods and data-driven decisions to address safety on local and rural roads.
- **Roadway Safety Foundation** - Collaborates with this organization to educate the public on road hazards, and promoting roadway research and technical transfer activities. The RSF cosponsors the National Roadway Safety Awards with FHWA.

- **Road to Zero** – A national safety coalition formed by the National Safety Council in partnership with the National Highway Traffic Safety Administration, the Federal Highway Administration and the Federal Motor Carrier Safety Administration. We collaborate with the National Safety Council and representatives from over 800 multi-disciplinary organizations to help achieve the RTZ vision of zero traffic fatalities by 2050. The coalition brings together multiple stakeholders including not only representatives of roadway, behavioral and vehicle safety, but also nonprofit groups, public health officials and technology companies. Thru the NSC and the Coalition, grants are used to fund safety projects that show evidence of the effectiveness of proven countermeasures, have measurable objectives and have innovative approaches that could be replicated in other locations.
- **Institute of Transportation Engineers** – FHWA partners with ITE on various products and services such as identification of necessary research, technical resources, and exchange of professional information.
- **Federal, state, regional, and local transportation agencies, academic institutions, foundations, or private firms** - Collaborate with FHWA on solving transportation-related problems, research, planning, and technology transfer activities thru jointly funded the Transportation Pooled Fund (TPF) Program.

These internal and external partnerships provide an array of benefits. By collaborating internally with the USDOT, we assure that federal safety programs related to safety program delivery are coordinated and provide coordinated information to our partners. The collaboration with our external partners improves oversight and stewardship with regard to improving roadway safety outcomes.

Benefits of Partnership and Partner Contributions to FHWA Safety Program Delivery.

Partner Organization	Safety Coordination and Data Analysis and Coordination	Advancing Safety Initiatives	Safety Deployment	Research Collaboration	Stakeholder Professional	Safety Outreach and Education
AASHTO	X		X	X	X	X
State Departments of Transportation	X	X	X	X	X	X
Transportation Research Board	X		X		X	X
American Traffic Safety Services Association	X			X		X
American Road and Transportation Builders Association	X				X	X
National Association of County Engineers	X	X	X	X	X	X
Road Safety Foundation	X		X			X

Road to Zero Coalition	X		X	X			X
Institute of Transportation Engineers	X		X		X	X	X
Federal, state, regional and local transportation agencies, academic institutions, foundations and private firms	X	X	X	X	X	X	X

Safety Design and Operations

\$3,887,000

Program Description/Activities/Objectives:

Program Description

The Safety Design and Operations program encompasses core safety engineering work that overlaps traffic engineering, geometric roadway design, transportation planning, and system management and operations, and aims to help stakeholders reduce fatalities and serious injuries on all public roadways. The program focuses on three critical areas identified as providing the greatest potential to reduce highway fatalities using infrastructure-oriented improvements, as follows:

- Roadway departure,
- Intersection crashes, and
- Pedestrian/bicycle crashes.

These three areas account for over 90% of roadway fatalities. Through this program, we:

- conduct research on safety improvements (e.g., to reduce roadway departure crashes in rural communities),
- evaluate, document and promote noteworthy practices,
- provide technical expertise and leadership,
- support professional capacity building internally and externally, and
- monitor and encourage innovative, infrastructure-based approaches to improving safety performance.

These activities aim to ensure that FHWA assists partners and stakeholders in making the most effective safety investments and reduce fatalities and serious injuries on rural and urban roadways.

Program Objectives

The main purpose of the Safety Design and Operations program is to improve safety and, ultimately, to save lives. Because the Federal-aid program is a State-administered and Federally-assisted program, the success of our efforts depends on working with stakeholders (e.g., State Departments of Transportation and local road owners). The program identifies the following objectives:

- Identify innovative road safety solutions and develop effective safety countermeasures
- Strengthen States' abilities to implement a performance-driven safety program by sharing information, training, and assistance;
- Improve the technical capacity of transportation safety professionals at all levels of government to advance safety programs;
- Evaluate the results of FHWA Safety Implementation efforts.

Key FY20 FHWA Safety Design and Operations R&T Program Activities.

Activity	Period of Performance	Partners/Notes
Identify innovative road safety solutions and develop effective safety countermeasures	2019-2024	<p>Examine how high friction surface treatments can be used to improve intersection safety.</p> <p>Develop data-driven safety plans to reduce rural roadway departures.</p> <ul style="list-style-type: none"> • Partner with States, LTAP Centers, and Counties • Establish an Intersection Safety Pooled Fund Project to address driver behavior at Multilane Roundabouts to counteract an unexpected rise in crashes. • Partnering with seven states (GA, IL, ME, MN, MT, WA, WI) and more under a new Pooled Fund Study
Strengthen States' abilities to implement a performance-driven safety program by sharing information, training, and assistance	2019-2024	<p>Enhance State knowledge and processes for reviewing crash testing and conducting an in-service performance evaluation of roadside safety hardware</p> <ul style="list-style-type: none"> • Partner with State DOT's and AASHTO • Enhance knowledge to reduce the severity of run-off-road crashes and advance crash analyses to improve highway safety and infrastructure security. • Provide objective, independent, technical support to program partners • Development of Crash Modification Factors for estimating pedestrian injuries and fatalities at intersections • Enable utilization of known safety countermeasures so that cost-effective design solutions are made to benefit vulnerable road users. <p>Improve the USLIMITS2 tool which can be used to establish appropriate speed limits. Recent research findings need to be incorporated into the system to ensure that it up to date and supports State and local stakeholders. Conduct new research based on the</p>

		<p>findings of recently completed research.</p> <p>Conduct research and analysis to complete the 2nd Edition of the Highway Safety Manual (HSM). This project will provide needed research/material to complete and implement the HSM 2nd Edition (e.g., inclusion of ped/bike models, systemic analysis, improved injury severity, calibration, etc.).</p>
<p>Improve the technical capacity of transportation safety professionals at all levels of government to advance safety programs</p>	<p>2019-2020</p>	<p>Naturalistic Driving Data Analysis for Curves</p> <ul style="list-style-type: none"> • Rely on the 2nd Strategic Highway Research Program Roadway Information Database to identify geometric factors in curve-related crashes. • Support for Roadway Departure, Intersections, and Pedestrian/Bicyclist Safety Focus States and Cities • Provide technical assistance to designated states and cities based on fatalities (e.g., develop action plans) to address Focus areas. Partners include State and local transportation agencies. <p>Providing technical assistance related to bikeway selection to improve safety.</p> <p>Develop a resource to outline principles and benefits of offset right-turn lane for application at high-speed unsignalized intersections.</p>

Evaluate the results of FHWA Safety Implementation efforts	2019-2022	Apply a Safe Systems Approach framework to address intersection crashes <ul style="list-style-type: none"> • Objective is a national strategy for improving intersection design and safety. Partners could include State DOTs and other transportation agencies. • Demonstrate crash reduction potential of the network- level pavement friction measurement on a continuous rather than sampling basis. <ul style="list-style-type: none"> ○ Partner with State DOTs to collect and correlate friction and crash data at high-risk locations for roadway departure, intersection, and pedestrian crashes.
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Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes, this program is authorized in sections 502 and 503 of title 23, United States Code, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas to improve highway safety, improve infrastructure integrity, strengthen transportation planning and environmental decision-making, reducing congestion, and enhancing freight productivity, among others.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety

FHWA’s Safety Design and Operations program primarily supports the Department’s Safety Strategic Goal while also providing support to elements of the Infrastructure, Innovation, and Accountability Goals. Specific contributions are as follows:

Safety: The Safety Design and Operations program develops infrastructure-related research to improve the safety of the Nation's roadways by focusing on priority technical areas to address National safety data trends and Departmental/Agency policy initiatives. This includes research promoting safer roadway design by evaluating, documenting and promoting new approaches to road design that enhances road safety through proven safety countermeasures – many of which are developed to address the disproportionate risk of fatal and injury crashes in rural communities.

Infrastructure: The Safety Design and Operations program examines the interrelationships among the roadway, road users, and roadway context to determine effective ways to improve the safety performance of the physical infrastructure. The program identifies low-cost safety infrastructure improvements that reduce crashes by improving infrastructure performance and reduce project delivery time and project costs.

Innovation: The program supports demonstrations of advanced vehicle automation technologies to assess existing infrastructure design and operation practices and considering the value of current infrastructure safety strategies and treatments for the future. The Safety Design & Operations program also seeks to ensure that Automated Vehicles do not negatively affect other road users, namely pedestrians, bicyclists, and motorcyclists. The program develops innovative safety countermeasures to reduce fatalities on all public roads.

Accountability: The Safety Design and Operations program advances a data-driven systemic approach to reduce highway fatalities. The program provides tools for transportation agencies to analyze safety data, develop safety implementation plans, and to identify and implement cost-effective safety countermeasures.

The Safety Design and Operations program develops tools and technical assistance that are tailored to the needs of rural roadways and their owners. Such work is coordinated through a Local and Rural Road Safety working group.

USDOT Research Priorities:

The Safety Design and Operations Program addresses several of the DOT research priorities as outlined below.

Economic Impact of Regulatory Reform: Through the promotion of proven safety countermeasures, this program supports the efforts to streamline regulatory oversight and compliance activities.

Economic Impact of Permitting Reform: This program supports the accelerated delivery of transportation projects through the development of roadside safety audits and other systemic approaches towards implementing proven safety countermeasures.

Performance-Based Regulations and Safety: The work activities of the Safety Design and Operations Program are fully focused on implementing performance-based, systemic, and innovative approaches to improving safety.

Potential Impact of Value Capture: The application of proven safety countermeasures and systemic safety approaches is known to have effects on creating value for that land. Case study examples on pedestrian and bicyclist safety have illustrated the revenue generation potential for nearby properties.

Improving the Mobility of Freight: Proven safety countermeasures that consider truck movements are given full consideration via this program.

Improving Mobility for Underserved Communities: Half the US fatalities occur in rural locations, and the performance-based and systemic approaches promoted through Safety Design and Operations reinforce proven safety countermeasures to address rural needs.

Cybersecurity: This program is considering the potential for connected automated vehicle technology, and the cybersecurity risks that may impede the safety benefit from these technologies.

Research Collaboration Partners:

The Safety Design and Operations program relies on its established network of partners in other public agencies, membership organizations, and in academia. Some technical areas have used stakeholder input to develop strategic plans (e.g., a strategic plan to improve pedestrian safety based on stakeholder-identified gaps and needs). FHWA also gains input on research needs from our stakeholders using a multitude of vehicles including but not limited to peer exchanges, conducting presentations and webinars that are open to the public, and seeking other means of sharing information with Federal, state, regional, and local transportation agencies, academic institutions, foundations, or private firms. Stakeholder input from these entities helps shape roadmaps, and other strategic planning documents as the Safety Design and Operations program activities are planned and implemented.

Non-government groups have been and continue to be collaborators. For example, FHWA worked with the National Association of Counties to conduct outreach on rural road safety to county officials. FHWA also works closely with the Institute of Transportation Engineers to learn of and disseminate noteworthy practices with this key constituency.

Key internal partners include but are not limited to:

- **Office of the Secretary ITS Joint Program Office** – ensures that safety needs are addressed in activities related to automated and connected vehicles.
- **Federal Railroad Administration** –to address safety issues at rail-grade crossings.
- **Federal Motor Carrier Safety Administration** – to address infrastructure issues related to large truck crashes.
- **National Highway Traffic Safety Administration** –to ensure that a holistic 4 Es (Engineering, Education, Enforcement, and Emergency Services) approach is used to address safety.

In addition, the FHWA Safety Design and Operations Program coordinates with other FHWA program offices (e.g., Operations, Planning, Policy, Infrastructure), the Resource Center, and Federal Lands to advance safety delivery initiatives.

External partners include but are not limited to:

- **American Association of State Highway and Transportation Officials** –Collaborates on research problem statements and various outreach projects, in addition to participating on various committees that focus on highway safety policy.
- **American Traffic Safety Services Association** - Represents the road safety, traffic safety, and highway safety industry and collaborates on Road to Zero initiatives.
- **American Road & Transportation Builders Association** – partners with us on a variety of program activities including training on Safe Guardrail Installation & Maintenance and collaborates on RTZ initiatives.
- **Motorcyclist Advisory Council** – this advises FHWA on infrastructure-related safety issues of concern to motorcyclists.
- **Transportation Research Board** – The mission of the Transportation Research Board is to provide leadership in transportation innovation and progress through research and information exchange, conducted within a setting that is objective, interdisciplinary, and multimodal. FHWA coordinates on research problem statements and safety program staff participates on various safety-related research projects and committees.
- **National Association of County Engineers** – Collaborates on evaluating and deploying life- saving countermeasures and advancing the use of scientific methods and data-driven decisions to address safety on local and rural roads.
- **National Association of Counties** – Collaborates to engage their members, county officials, in the safety conversation.
- **Roadway Safety Foundation** – Collaborates with this organization to educate the public on road hazards, and promoting roadway research and technical transfer activities. The RSF cosponsors the National Roadway Safety Awards with FHWA.
- **Road to Zero Coalition** – A national safety coalition formed by the National Safety Council in partnership with the National Highway Traffic Safety Administration, the Federal Highway Administration and the Federal Motor Carrier Safety Administration. We collaborate with the National Safety Council and representatives from over 800 multi-disciplinary organizations to help achieve the RTZ vision of zero traffic fatalities by 2050. The coalition brings together multiple stakeholders including not only representatives of roadway, behavioral and vehicle safety, but also nonprofit groups, public health officials and technology companies. Thru the NSC and the Coalition, grants are used to fund safety projects that show evidence of the effectiveness of proven countermeasures, have measurable objectives and have innovative approaches that could be replicated in other

locations.

- **Institute of Transportation Engineers** – FHWA partners with ITE on various products and services such as identification of necessary research, technical resources, and exchange of professional information.
- **Operation Lifesaver** – helps FHWA and other USDOT modes promote rail crossing safety.
- **Local Technical Assistance Program** – works with FHWA to ensure that local and rural safety stakeholders are part of the conversation.
- **Federal, state, regional, and local transportation agencies, academic institutions, foundations, or private firms** - Collaborate with FHWA on solving transportation-related problems, research, planning, and technology transfer activities thru jointly funded the Transportation Pooled Fund (TPF) Program.

Benefits of Partnership and Partner Contributions to FHWA Safety Design and Operations R&T Program

Partner Organization	Coordination/ Collaboration	Data Analysis / Coordination	Advance Safety Initiatives	Safety Innovation Activities	Safety Deployment	Research Collaboration	Nationwide Goal Setting	Professional Development	Public Education
American Association of State Highway and Transportation Officials	X	X	X	X	X	X	X	X	
American Traffic Safety Services Association			X		X			X	X
American Road & Transportation Builders Association	X		X					X	
Motorcyclist Advisory Council	X	X		X		X			
Transportation Research Board	X	X		X		X	X	X	
National Association of County Engineers	X		X	X	X		X	X	
National Association of Counties	X		X	X	X				X
Roadway Safety Foundation	X		X		X		X	X	X
Road to Zero			X	X	X			X	X
Institute of Transportation Engineers	X		X	X	X	X	X	X	
Operation Lifesaver			X					X	X
Local Technical Assistance Program	X				X			X	

Federal, state, regional, and local transportation agencies, academic institutions, foundations, or private firms	x	x	x	x	x	x	x	x	x
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Safety Data and Analysis

\$3,551,000

Program Description/Activities/Objectives:

Program Description

The Safety Data and Analysis program area focus on the use of safety data to inform highway investment decision making through a systemic safety approach based on crash experience, crash potential, crash rate, or other data-supported means. The scope of the program includes research, development, and technology (RD&T) to improve State and local safety data systems commonly record crash, roadway inventory, and traffic volume data. The program enhances our State and local partners' capability to use safety data systems for analysis and evaluation supporting highway investment decision making to help ensure efficient and timely detection of critical safety hazards. The program also includes analyses supporting FHWA safety policy decision making, providing a foundation for systemic, performance-based approaches to improving safety. This is reinforced via the Roadway Safety Data Program, which helps States and local agencies advance their data capabilities through resource development, technical assistance, data management, and data analysis.

Program Objectives

Data-driven technologies and decision making is a key theme for all FHWA programs. This is especially true for Safety. The Safety Data and Analysis Program reflects this priority for supporting highway infrastructure investment decision making. The main goal of the program is to discover new ways to use data and analysis tools to save lives and improve the ability of road owners and operators to make science-based safety decisions.

The Safety Data and Analysis Program identifies six primary objectives to address the broad challenge:

- Research and develop new methodologies and tools for safety data collection, management, analysis, and evaluation.
- Increase the utilization of proven methodologies and tools for safety data collection, management analysis, and evaluation.
- Broaden the integration of safety data and analysis into planning, programming, and project development processes.
- Improve understanding of the benefits of safety data-driven decision making.
- Advance safety data and evaluation as a means of supporting Transportation Performance Management.

Existing gaps in safety data systems, analysis, and evaluation capabilities limit the effectiveness of investment decisions at the Federal, State, and local levels. An investigation in 2018 for the US Roadway Safety Data Capabilities Assessment estimated an overall national average capability level of 3.20 on a scale of 1 (ad hoc) to 5 (optimized). The capability level is below 3 in several key subareas: data quality management practices for completeness, timeliness, accuracy, and uniformity; analyses supporting countermeasure selection, the roles, responsibilities and policies for data management and governance; and performance management analysis. The national average of States' desired capability level is 3.97, i.e., States wish to improve, on average, by almost one full capability level.

Key FY20 FHWA Safety Data and Analysis Program R&T activities

Activity	Period of Performance	Partners/Notes
Research and develop new methodologies and tools	2016-2022	<p>Develop new safety countermeasures based second Strategic Highway Research Program (SHRP2) Roadway Inventory Database (RID) analyses.</p> <p>Release of state DOT-based research on SHRP2 based safety countermeasure development and effectiveness.</p> <p>Evaluate potential motorcycle crash countermeasures identified through analysis of Motorcycle Crash Causation study data and input from motorcycle safety stakeholders</p> <p>Develop an integrated and holistic process for safety analysis by merging hotspot and systemic analysis models for a balanced approach that ensures the best possible selection of safety improvements.</p> <p>Enhance a safety performance development tool that incorporates the implementation of statistical goodness of fit.</p>
Increase the utilization of proven methodologies and tools	2014-2024	<p>Update the Interactive Highway Safety Design Model (IHSDM) tool to provide decision makers with better information so that they can make cost-effective decisions. Define migration path for AASHTO to host the software</p> <ul style="list-style-type: none"> • Work with Data-Driven Safety Analysis Initiative program participating agencies
Broaden the integration of safety data and analysis into all processes	2017-2026	<p>Maintain and operate the Highway Safety Information System VI for roadway safety analysis</p> <p>Define concept for Highway Safety Information System VII applying new big data analytics</p>
Improve understanding of the benefits of safety data-driven decision making	2016-2023	<p>Partner with the agencies participating in Evaluation of Low-Cost Safety Improvements Pooled Fund Study to evaluate the safety effectiveness of unproven safety countermeasures and to identify and addresses methodological issues with the development, application, and assessment of CMFs</p> <ul style="list-style-type: none"> • CMF development for mini-roundabouts • CMF development for wrong-way driving countermeasures
Advance safety data and evaluation as a means of supporting Transportation	Ongoing	<p>Administer the Roadway Safety Data Program to include roadway safety data collection, analysis, and management</p>

Performance Management.		<ul style="list-style-type: none"> • Provide roadway safety data and analysis technical assistance to practitioners in State and local agencies. <p>Improve the fundamental data sets and develop the next version of the model inventory of roadway elements that states may collect in developing a comprehensive roadway and traffic data inventory for safety management.</p>
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Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes, this program is authorized in sections 502 and 503 of title 23, United States Code, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas in order to improve highway safety, improve infrastructure integrity, strengthen transportation planning and environmental decision-making, reducing congestion, and enhancing freight productivity, among others.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety

FHWA’s Safety Data and Analysis program primarily support the Department’s Safety Strategic Goal. Additionally, the secondary impacts of the Safety Data and Analysis program also contribute to the other USDOT Strategic Goals and priorities. Specific contributions as follows:

Safety/Promoting Safety: Through the Safety Data and Analysis Program, FHWA has lead Federal responsibility to encourage and support State and local highway agencies in the improvement of roadway inventory and traffic volume components of safety data systems, and supporting crash data improvement. Accurate, complete, and timely data is critical to support effective systemic safety approaches and inform performance-based regulations. The program also establishes processes for integrating roadway inventory and traffic volume data with crash data through geolocation to a highway base map that provides a geospatial referencing system for all public roads. Improved data on all roads, whether urban or rural, leads to accurate problem identification, analysis, and effective safety countermeasure development. Much of the safety research stems from a detailed analysis of the causal factors for crashes. The Highway Safety Information System (HSIS) provides a detailed crash data coupled with high-resolution roadway characteristics to enable such analyses.

Infrastructure/Improving Infrastructure: The program advances tools in safety data analyses that lead towards improving the infrastructure. The program is supporting the Highway Safety Improvement Program (HSIP) planning, implementation, and evaluation efforts through the analysis of safety data available through various partners, establishing national level benchmarks. The program also performs data analysis that benefits the explicit, quantitative

consideration of safety in planning, programming, project development, and operations decision making. The program established the Model Inventory of Roadway Elements (MIRE) as a guideline to help state agencies improve their roadway and traffic data inventories.

Innovation: The evaluation focus of the Safety Data and Analysis program advances the state-of-practice in safety evaluation. These analyses lead to countermeasure evaluation and crash modification factor (CMF) development, delivery, and use. This leads to making effective decisions, particularly on rural roads where safety deficiencies are more pronounced, about how to obtain more reliable data on the effectiveness of crash countermeasures. The program continually evaluates programs and processes for improving safety data and enhancing the analysis and evaluation capabilities at the State and local levels. Recently the Safety Training and Analysis Center (STAC) was created to study Naturalistic Driving Study data collected through the second Strategic Highway Research Program (SHRP2). This data captured the driver behavior and the movement of vehicles through everyday driving experiences, enabling new research into how crashes can be avoided.

Accountability: As road owners and operators gather and use more data and information for decision making, they will become more accountable to the public.

With a disproportionate rate of fatalities in rural areas, any activities to promulgate the scientific, data-driven approach to safety will save lives in those areas. Several emphasis areas in the Safety Data and Analysis program are highly relevant to rural safety, including a special set aside in the MIRE FDE for describing rural roads, and the use of the Systemic Approach to Safety.

USDOT Research Priorities:

The Safety Data and Analysis Program addresses several of the DOT research priorities as outlined below.

Economic Impact of Regulatory Reform: Through the promotion of advanced data analysis, this program supports the efforts to streamline regulatory oversight and compliance activities.

Economic Impact of Permitting Reform: This program supports the accelerated delivery of transportation projects by creating the tools for predicting the future crash reduction potential of safety countermeasures. In turn, this supports decision making on effective safety countermeasure implementation.

Performance-Based Regulations and Safety: The work activities of the Safety Data and Analysis are fully focused on supporting the use of scientific methods and data-driven processes to guide safety programs and enable innovative approaches to improving safety.

Potential Impact of Value Capture: The analysis of safety countermeasures that enable safe ingress and egress to privately owned land is known to have effects on creating value for that land. Studies on pedestrian and bicyclist safety often consider the revenue generation potential for nearby properties.

Improving the Mobility of Freight: Through safety data analysis, safety countermeasures that consider truck movements are given full consideration.

Improving Mobility for Underserved Communities: A component of the Safety Data and Analysis program is the Evaluation of Low-Cost Safety Improvements Pooled Fund Study, involving 40 States. Half the US fatalities occur in rural locations, and improved analysis has created new countermeasures.

Cybersecurity: This program is considering the data produced through connected and automated transportation technologies for their safety analytical value. This program collaborated with other programs to explore the potential and is considering new statistical methods.

Research Collaboration Partners:

The Safety Data and Analysis program relies on its established network of internal and external partners in other public agencies and in academia. The FHWA staff engaged in this program are active participants in national and international committees such as the World Road Association, the Transportation Research Board, the Institute of Transportation Engineers, and the American Association of State Highway and Transportation Officials. We track the input from partners through regular reporting on program status at the meeting (DOT-TRCC; TRB) and other venues.

The Safety Data and Analysis program frequently interacts with the following internal Department partners:

- **DOT Traffic Records Coordinating Committee (DOT|TRCC), Federal Motor Carrier Safety Administration, National Highway Traffic Safety Administration, Office of The Secretary** - This multi-modal group works to improve the collection, management, and analysis of traffic safety data at the State and Federal level.
- **FHWA's Safety Performance Measures Management Final Rule (23 CFR 490) and NHTSA's Uniform Procedures for State Highway Safety Grants Program Interim Final Rule (23 CFR 1300)** establish a single, national definition for States to report serious injuries per the Model Minimum Uniform Crash Criteria (MMUCC) 4th Edition.
- **USDOT Safety Data Initiative**: this multimodal initiative, led by OST-P is leapfrogging the department into the next generation of data and tools to inform and improve safety decisions.

Additionally, the Safety Data and Analysis Program coordinates frequently, but not limited to, the following:

- **American Association of State Highway and Transportation Officials (AASHTO)** – Collaborates on research problem statements.
- **Transportation Research Board** – Coordinates on research problem statements. Safety program staff participates on various safety-related research projects and committees.
- **National Association of County Engineers** – Collaborates on projects to address safety on local and rural roads.
- **Institute of Transportation Engineers** – Collaborates on an annual Excellence in Highway Safety Data Award Paper Competition to encourage data-driven safety countermeasure development.

Benefits of Partnership and Partner Contributions to FHWA Safety Data and Analysis R&T Program.

Partner Organization	Coordination/ Collaboration	Data Analysis / Coordination	Advance Safety Initiatives	Safety Innovation Activities	Safety Deployment	Research Collaboration	Nationwide Goal Setting	Professional Development	Public Education
American Association of State Highway and Transportation Officials	X	X	X	X	X	X	X	X	
Transportation Research Board	X	X		X		X	X	X	
National Association of County Engineers	X		X	X	X		X	X	
Institute of Transportation Engineers	X		X	X	X	X	X	X	
Federal, state, regional, and local transportation agencies, academic institutions, foundations, or private firms	X	X	X	X	X	X	X	X	X

The Safety Data and Analysis program collaborates with Planning, Environment, and Realty and the Office of Innovative Program Delivery as safety data and analysis experts in matters relevant to MPO/Planning organizations and local agencies. The program has been instrumental in supporting the Performance-Based Practical Design effort led by the Office of Infrastructure.

Safety Data and Analysis program activities rely on strong collaborations with the Office of Highway Policy Information staff members who manage the Highway Performance Monitoring System (HPMS) and the All Road Network of Linear Referenced Data (ARNOLD) requirements and strategic initiative. The Safety Data and Analysis program has developed a cross-cutting SHRP2 Safety Data pooled fund program that will include the Offices of Operations and Planning. Also, the program coordinates with the FHWA Office of Operations on a safety analysis needs assessment for Transportation Systems Management and Operations and safety analysis of freeway lane narrowing and shoulder use.

The Safety Data and Analysis program is also represented on the FHWA Data Governance and Data Business Planning Committees. At the USDOT level, the Safety Data and Analysis program participates in the USDOT Traffic Records Coordinating Committee and contributes to NHTSA's Minimum Model Uniform Crash Criteria (MMUCC) activities and crash data improvement efforts.

These internal and external partnerships provide many benefits. By collaborating within the USDOT, we assure that the federal safety programs related to data provide coordinated and clear information to our partners. Further, each mode is at a different level of expertise and sophistication with regard to data, and working together allows us all to benefit from the knowledge of the more advanced modes. The collaboration with our external partners improves our outreach and technology transfer with regard to encouraging road owners and operations to move toward a science-based approach for making critical safety decisions.

Human Factors Analytics

\$1,422,000

Program Description/Activities/Objectives:

Program Description

The purpose of the Human Factors Analytics program is to better understand human behavior and the relationship between roadway users, infrastructure, and vehicles. This program is responsive to the DOT Research, Development, and Technology deployment strategies for safety. Specifically, this program supports accelerating technology integration by studying the safe integration of people with emerging automated driving systems technology. This program also develops strategies for influencing driving behavior by studying driver interpretations of roadways.

Human Factor Analytics encompasses human factors research and related activities. Human factors studies consider how drivers, pedestrians and special users' needs can be met through improved roadway designs. HF research looks at how people respond to highly visible, easy to read signs, improved pavement markings, vehicle automation technology, innovative operational changes, and safer streets with improved walkability.

US crash report data identifies human error as a factor in approximately 94% of vehicle crashes (1). Human factors research is a cross-cutting field that routinely conducts both applied and more fundamental investigations for projects in areas such as traffic control device effectiveness, novel intersection designs, and pedestrian & bicyclist safety, to help reduce vehicle crashes resulting from human behavior and error. The Human Factors Analytics program includes the Highway Driving Simulator (HDS), two Field Research Vehicles, the Highway Sign Design and Research Lab (also known as the Sign Lab), the MiniSim™ driving simulator, and the Virtual Reality Lab.

Some key focus areas for the Human Factors Analytics and the Human Factors Program are the following:

- Connected and Automated Vehicles (CAV)
- Traffic Control Devices
- Safety Data Analyses and Technology Assessment
- Roadway User Behavior (including traveler information research)
- Roadway Design Evaluation (including alternative intersection and interchange evaluation research)

Program Objectives

The Human Factors Analytics program produces valuable research that promotes and improves the safety of our transportation system by gaining a better understanding of road users behavior.

The program identifies the following objectives:

- Improve the effectiveness of safety countermeasures as well as tools that promote operational efficiency.
- Understand how connected and automated vehicles can be safety integrated into the Nation's roadway systems by evaluating the human behaviors related to the deployment of cooperative automation.
- Improve roadway designs that meet the needs of drivers, pedestrians and vulnerable users.
- Understand how people respond to the roadway environment, including signs and markings, emerging vehicle and roadway technology, innovative operational changes, safer streets with improved walkability, and other new roadside innovations.

- Identify how human factors for safety may guide safety programs and enable innovative approaches to improving safety.

The Human Factors Analytics program provides a range of research products and guidance that includes visualization and experimental studies that result in informed decision-making to help improve roadway design, evaluate safety countermeasures, and provide technology assessments to improve safety. Human Factors staff have also worked with the Office of Safety staff to help develop Human Factors training, including a course based on the Human Factors Guidelines for Roadway Systems (NCHRP Report 600). The Office of Safety is involved in the current TRB update of the HFG for Roadway Systems, as well as a condensed set of guidelines for rural users. The updated guidelines will be based on roadway research studies. The program also coordinates closely with the DOT Human Factors Coordinating Committee on a systematic view of human factors interactions with vehicle factors and roadway factors to deliver continued improvement to safer roadway design.

Key FY20 FHWA Human Factors Analytics R&T Program Activities.

Activity	Period of Performance	Partners/Notes
Improve the effectiveness of safety countermeasures as well as tools that promote operational efficiency	2019-2020	Enhancements to Lane Reduction Transitions through signing and lane markings <ul style="list-style-type: none"> • Work with over 25 states through Traffic Control Device Pooled Fund Study
Improve roadway designs that meet the needs of drivers, pedestrians and vulnerable users	2018-2022	Partner with industry on developing Virtual Reality Bicycle Simulator for testing bicycle warning applications Create an open source module for shared multi-simulator connected simulation Truck Platooning Operations and their effects on passenger car drivers Multi-Driver Interaction using Virtual Reality to allow multiple simulators to interact with one another, facilitating multiple participant experimentation

Activity	Period of Performance	Partners/Notes
Understand how people respond to signs and markings, emerging vehicle technology, innovative operational changes, safer streets with improved walkability, and other new roadside innovations	2018-2021	Level 1 Vehicle Automation Applications Integrate human factors considerations with Cooperative Automation Research Modeling and Analysis (CARMA) platform Build Level 2 capable Automated Vehicle for field research Upgrade Highway Driving Simulator capabilities to model Level 2 vehicle automation Upgrade Highway Driving Simulator visual presentation to experimental subjects for more realistic testing.

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes, this program is authorized in sections 502 and 503 of title 23, United States Code, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas to improve highway safety, improve infrastructure integrity, strengthen transportation planning and environmental decision-making, reducing congestion, and enhancing freight productivity, among others.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety

FHWA’s Human Factors Analytics primarily supports the Department’s Safety Strategic Goal. Additionally, the Human Factors Analytics program delivers secondary impacts to other USDOT Strategic Goals and Priorities. Specific contributions are as follows:

Safety: Many of our Human Factors research projects promote safer roadway design by evaluating and improving the design of roadway signing, and researching how emerging vehicle technologies can improve roadway safety and decrease crash frequency and severity. Human factors alternative intersection and interchange evaluation research is also focused on improving roadway safety, while simultaneously improving roadway efficiency.

Infrastructure: All our HF projects collect and analyze human performance and behavior data as a basis for decision making, technology evaluation and implementation, guidelines, recommendations, and policy creation. This includes projects in all our research areas, including

Connected and Automated Vehicles (CAV), Traffic Control Devices and signing research, SHRP2 research, roadway user behavior (including traveler information research), and roadway design evaluation (including alternative intersection and interchange evaluation research). Our projects and research studies include a variety of driving performance data including data from the driving simulators, field research vehicles, sign laboratory, and test track that are collected and analyzed to answer specific research questions.

Innovation: Automated Vehicles (as well as Connected Vehicles) are important areas for the Human Factors program and active areas of research. AVs has been an important area in the HF program in the last four years, and this will continue to be a very important and dynamic area for the program. The Human Factors Analytics program is coordinating within the Department on “Driver Acceptance of Vehicle Automation for Function-Specific Automation Applications.” This project builds on a previous multi-year program on “Cooperative Adaptive Cruise Control (CACC): Investigation of Key Human Factors Issues.”

Prior research activities considered the application of alternative intersection designs for rural locations. One design, the Restricted Centerline U-Turn (RCUT), was developed based on simulation work to understand how traffic flows for minor roadways would be affected as they intersect fast-moving arterial highways. Visualization work enables roadway designers to understand how design choices affect safety while providing valuable tools for building local community support.

USDOT Research Priorities:

The Human Factors Analytics Program addresses several of the DOT research priorities as outlined below.

Economic Impact of Regulatory Reform: The analysis of human factors contributes overall to the efforts to streamline regulatory oversight and compliance activities by exploring the acceptability of roadside and roadway changes to everyday people.

Economic Impact of Permitting Reform: This program supports the accelerated delivery of transportation projects by evaluating the human response to emerging safety countermeasures. In turn, this supports decision making on effective safety countermeasure implementation.

Performance-Based Regulations and Safety: The human factors analyses of safety countermeasures and emerging Connected and Automated Vehicle technology enable innovative approaches to improving safety.

Potential Impact of Value Capture: New human factors studies on pedestrian and bicyclist safety can lead to developments that reinforce walkable communities and the economic development opportunities generated through such approaches.

Improving the Mobility of Freight: Human factors studies are actively engaged in the study of Truck Platooning Operations and related automation approaches.

Improving Mobility for Underserved Communities: Improved analysis through human factors has created new countermeasures for rural locations. Alternative intersection designs, for instance, underwent extensive testing to refine the design for human acceptability. These alternative intersections are most often implemented along rural corridors.

Cybersecurity: This program is considering the data produced through connected and automated transportation technologies for their safety analytical value. This program is considering how human behavior is affected by engagement and disengagement of automated driving systems.

Research Collaboration Partners:

The Human Factors Analytics program collaborates internally and externally to develop research activities and to exchange information among peer organizations. Every year the Human Factors Analytics program is actively engaged in human factors workshops convened through the Transportation Research Board Annual Meeting. The research community, including industry partners, have sustained long-lasting relationships with the program and its activities.

The Human Factors Analytics Program most frequently collaborates with internal Department partners indicated below:

- **U.S. Department of Transportation’s Human Factors Coordinating Committee** – As one of the twelve cross-modal technical research groups tasked with coordinating on high priority research topics and reducing duplication of effort, this committee is comprised of representatives from various modal agencies of DOT. The committee meets every month to coordinate activities and provide updates on human factors projects.
- **Office of the Secretary ITS Joint Program Office** – FHWA Safety staff serve as project managers on the validation, testing, and evaluation of vehicle to vehicle safety applications. The FHWA Safety program attends regular ITS Strategic Planning Group meetings that focus on the progress and identification of new research. Human Factors expertise in the FHWA Safety program enables the ITS program to fully consider the adaptability of vehicle operators responding to dynamic features on the roadway, like adaptive signal systems and changeable message signs.
- **Federal Railroad Administration and Federal Motor Carrier Safety Administration** - collaborate on intelligent transportation systems R&D.
- **National Highway Traffic Safety Administration** – Safety program staff evaluate Cooperative Adaptive Cruise Control (CACC) applications. The collaboration with the Human Factors team with NHTSA and the ITS Joint Program Office explores the adaptability of drivers to new vehicle technology, and the human response to varying degrees of automation. This has helped to refine automated vehicle following algorithms that can be tolerated by everyday people.

- External partners include but are not limited to:
- **American Association of State Highway and Transportation Officials (AASHTO)** – Collaborates on research problem statements.
- **Transportation Research Board** – Coordinates on research problem statements. Safety program staff participates on various safety-related research projects and committees.
- **National Association of County Engineers** – Collaborates on projects to address safety on local and rural roads.
- **Trilateral (EU, US, JPN) Human Factors Working Group** - Identifies opportunities for human factors research collaboration, aligns its research, and identifies differences for a broad set of human factors issues, including driver distraction, Human-Machine Interaction (HMI), and human factors for automation.

- **European Commission** – Engage in project ‘twinning’ with similar projects being conducted by European nations. This includes exchange of experimental design, data collection, data management, and exchange of experimental results.
- **Industry** – Engage with a variety of industry partners to advance the human factors safety mission in a variety of areas, including driving simulation, vehicle automation, and testing, and pedestrian and bicycle safety.

Benefits of Partnership and Partner Contributions to FHWA Human Factors Analytics R&T Program.

Partner Organization	Coordination/ Collaboration	Data Analysis/Coordinati on	Advance Safety Initiatives	Safety Innovation Activities	Safety Deployment	Research Collaboration	Nationwide Goal Setting	Professional Development	Public Education
American Association of State Highway and Transportation Officials	X	X	X	X	X	X	X	X	
Transportation Research Board	X	X		X		X	X	X	
National Association of County Engineers	X		X	X	X		X	X	
Trilateral (EU, US, JPN) Human Factors Working Group	X		X	X		X			
European Commission	X	X	X	X	X	X	X	X	
Federal, state, regional, and local transportation agencies, academic institutions, foundations, or private firms	X	X	X	X	X	X	X	X	X

Transportation Systems Management and Operations

\$5,372,000

Program Description/Activities/Objectives:

Program Description

The *Moving Ahead for Progress in the 21st Century Act* (P.L. 112-141), under Section 1103 (a) (30)(A) defined Transportation Systems Management and Operations (TSMO) as “an integrated set of strategies to optimize the performance of existing infrastructure through the implementation of multimodal and intermodal, cross-jurisdictional systems, services, and projects designed to preserve capacity and improve security, safety, and reliability of the transportation system.”

Because of the need for alternatives to capacity projects -- due to limited resources, growing customer expectations, emergence of real-time decision support systems and on-demand mobility applications, and an emphasis on performance-based programs -- there is an increasing focus on TSMO in U.S. urban and rural areas. The need continues to grow for a transportation system that provides travel options for the effective movement of people and goods that will mitigate as congestion impacts on urban areas and allow for increasing freight transportation, especially with a growing awareness of the needs of underserved communities. As consumer technologies (smart phones, apps, GPS, etc.) progress, the traveling public expects that transportation agencies will find creative ways to apply these advances to improve their travel experience. TSMO provides a range of strategies that can leverage technology, strategically address the unique issues of an area in a cost-effective manner, and optimize the use of existing and future infrastructure. TSMO has the potential to make significant improvements in safety, reduce congestion and fuel consumption, enable better management of the road network, expand mobility services to underserved communities, improve the convenience of travel, and stimulate the economy through improved freight movement.

TSMO can provide solutions using the opportunities created by technology, real-time information, and innovation. TSMO practitioners are using technology and data to monitor travel conditions, enhance real-time traveler information with public data, coordinate incident and emergency response, manage travel demand, operate managed lanes, minimize impacts of work zones and weather, improve traffic signal operation, and manage agency resources with decision-support capabilities. Research indicates that today most State and local transportation agencies are only starting to apply these strategies in an integrated and systematic manner, and opportunities abound to continue to make U.S. transportation systems more efficient, safe, and responsive through TSMO. These agencies are also beginning to focus on both long-term and catastrophic impacts to ensure the system is resilient to impacts such as the increasingly common extreme weather events, cybersecurity threats, and natural disasters.

To use technology and data effectively to achieve better system operations, agencies need a strong TSMO foundation to apply those tools. The second Strategic Highway Research Program (SHRP2), which ended in fiscal year 2017, raised greater awareness of TSMO benefits and offered additional tools to assist agencies. The activities proposed in this TSMO R&T Program build on that momentum and continue critical research and deployment support to help State and local agency partners realize the true potential of TSMO.

The proposed TSMO Program has three primary elements:

- Foundation for Successful Operations
- Data-Driven Operations Decision-Making

- Implementing Operations Strategies.

Foundation for Successful Operations. The Foundation for Successful Operations program element advances state-of-the-art institutional structures and capabilities to ensure that advanced and emerging innovative operational strategies and technologies are successfully delivered and sustained for the public and private sectors. SHRP2 Reliability research revealed that the distinguishing factors between agencies that are more advanced in TSMO versus agencies that were not technology deployment or funding levels, but how effective their organization's technology and facilities process and institutional elements were. The SHRP2 effort developed additional tools to help agencies advance these organizational capabilities to more effectively deliver TSMO. These tools have received broad support and have established strong momentum for mainstreaming TSMO as a key program in transportation agencies. Funding limitations and space constraints for highway expansion make it critical that agencies have a strong foundation of TSMO capabilities so they can effectively operate their system to get the most out of current capacity. As our transportation challenges increase, and the available technology and data tools grow, managing and operating the transportation system gets more complex. A strong foundation for successful operations is critical to both handle these challenges and leverage the power of the new tools.

Given the legacy of transportation agencies in delivering traditional road and bridge infrastructure with long time horizons from planning to completion, this element of the program will provide the tools and organizational support to enable agencies to evaluate, plan, fund, design, and quickly capitalize on emerging cost-effective transportation technologies and operational strategies to improve reliability, mobility, safety, and economic competitiveness. Research and technology transfer will be conducted to determine effective means to structure organizations and carry out organizational functions to successfully deploy and sustain innovative operational strategies. This program will support efforts to mainstream TSMO in agencies nationwide and the professional capacity building of agencies and the TSMO workforce to meet the transportation needs of today and tomorrow. It will help agencies capitalize on efforts for performance management, including through better understanding of the causes of congestion and other operational issues, benefit-cost analysis of potential investments in transportation system improvements, and planning and design that includes consideration of TSMO strategies and use of emerging technologies and approaches.

This element of the TSMO program will research and develop resources on operations program delivery options, including public private partnerships, shared use mobility providers, multi-agency consortia, and risk sharing. It will also serve as the key link between the research programs of other FHWA Offices (such as Safety, Planning, and Infrastructure) and Operations to ensure broad support and to leverage related work being led by others.

This element of the program will also provide the foundation to enable the successful implementation of other Operations Programs Areas (Managing Disruptions to Operations and Connected and Automated Vehicles) and the other elements within this Program. It will support the successful implementation of work and products related to Data-Driven Operations Decision-Making and Implementing Operations Strategies.

Data-Driven Operations Decision-Making. This element of the program estimates and evaluates the transportation impacts of operations strategies using data management and analytics; analysis modeling and simulation (AMS) tools; and transportation performance management techniques. Activities in this element include: developing and improving tools for researchers and practitioners; providing tools on innovative strategies and technologies to improve data and performance measures

and management practices that lead to improved transportation operations; collaborating with industry partners to adopt newly developed tools and capabilities in commercial software, agency processes and procedures, and industry-wide state of practice; developing management support systems to improve the efficiency and effectiveness of both operational and organizational performance; developing data business planning assistance; developing congestion reporting and operations performance measures and management tools; and improving both planning-level and real-time operational decision-making. These research, development, and deployment efforts will help make more effective use of scarce transportation resources by helping agencies determine:

- more effective and suitable strategies for efficient operations of our existing facilities, and
- where and how to make future transportation investments based on a better understanding of the causes of mobility and safety issues and what solutions will be efficient and effective.

Data and analytical resources used across the industry sometimes provide results that are inconsistent or of questionable quality, and do not support national level monitoring and evaluation of the transportation system. This program element will also support the storage and documentation of data acquired from operations projects, improving consistency and making them accessible to the public. It includes developing and supporting advanced data storage, management, and analytics practices.

Implementing Operations Strategies. The U.S. has invested billions of dollars in building our existing transportation infrastructure. Once facilities are built, our role as stewards of this system is not done. The facilities need to be operated well so that we use them efficiently and effectively. This element of the program supports the use and deployment of operational strategies and practices to improve the performance of existing transportation infrastructure.

This element of the program targets a range of traffic, demand, and parking management tools and strategies that agencies can employ (largely with existing resources) to reduce congestion, improve safety, and improve travel time reliability. Its core mission is to more effectively apply and integrate readily available (but perhaps underutilized) and innovative operational strategies, practices, and technologies for more efficient day-to-day management of the surface transportation system. The operational strategies and tools include traffic control systems, traveler information, pricing, shared use mobility, Integrated Corridor Management (ICM), Active Transportation and Demand Management (ATDM), traffic control device application, traffic management centers (TMCs), and parking management systems. This element of the TSMO Program will enable agencies to advance their current state of operations to a more proactive, integrated, performance-driven, and holistic approach of TSMO.

For example, effective signal timing enables us to move more vehicles safely and reliably through our existing infrastructure. Traveler information, congestion and parking pricing, ATDM, and ICM can dynamically spread demand to use more facilities at a wider range of time by giving travelers choices, incentivizing them to smarter use of facilities, and enabling agencies to adjust operations in real-time as needed. Clear, easy to understand signage reduces confusion and smooths traffic flow, leading to reduced congestion and improved safety. Fixing bottlenecks means that one chokepoint does not reduce capacity along a whole corridor, enabling more efficient use of the entire facility. This program element enables FHWA to address needs of agencies in using our transportation assets by developing strategies, policies, resources, and training; compiling best practices; organizing peer exchanges; and conducting applied research that helps agencies more effectively manage their facilities using proactive, dynamic, and performance-driven approach to traffic management and operations.

Surface Transportation System Funding Alternatives (STSFA) Program. The TSMO Program also provides administration, evaluation, outreach, and results dissemination for the STSFA Program, required under Section 6020 of the Fixing America's Surface Transportation (FAST) Act. No administrative funds were provided under the STSFA legislative language, requiring the use of alternative research and deployment funds to support the program. The STSFA Program supports States in advancing STSFA strategies designed to provide alternate funding mechanisms to the gas tax for financing transportation infrastructure improvements.

The TSMO Program is synergistic with other proposed Operations-related research programs areas, including Managing Disruptions to Operations, Connected and Automated Vehicles, and Freight Management and Operations.

Program Objectives

The objectives of the Foundation for Successful Operations element include:

- Mainstreaming TSMO as a core function in State and Local transportation agencies.
- Enhancing planning and operations functions to improve and strengthen the key institutional underpinnings and linkages that are needed for effective TSMO.
- Supporting agencies with objectively assessing organizational capabilities and developing targeted action plans for improvement to build strong foundations for operations.
- Enhancing performance-based planning and programming so that investments in operations provide regional and multi-modal benefit.
- Providing information to support the identification of TSMO strategies and objective analysis of benefits and costs of potential operational improvements.
- Enhancing agency capabilities to plan for, deploy, and manage TSMO technologies and operational strategies through business processes, systems engineering, asset management, and deployment support.
- Incorporating risk management and scenario planning principles to operations technology deployments.
- Identifying linkages between TSMO strategies and other transportation disciplines (e.g., Safety, Design) and deployment opportunities to improve multi-disciplinary objectives.
- Providing training and technical assistance resources to prepare the transportation workforce to effectively manage and operate the transportation system and leverage emerging technologies and data.
- Providing mechanisms to assess and programmatically address emerging trends including multi-modal, mobility on demand, mobility as a service, and shared use mobility services.
- Providing resources to advance the state-of-practice in operations-related system resiliency.
- Providing support and collaboration with the National Operations Center of Excellence (NOCoe) and the American Association of State Highway and Transportation Officials (AASHTO) Committee on Transportation Systems Operations (TSO) Committee to advance TSMO.

The objectives of the Data-Driven Operations Decision-Making element include:

- Supporting agencies in their use of analysis, modeling, and simulation tools to find the best solutions for their unique transportation problems and to improve decision-making.
- Utilizing data, analysis tools, and performance management to quantify the benefits of operational solutions of sophisticated and complex transportation systems.
- Providing the appropriate data and analysis tools for agencies to effectively assess the performance of their transportation systems.

- Helping partner agencies to implement data-driven decision making.
- Increasing the use of travel time reliability as a measure in transportation analysis and decision-making.
- Supporting successful implementation of the MAP-21 performance measures for system performance and Congestion Mitigation and Air Quality (CMAQ) traffic congestion (PM3).

The objectives of the Implementing Operations Strategies element include:

- Providing resources and technical support to help agencies apply and achieve greater benefits from integrated corridor management (ICM), including arterial operations, traffic signal infrastructure, freeway and ramp operations, ITS infrastructure, bottleneck reduction treatments, demand management, parking management, and traffic management center (TMC) systems.
- Providing resources and technical support to achieve improved performance of managed lanes through pricing, vehicle eligibility, time of day use, active traffic management, ICM, part-time shoulder use, or other operational strategies.
- Advancing the state-of-the art and practice in TMC operations.
- Providing resources and technical support to make more efficient use of transportation systems through traveler information, travel demand management, and shared use mobility services.
- Ensuring that the MUTCD is maintained and is updated in a timely manner to reflect current and forthcoming needs of practitioners and road users, and that it accommodates automated driving systems.
- Identifying system cybersecurity vulnerabilities related to technology-based deployments and transportation operations assets, such as traffic signals and traffic management centers, and working with partner agencies, associations, and system manufacturers to define systematic strategies to address them and advance the state-of-the-practice.

The TSMO Program will also supporting delivery of the STSFA Program to develop and pilot test alternate funding mechanisms to the gas tax for financing transportation infrastructure improvements.

Key FY20 FHWA TSMO R&T Program Activities.

Activity	Period of Performance	Partners/Notes
Foundation for Successful Operations		
Develop outreach and training materials and conduct targeted outreach and technology transfer to advance the state-of-the-practice and improve the capabilities of agencies for developing and delivering TSMO programs.	2018-2023	AASHTO, MPOs, State DOTs, Local Agencies
NEW – Research and develop policy options that support mainstreaming TSMO.	2020-2022	AASHTO, State DOTs, MPOs, Local Agencies
Develop reference/toolkit of TSMO strategies to assist agencies in selecting strategies and accessing key resources to support deployment.	2019-2020	AASHTO, State DOTs, MPOs, Local Agencies
Develop implementation resources for emerging trends including mobility-on-demand, shared use mobility, public and	2018-2022	State DOTs, MPOs, Local Agencies

private incentives, and other transportation demand and parking management strategies.		
NEW – Research the nexus between TSMO and safety strategies and their benefits. Assess research done to date and existing tools for analyzing this nexus, and define gaps for future research and development.	2020-2021	AASHTO, State DOTs, Local Agencies, Universities, TRB Regional TSMO and Performance Management Committees
NEW – Research the applications of TSMO strategies in rural environments. Identify gaps for additional research, development, and technology transfer to enhance rural TSMO.	2020-2021	AASHTO, State DOTs, Local Agencies, National Association of Development Organizations (NADO) , TRB Regional TSMO and Performance Management Committees
NEW – Convert 2 workshops with stable content in mature TSMO program areas to long-term, self-sustaining training courses.	2020-2021	AASHTO, State DOTs, Local Agencies, National Operations Center of Excellence (NOCoE)
Support the advancement of TSMO through initiatives with the NOCoE and AASHTO on TSMO workforce development, strategy deployment, and preparing for emerging trends and technologies.	2019-2024	AASHTO, State DOTs, Local Agencies, National Operations Center of Excellence (NOCoE)
NEW - Develop framework and plan for TSMO research implementation program that accelerates deployment of results from FHWA research and development activities.	2020	AASHTO, State DOTs
Surface Transportation System Funding Alternatives (STSFA) Program		
Administer and support the delivery of the STSFA grant program, evaluate program outcomes, and conduct outreach and technology transfer.	2018-2023	MPOs, State DOTs, Local Agencies
Conduct outreach to educate and inform State legislators about tools available to States interested in advancing STSFA strategies designed to provide alternate funding mechanisms to the gas tax for financing transportation infrastructure improvements.	2019-2021	State DOTs, National Conference of State Legislatures
NEW - Explore what would be needed to conduct a national pilot of STSFA strategies and develop a framework that could be used for a pilot.	2020-2021	MPOs, State DOTs, Local Agencies, Mileage-Based User Fee Alliance
Data-Driven Operations Decision-Making		
Develop tools and resources to monitor national transportation system performance and conduct outreach and technology transfer to advance state and local agency performance management capabilities.	2018-2020	AASHTO, MPOs, State DOTs, Local Agencies, TRB Regional TSMO and Performance Management Committees

NEW – Based on experiences during initial implementation, in 2019, of the congestion and reliability performance measurement rule (PM3), develop resources to support travel time measure/target setting topics. Conduct follow-up research on multimodal system performance measures and complete trip data.	2020-2021	AASHTO, MPOs, State DOTs, Local Agencies, TRB Regional TSMO and Performance Management Committees
Develop and disseminate resources to enable holistic analyses of operational improvement benefits at system, network, and facility levels.	2018-2022	MPOs, State DOTs, Local Agencies, Universities
Enhance tools and decision support systems for operational/tactical and executive/organizational TSMO decisions by adding functionality for emerging technologies.	2019-2022	MPOs, State DOTs, Local Agencies, Universities
Provide technical assistance to advance the practice on data analytics/business intelligence, post project evaluation using empirical data, and multi-objective tradeoff analysis.	2018-2022	MPOs, State DOTs, Local Agencies
Develop case studies and videos to share results of reliability data and analysis tool deployment projects, increase agency capabilities for reliability analysis, and grow use of reliability evaluations in systems planning and operational activities.	2018-2020	MPOs, State DOTs, Local Agencies, Universities
NEW – Develop criteria and a framework for cost-benefit and before-and-after analysis to assess the effectiveness of TSMO strategies and combinations of strategies. Identify data sources.	2020-2021	AASHTO, MPOs, State DOTs, Local Agencies, TRB Regional TSMO and Performance Management Committees, Universities, Grantees of TSMO-related grant programs. It is hoped that some of the data needed for these assessments can be gathered from grantees in the relevant grant programs.
Develop and implement a Data Resource Testbed (DRT) for storing, documenting, and accessing/sharing data from past and ongoing FHWA projects. The DRT will provide analysis resources, procedures, interface, and support to allow the public or FHWA staff to access and use the data generated and saved from FHWA projects.	2020	MPOs, State DOTs, Local Agencies, Universities
NEW - Use the trajectory-level driving data characterizing the vehicle's behavior and the behavior of the surrounding vehicles from the SHRP2 Naturalistic Driving Study dataset to calibrate existing behavior models and generate	2020-2021	MPOs, State DOTs, Local Agencies, Universities

new models that can be used in microsimulation. This will introduce avenues to analyze the behavior of a diverse group of drivers in a broad range of operational conditions on numerous roadway types.		
Together with the Traffic Analysis and Simulation Pooled Fund Study members, develop national guidance on the use of multiresolution modeling (MRM) in traffic analysis, including: recommendations of preferred integration structures and methods, data needs, calibration/validation criteria, recommendations on when to apply a specific integration structure, and an estimation of MRM benefits.	2019-2021	MPOs, State DOTs, Local Agencies, Universities
Develop a prototype technique to demonstrate opportunity and benefit of a comprehensive decision-making Framework which is objective and performance driven, assessing various data sources, including but not limited to crowd sourced data, private data sources, public data sources, data management and TMC outlets, and demonstrating how integrated data from multiple sources and the analysis of that data can influence decisions.	2019-2021	MPOs, State DOTs, Local Agencies, Universities
NEW – Demonstrate how calibration methods included in the Traffic Analysis Toolbox Volume III can benefit the project evaluation process by compiling examples and conducting workshops.	2020-2021	MPOs, State DOTs, Local Agencies
Implementing Operations Strategies		
Develop the capabilities, tools, and guidance to enable more proactive, dynamic, integrated and performance-driven management and operations.	2017-2022	MPOs, State DOTs, Local Agencies
Research and document best practices and conduct targeted outreach and technology transfer to share early deployment lessons learned and to proactively advance the adoption of ATDM and ICM solutions and strategies.	2018-2023	MPOs, State DOTs, Local Agencies
NEW - Develop an ATDM field evaluation methodology framework and support ATDM implementers through a cohort/shadow deployers model.	2020-2022	MPOs, State DOTs, Local Agencies
NEW - Research and document best practices and develop new tools and methodologies for integrating parking management strategies within broader TSMO systems.	2020-2021	MPOs, State DOTs, Local Agencies

NEW – Research and develop broader understanding of ATDM impacts on traveler behavior.	2020-2023	MPOs, State DOTs, Local Agencies
Develop tools and strategies to devise and evaluate remedies to promote congestion management and mitigation under recurring congestion.	2018-2023	MPOs, State DOTs, Local Agencies
Conduct targeted outreach and technology transfer on best practices for improving the usage of managed lanes.	2018-2023	MPOs, State DOTs, Local Agencies
Support and manage the High Occupancy Vehicle (HOV)/Managed Lane and TMC Pooled Fund Studies to advance the state-of-the-practice.	2018-2023	MPOs, State DOTs, Local Agencies
Conduct targeted outreach and technology transfer on best practices and lessons learned to promote and advance the use of automated traffic signal performance measures and Signal Phasing and Timing Applications, and provide assistance and resources to support state and local agency development of Traffic Signal Management Plans. Develop and deliver training that addresses workforce capability and objectives and performance-based approaches to managing traffic signal programs. Incorporate 2018-2019 updates to Model Systems Engineering Guidance for Signal Systems, Automated Traffic Signal Performance Measures, and Adaptive Signal Control to support application of Systems Engineering and ITS Architecture to Traffic Signal Systems.	2017-2021	MPOs, State DOTs, Local Agencies, TRB, ITE, AASHTO, NOCoE
Manual on Uniform Traffic Control Devices (MUTCD)		
NEW – Develop and issue Notice of Proposed Amendments (NPA) for a new edition of the MUTCD and manage rulemaking process.	2019-2020	MPOs, State DOTs, Local Agencies, AASHTO
NEW – Distill public docket comments and develop new edition of the MUTCD.	2020-2021	MPOs, State DOTs, Local Agencies, AASHTO
Manage technical corrections, support the administration of MUTCD statutory requirements, and conduct outreach and implementation support activities.	2018-2023	MPOs, State DOTs, Local Agencies, AASHTO
Support pooled fund studies that contribute to the MUTCD’s development/update.	2018-2023	MPOs, State DOTs, Local Agencies, AASHTO

Statutory Requirements:

Is this program statutorily mandated (Y/N): __Y__

The following statutory requirements apply:

- The program is authorized in title 23, United States Code sections 502 and 503, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas to improve highway safety, better infrastructure integrity, strengthen transportation planning and environmental decision-making, **reduce congestion, improve highway operations and enhance freight productivity**, among others. This research supports areas of research identified in section 503 part (5) Reducing Congestion, Improving Highway Operations, and Enhancing Freight Productivity.
- This program supports implementation of other statutory mandates, specifically, the National Performance Management Measures (23 CFR 490).
- This research also provides administration, evaluation and results dissemination of the Surface Transportation System Funding Alternatives (STSFA) Program, required under Section 6020 of the Fixing America's Surface Transportation (FAST) Act. No administrative funds were provided under the STSFA legislative language, requiring the use of alternative research and deployment funds to support the program.
- The Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) is the national standard for traffic control devices on any street, highway, bikeway, or private road open to public travel, in accordance with 23 U.S.C. §§ 109(d) and 402(a). It is incorporated by reference in 23 CFR Part 655, Subpart F. The MUTCD is administered by FHWA, which issues revisions and updated editions through the Federal rulemaking process. The last edition was published in 2009, with two revisions in 2012.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Infrastructure

FHWA’s TSMO R&T Program primarily supports the Department’s Infrastructure Strategic Goal and offers additional support to the Innovation and Safety goals:

Infrastructure: FHWA’s TSMO R&T Program closely supports the Department’s Infrastructure Strategic Goal. The TSMO Research Program improves system reliability and enhances performance of the transportation system. Particularly, the research supports strategies that focus on operational improvements intended to maintain and, in some cases, restore the performance of the existing transportation system before extra capacity is needed. This may enable transportation agencies to “stretch” their funding to benefit more areas and customers. The TSMO research also helps agencies to balance transportation system supply and demand, provides flexible solutions to match changing conditions, and reduces the need for excess infrastructure capacity during non-peak times.

Finally, it helps agencies make informed decisions about the management of infrastructure related resources, such as snow and ice treatments, and how to plan for future system needs using performance metrics that account for travel conditions on specific route segments and from a systems perspective, including the potential for travel mode shift.

Innovation: TSMO applications rely heavily on technology and innovation, taking advantage of new data sources and advances in consumer applications, as well as innovations in traffic assets, such as traffic signal controllers, sensors, and communication devices.

Safety: TSMO applications often smooth the flow of traffic, which can reduce unexpected congestion that leads to crashes. Through detection and active system management, TSMO can enable system owner-operators to detect congestion, alert drivers of road conditions through traveler information so they are prepared before reaching congestion, and facilitate improved traffic flow in near real-time through strategies such as adjusting signal timing, opening an auxiliary travel lane, or providing alternate route information. Unexpected congestion can particularly be a hazard in rural areas where congestion is not typically present.

USDOT Research Priorities:

The TSMO AMRP addresses several of the DOT research priorities:

- Performance Based Regulations and Safety - Monitoring the national performance measures for the congestion and reliability performance measurement rule (PM3) and developing resources that help State and Local agencies set target that guide investment decision, leads to performance based use of transportation funding to improve the operation of the transportation system.
- Potential Impact of Value Capture - Incorporating private mobility services and alternative business models for new mobility services into transportation leverages the value of private sector providers and services to enable transportation agencies to stretch their resources to meet other transportation system needs.
- Improving the Mobility of Freight – Improving TSMO strategies and helping agencies improve their capabilities for developing and delivering TSMO programs leads to improved operation of the transportation system that improves the mobility of freight.
- Improving Mobility for Underserved Communities – TSMO strategies improve mobility for all system users, including underserved communities. The TSMO Program includes research that specifically addresses how TSMO can best be applied in rural communities, as well as research and technology transfer for private mobility services and alternative business models for new mobility services that often expand options for underserved communities.
- Cybersecurity – The TSMO Program involves many technology and communications systems that can be the target of cybersecurity attacks. Rather than lead efforts in this area, to avoid duplicative efforts the TSMO Program works with leading internal and external partners in cybersecurity to help them incorporate TSMO-related cybersecurity vulnerabilities and strategies into their research efforts. The TSMO Program assists with sharing cybersecurity information with TSMO practitioners.

Research Collaboration Partners:

The input obtained through interactions with partners is considered by program staff as they identify and formulate a program of research and technology initiatives that, in accordance with 23 USC 502(a)(3),

- Is of national significance;
- Delivers a clear public benefit and occurs where private sector investment is less than optimal;
- Supports a Federal stewardship role in assuring that State and local governments use national resources efficiently;
- Meets and addresses current or emerging needs;

- Addresses current gaps in research;
- Presents the best means to align resources with multiyear plans and priorities; or
- Presents the best means to support Federal policy goals compared to other policy alternatives.

Program partners (both government and non-government), benefits derived from partnerships, and partner contributions are summarized below.

Benefits of Partnership and Partner Contributions to FHWA TSMO R&T Program.

Partner Organization	User Perspective on Needs	Industry Perspective	Standard Setting	Field Trials	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Donation of Material or	Funding
State DOTs	X			X	X	X		X	X
MPOs	X			X	X	X		X	X
Local Agencies	X			X	X			X	
Universities and other Research Organizations				X		X	X	X	X
Engineering Associations		X	X				X		
Roadway Technology Developers		X	X	X	X	X	X		
Analysis, Modeling and Simulation (AMS) Developers		X	X		X	X	X		
Information and Data Developers		X	X	X	X	X	X		
AASHTO	X	X	X	X	X	X		X	X
TRB	X	X				X	X		
National Operations Center of Excellence (NOCoe)	X	X					X		
Mileage-Based User Fee Alliance	X	X					X		
National Conference of State Legislatures	X	X					X		
National Association of Development Organizations	X	X				X	X		

Connected and Automated Vehicles

\$5,255,000

Program Description/Activities

The FHWA, in collaboration with the ITS Joint Program Office, other USDOT modes, State and local public agencies, Academia, industry, and other surface transportation stakeholders, will conduct a Connected and Automated Vehicle research program to address the challenges of integrating vehicles with Automated Driving Systems (ADS) with the road infrastructure system. Research in FY 2020 will focus in six major areas: (1) Support Development of Integration Paths for Road Infrastructure and Automated Driving Systems; (2) Roadway and ADS Data Assessment and Data Systems Framework; (3) Transfiguration of the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) for Connected and Automated Vehicles; (4) Enabling Technology for Connected and Automated Vehicles; (5) Cooperative Automated Vehicles; and (6) Next Generation Traffic Management Systems (TMS).

Support Development of Integration Paths for Road Infrastructure and Automated Driving Systems: Efforts will build from the FHWA National Dialogue on Highway Automation that aided the identification of challenges through interactive discussions with stakeholders. This research will advance the conversation about roadway readiness for AV integration and provide Infrastructure Owners and Operators (IOOs) and automation technology developers a collective understanding and tools to jointly move forward together. FY 19 research put into motion the development of a First Stage Concept of Operations to better understand the unique mixed roadway environment under which initial ADS deployment will occur. The next steps are to define and evaluate specific operational scenarios and develop alternative integration scenarios to proactively prepare the roadway environment for the deployment of ADSs. IOOs and ADS developers and manufactures will need to understand the elements of organizational, technological, and roadway readiness from all perspective to identify the nexus needed between ADS and roadway capabilities.

Determining collaborative roadway integration paths will necessitate the need for interaction and coordination among all ADS stakeholders. To support the stakeholders collectively moving forward, FHWA will support ongoing establishment of an ADS stakeholder forum starting with and from existing coalitions. FHWA will assist stakeholders evolve the current coalitions such that the forum evolves to include and support all ADS stakeholders' participation. It is envisioned that the forum as it evolves will inform and guide the national level efforts to research and develop possible paths that can be taken to establish roadway readiness in relation to organizational, technological, and roadway perspectives. The forum will provide a mechanism for all stakeholders to collaborate and coordinate to develop understanding of other perspective such that all perspectives are integrated into a shared vision of ADS integration. It is expected that the forum will facilitate stakeholders share public sector research products and outcomes, catalyze exchange of lessons learned from transportation automation demonstrations and testing, coordinate with other national organizations and agencies to support their education of the public and elected officials, and support and expedite harmonization of relevant national standards and guidance.

An evaluation of alternative integration scenarios will require the development of appropriate test and evaluation tools. It is envisioned that current planning, operations, and automation simulation and modeling tools will form the foundation of the tools need for integration scenario test and evaluation. This research will identify the needs and requirements for Integration Scenarios Test and Evaluation

Tools and work with tool developers to develop prototype tools that AV stakeholders can review and assess regarding usefulness and usability. A set of test integration scenarios will be used to facilitate the stakeholders' assessment that will result in a ranking of the tools. After the tools are ranked, FHWA and the stakeholders will develop an integration scenario test and evaluation plan. The plan will identify the tools that will be used to assess the set of scenarios and the results will be compared to support both an assessment of the tools used and a preliminary assessment of integration scenario alternatives.

As indicated, this new research uses the Concept-of-Operations that establishes a joint vision for initial AV integrations and moves the conversation toward implementation. The implementation facilitated by stakeholder input will be broken down by operational scenarios, integrations scenarios, and proactively understanding readiness in terms of organizations, technology, and the roadway. The objective will be to identify various paths that various stakeholders can take to support their readiness and interface with the readiness of other stakeholders.

Roadway and ADS Data Assessment and Data Systems Framework: Many attendees of the National Dialogue on Highway Automation reaffirmed the need for both static and dynamic data exchanges between the roadway and ADS to facilitate safe and efficient operations. The development of a database of traffic regulations is one example of these data. This research builds off the Work Zone Data Exchange; the Work Zone Data Initiative; and the ADS Operational Behavior and Traffic Regulation Information work, and takes a systems perspective regarding the data needs of ADS and roadways to investigate requirements to support the access and exchange of data. The investigation will identify and define the different data needs in relation to different integration scenarios; assess data element definitions and formats; determine the access and exchange operations; and develop alternative data systems configurations. This research will facilitate stakeholders having the information needed to establish a collaborative understanding of data systems that will increase exchange and access to data that supports AV development and integration.

Transfiguration of the *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)* for Connected and Automated Vehicles. The MUTCD is the national standard for traffic control devices on any street, highway, bikeway, or private road open to public travel, in accordance with 23 U.S.C. §§ 109(d) and 402(a). It is incorporated by reference in Title 23 of the *Code of Federal Regulations*, Part 655, Subpart F. The MUTCD is administered by FHWA, which issues revisions and updated editions through the Federal rulemaking process. The last edition was published in 2009, with two revisions in 2012.

This research has been strategically positioned to support incorporation of AV related issues after a planned update, announced in October 2018, of current technical provisions to address advancements in technology and operational practices. Many of the changes that will be made may address ADS or at least set the stage for additional updates when information on ADS technology is available. National Dialogue attendees identified and described the challenges associated with the lack of uniformity, consistency, and maintenance of traffic control device infrastructure from one State to another and even within the same jurisdiction. Many States have also commented that it will be challenging to maintain traffic control devices to the extent that ADS will rely on them, either exclusively or principally, and that the extent of this reliance is not yet well-understood. This research investigates how the MUTCD and traffic control device maintenance practices might be adapted to accommodate ADS and how ADS can optimize its reliance on traffic control devices and redundant systems that account for a traffic control device that is missing due to knockdown or other event.

Enabling Technology for Connected and Automated Vehicles: The Enabling Technology activity area supports the development of tools and products that will be deployed by IOOs to support testing and evaluation, and eventual deployment of connected and automated vehicles (CAVs) on the Nation's roadways. Analysis, modeling, and simulation (AMS) tools are used by state and local agencies to evaluate operational improvements to their transportation systems. In 2018, FHWA developed an AMS framework that identified the needs and gaps in current capabilities to support the evaluation of CAVs on our roadways. These gaps need to be filled so that our state and local partners can make informed decisions related to the impact of CAVs on today's transportation system and on the opportunities CAVs offer for improved operational strategies. This research builds on work in 2019 to improve modeling capabilities for the operation of CAVs in traffic.

State and local agencies are progressing in the early deployment of connectivity between their transportation systems and the vehicles that operate within. Continued deployments and buy-in from IOOs into connectivity to their transportation systems is one of the foundations to cooperative automated vehicles. FHWA will continue to support State and local agencies in development of interoperable data exchange between vehicles, other road users, and infrastructure based components of the transportation system.

Cooperative Automated Vehicles: Cooperative Automation is the concept of using *shared maneuvers* performed by automated vehicles to address transportation issues, such as work zones, traffic incidents, adverse weather, recurring congestion, etc. Shared maneuvers are enabled by data from other vehicles and intelligent infrastructure. Early work by FHWA indicates that Cooperative Automation can safely improve the efficiency of the road network while reducing fuel consumption. In October 2018, FHWA launched CARMA as an Open Source software platform to develop and evaluate Cooperative Automation concepts and applications. CARMA is created to be vehicle and technology agnostic, and to support industry collaboration and expand on existing automation capabilities to reduce R&D time and advance automated vehicle (AV) technology. In 2019, FHWA acquired light vehicles, and the Federal Motor Carrier Safety Administration (FMCSA) had commercial trucks retrofitted with a CARMA-enabled research-grade ADS, for test and evaluation of applications. In 2020, FHWA, in collaboration with modal partners, IOOs, Academia, and industry, will develop shared maneuver applications that address key transportation issues.

FHWA and the ITS JPO also work cooperatively with automotive original equipment manufacturers (OEMs), through an agreement with the Crash Avoidance Metrics Partners, LLC (CAMP), and with IOOs, through the Connected Vehicle Transportation Pooled Fund Study (CV PFS), to jointly develop, prototype, test, and evaluate cooperative automation of driving automation systems.

Next Generation Traffic Management Systems (TMS): State and local agencies typically operate their traffic management systems (TMS) to meet today's demands and seldom have the opportunity to implement processes that will migrate to the technology innovations and solutions of tomorrow. The rapid advancement in technology, especially in the areas of computing, communications, and automation, may result in outdated TMS technology that is unable to manage the demands of the high-tech components operating within the system. State and local agencies need a process that can support the assessment of all aspects of their current capabilities (e.g., plans, policies, procedures, functions, services provided, performance, platforms and technologies) of their TMSs. This process, when implemented, will allow agencies to plan and take the appropriate steps towards the next generation of TMS that will meet demands imparted by CAVs and other disruptive technologies.

Program Objectives

The Connected and Automated Vehicles research program supports a safe and efficient surface transportation system by developing concepts, tools, and products that will enable the integration of ADS with the road infrastructure system and to collaboratively develop concepts and prototype applications for shared maneuvers by ADS. Specific objectives in FY 2020 include:

- Advance the conversation to facilitate identification of roadway integration paths for Automated Vehicles that includes understanding what stakeholders need to implement to achieve organizational, technological, and roadway readiness.
- Facilitate advancement of testing and evaluation, and data and data system capabilities among stakeholders to achieve collaborative testing, relationship development, and data access and exchange.
- Develop an understanding of the impact of automated vehicles on the operation of traffic signals and other traffic management systems, and impact interactions with law enforcement and first responder traffic incident management activities.
- Develop new traffic management technologies and applications to leverage cooperative automated driving systems.
- Advance analysis, modeling, and simulation tools to support evaluations of the impact of connected and automated vehicles on the road network, and to evaluate transportation systems management and operations concepts and processes.
- Provide technical assistance and guidance to IOOs in the deployment of V2X technologies and the development of new connected infrastructure.
- Develop and test Proof-of-Concept shared maneuver applications for Cooperative Automation that address common traffic issues.
- Identify needs and strategies to improve Traffic Management Systems (TMSs) to address technological changes that will impact traffic.

Key FY20 FHWA Connected and Automated Vehicles R&T Program Activities.

Activity	Period of Performance	Partners/Notes
<p>Support Development of Integration Paths for Road Infrastructure and Automated Driving Systems:</p> <ul style="list-style-type: none"> • Identify elements needed to safely and effectively prepare the roadway system to support the integration of ADS. • Establish a national automated vehicle roadway integration forum to inform and guide national level efforts to research and develop potential paths for integration of ADS and roadways. • Identify needs and requirements for Integration Scenarios Testing and Evaluation Tools. • Develop an integration scenario test and evaluation plan 	2020-2023	Build from the FHWA National Dialogue on Highway Automation and First State Concept of Operations. Partners include State and local agencies, Academia, industry, and other stakeholders.

<p>Roadway and ADS Data Assessment and Data Systems Framework This investigation will identify and define the different data needs in relation to different integration scenarios; assess data element definitions and formats; determine the access and exchange operations; and develop alternative data systems configurations.</p>	<p>2020-2022</p>	<p>AV stakeholders that include Infrastructure owners and operators including traffic engineers, Manufactures including ADS developers, data collectors including data managers and providers.</p>
<p>Transfiguration of the <i>Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) for CAV</i> This research has been strategically positioned to support incorporation of AV related updates to the updates to technical provisions that address advancements in technology and operational practices.</p>	<p>2020-2023</p>	<p>AV stakeholders that include Infrastructure owners and operators, Manufactures, ADS developers, and State and Local traffic engineering stakeholders, AASHTO, National Committee on Uniform Traffic Control Devices (NCUTCD).</p>
<p>Enabling Technology for Connected and Automated Vehicles</p> <ul style="list-style-type: none"> • Develop improved Analysis, Modeling, and Simulation (AMS) capabilities to assess the performance of connected and automated vehicles (CAV). • Conduct Hardware-in-the-Loop (HIL) Proof-of-Concept (PoC) testing to support improved cooperative ADS modeling and simulation benefits assessment for signalized corridors. • Evaluate protocol/transaction alternatives to implement national Electronic Toll Collection (ETC) interoperability 	<p>2018-2023</p>	<p>ITS JPO, IOOs, AMS tool developers.</p>
<p>Cooperative Automated Vehicles</p> <ul style="list-style-type: none"> • CARMA Platform: Develop enhancements to CARMA products for FHWA, FMCSA, MARAD, ITSJPO users. Conduct test and evaluation of CARMA Platform enhancements and develop Prototype Cooperative Automation applications. • CARMA Collaborative: Provide technical support on the use of 		<p>ITS JPO, IOOs, Automotive OEMs, CARMA Collaborative (USDOT modes, Universities, industry, and test facilities).</p>

CARMA Platform by Universities, industry, test facilities, and other users to advance TSMO use case development, prototyping and testing.		
Next Generation Traffic Management Center Develop guidance to support IOOs in assessing the current capability of TMSs, and planning for the next generation of TMSs.		Traffic Management Center Pooled Fund Study (TMC PFS), IOOs

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes. The Connected and Automated R&T Program is a component of the Department’s highway and research development program that is responsive to 23 U.S.C. §§ 503(b)(2) and 503(b)(5). Specifically, the program includes the conduct of research, development, technology transfer, and technical assistance regarding advanced technologies to achieve long-term safety gains, improve highway operations, and enhance freight productivity. In addition, the program directly supports a review and transfiguration of the MUTCD that may be required to support development and deployment of automated driving systems. The MUTCD is the national standard for traffic control devices on any street, highway, bikeway, or private road open to public travel, in accordance with 23 U.S.C. §§ 109(d) and 402(a). It is incorporated by reference in Title 23 of the *Code of Federal Regulations*, Part 655, Subpart F. The MUTCD is administered by FHWA, which issues revisions and updated editions through the Federal rulemaking process.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Innovation

FHWA’s Connected and Automated Vehicles R&T Program primarily supports the Department’s Innovation Strategic Goal and provides additional support for the Safety and Infrastructure Strategic Goals. Collaborating with stakeholders on integrations paths, operational scenarios, and integrations scenarios support implementation on innovative ADS technology that will increase safety and mobility. Developing information regarding data systems to support ADS will advance the deployment of this technology, and will advance the establishment by stakeholders of innovative Information Technology that supports access and exchange of transportation data and information. Using an open source platform to collaboratively develop, test, and evaluate cooperative automation applications that address traffic issues supports rapid prototype and standards development and early deployment. Specific contributions include:

Innovation: The Connected and Automated Vehicles R&T Program will address the disruptive nature of automated vehicle technology by supporting the development of potentially beneficial technologies that are not easily commercialized. The program will identify opportunities where Federal leadership is critical to leverage advances by industry and extend the emerging

capabilities of automated vehicles to improve safety, mobility, and the infrastructure in ways that benefit the public.

Safety: Rapidly advancing connected and automated vehicle technologies have the potential to dramatically reduce the number of crashes with fatalities or serious injuries. The Connected and Automated Vehicles R&T Program will support improvements in safety by developing and testing concepts for shared maneuvers by automated vehicles that can improve response to hazardous conditions such as emergency stops caused by leading vehicle movement. The Connected and Automated Vehicles R&T Program also supports efforts by public agencies to deploy connected vehicle infrastructure.

Infrastructure: The Connected and Automated Vehicles R&T Program supports informed, performance-based infrastructure investments through research that will inform infrastructure owners and operators regarding infrastructure design practices that may improve the operation of automated vehicles. This potential must be assessed and opportunities to incorporate infrastructure improvements identified so that stakeholders can make sound investment decisions. The program will also develop, test, and evaluate transportation systems management and operations (TSMO) strategies that use technology and data to improve roadway operations.

Rural Impact: Traffic issues, such as work zones, incident response, adverse weather, recurring congestion, etc., occur throughout the Nation's surface transportation system including freeways and arterials, urban and rural roads. The concepts, tools, and products developed under the Connected and Automated Vehicles research program are directed at addressing traffic issues on all roads. The program closely collaborates with IOOs and industry to provide for rapid prototyping and development of solutions and to support investment decisions by State and local agencies.

USDOT Research Priorities:

- **Improving the Mobility of Freight:** The collaborative development of Cooperative Automation applications to enable shared maneuvers is responsive to discussions between IOOs, OEMs, and ADS developers regarding solutions to traffic issues such as recurring congestion, work zones, traffic incident response, adverse weather, etc. Shared maneuvers by ADS equipped vehicles holds the promise to improve traffic flow, reduce congestion, and improve the reliability and predictability of travel. This will aid freight operations managers in scheduling freight movements and deliveries, and will also provide improved travel reliability for individuals.

Research Collaboration Partners:

The Connected and Automated Vehicles research program collaborates internally and externally to develop and conduct research activities. The input obtained through these interactions is considered by program staff as they identify and formulate a program of research and technology initiatives that, in accordance with 23 USC 502(a)(3),

- Is of national significance;
- Delivers a clear public benefit and occurs where private sector investment is less than optimal;
- Supports a Federal stewardship role in assuring that State and local governments use national resources efficiently;
- Meets and addresses current or emerging needs;
- Addresses current gaps in research;

- Presents the best means to align resources with multiyear plans and priorities; or
- Presents the best means to support Federal policy goals compared to other policy alternatives.

Benefits of Partnership and Partner Contributions to FHWA Connected and Automated Vehicles R&T Program.

Partner Organization	User Perspective on Needs	Industry Perspective	Standard Setting	Field Trials	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Donation of Material or Services	Funding
State Departments of Transportation (DOTs)	X		X	X	X	X	X		
AASHTO, including (IOO/OEM) Forum	X	X		X	X	X	X	X	
Cooperative Automated Transportation (CAT) Coalition	X	X		X		X		X	
Society of Automotive Engineers (SAE)		X	X			X	X	X	
ITS America	X	X							
U.S. Army Aberdeen Test Center (ATC)				X			X	X	
Federal Law Enforcement Testing Center (FLETC)				X					
Universities, including UTCs						X	X		
Connected Vehicle Pooled Fund Study (CV PFS)	X				X			X	X
Partner Organization	User Perspective on Needs	Industry Perspective	Standard Setting	Field Trials	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Donation of Material or Services	Funding
Automotive OEMs, including CAMP	X	X	X	X	X	X	X		X
Automated System Developers	X	X	X	X	X	X	X	X	
Institute of Transportation Engineers (ITE)	X			X	X	X		X	
Transportation Research Board (TRB)	X						X	X	

Testing Facilities				X		X	X	X	
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Managing Disruptions to Operations

\$2,537,000

Program Description/Activities/Objectives:

Program Description

Management of disruptions associated with non-recurring events (e.g., work zones, traffic incidents, planned special events, or adverse weather) is a significant and specialized aspect of transportation management. Disruptions to transportation system operations result in significant impacts on safety and mobility and pose management challenges not present in “stable state” systems where congestion is predictable and recurring demand patterns can be relatively easily identified. The disruptive nature of non-recurring events presents specific, significant risks in terms of personal and economic consequences, and present huge demands on system owners and operators. Non-recurring events account for about half of all the delays, create conditions that are associated with a higher risk of dangerous crashes, and contribute to unfavorable public perception regarding the capability of Infrastructure Owner/Operators (IOOs) to manage public investment in infrastructure.

Ensuring organizational preparedness to deal with non-recurring events – and associated disruptions to transportation operations – demands specialized attention to the following:

1. understanding disruptive events in the context of their impact on overall transportation system specially safety and operations,
2. strategies to better understand or predict where and when these events are occurring,
3. effective strategies and countermeasures to mitigate disruptions, and
4. processes to assess the effectiveness of strategies for consideration in future improvements.

Non-recurring events can introduce significant variability in operations through a combination of surge demand, capacity reduction, or increased navigational difficulty. Unplanned nonrecurring events such as incidents or weather occur suddenly and demand a rapid change in driver behavior with little advance notification. Even events such as work zones or special events can impart uncertainty into transportation system management, with variations in event start time, duration, and level of impact not always being precisely understood or conveyed among various stakeholders.

Response strategies for disruptive events involve a broad range of stakeholders and touch an equally broad range of applications within the transportation management workflow, some of which are highlighted as follows:

- IOOs who own and manage transportation systems are expected to manage disruptions on their facilities to minimize the impact to the traveling public. Accordingly, allocation of resources to manage disruptions from non-recurring events is an important internal function within transportation agencies. The need for active management of disruptions in real time is further amplified by the anticipated deployment of connected and automated vehicles in the traffic fleet where any disruption of expected operating conditions poses significant operational challenges.
- Research institutions and similar organizations play a significant role in quantifying the influence of non-recurring events and working in partnership with IOO-led coalitions to advance strategies and countermeasures. The Managing Disruptions for Operations program seeks improved processes for collection of real-time or historical information on non-recurring events to conduct studies or assist IOOs in development of strategies and countermeasures and in performance management activities.

- Industry, such as automobile Original Equipment Manufacturers (OEMs) and traffic control device manufacturers, are cooperative participants with IOOs in developing products that facilitate transportation management functions. Industry representative organizations have advocated for a federal role in guiding the development of improved technology to encourage a competitive market environment for developing these products.
- Other private sector entities, such as data aggregators or digital map providers, serve as a bridge to enhance public accessibility of information used by Transportation Management Centers (TMCs). This model can be extended to improve traveler information functions.

Despite all the challenges that this dynamic environment creates, public agencies continue to make great advancements to minimize these impacts, especially in the form of proactive management strategies (e.g., decision support systems) and enhanced institutional capabilities. FHWA and its partners are uniquely positioned and play a pivotal role in the development, test, and evaluation of these systems and strategies, as well as through tireless knowledge and technology transfer efforts that enable these operating agencies to improve both their performance and the performance of the transportation system as a whole (i.e., in coordination with the private sector). While some of these products are mature, and require only minimal resources to maintain currency, others are still amid development and require significant levels of funding (e.g., the Integrated Model for Road Condition Prediction that integrates weather, work zone, traffic and incident models to predict road conditions hours into the future). New research and development needs will emerge as the vehicle fleet changes. And the need for extensive coordination across external partners (e.g., the various incident management disciplines), as well as the need for the aforementioned knowledge and technology transfer materials, are expected to continue for the foreseeable future in order to maintain current or improved level of system efficiency. Work is also needed to account for both long-term and catastrophic impacts, ensuring the system is resilient to impacts such as the increasingly common extreme weather events, cybersecurity threats, and natural disasters.

The scope of the program is broad, starting with applied research (from concept development to field testing and evaluation) and continuing through all the training, outreach and coordination necessary to ensure successful implementation by the operating agencies. The work is done through extensive coordination between the Office of Operations, the ITS Joint Program Office, the Office of Operations R&D, as well as with the Office of Safety, the Office of Infrastructure, and the Office of Safety R&D. Work on climate resilience is done in close coordination with the Office of Environment, Planning and Realty, and the Office of Policy.

Managing Disruptions to Operations focuses on those operating conditions that present distinct challenges to our public-sector partners (especially State DOTs). This work is closely coordinated with other research and technology priorities. Continuous and extensive collaboration across offices ensures that the efforts complement each other and there is no duplication. In particular, this work ties to the following cross-cutting priorities:

- Non-recurring events present the most challenging environments under which automated vehicles travel. Work under this program will both inform and learn from the research conducted in this cross-cutting area. In addition, this work will help to better understand any new requirements that automated vehicles may put upon the system and the system owners (e.g., special pavement markings through work zones). The challenges and opportunities for the incident responder community is unknown at this point but warrants responder-focused research.

- The data needs surrounding these non-recurring events go above and beyond the standard elements, and consequently require targeted resources to identify these unique data types, determine how to collect and process the data to make it useful, and how to use the data to better predict how these disruptions will affect highway operations (and, by extension, how transportation system operators can use them to better manage the system.) Data collection, crowd sourcing, and big data work already underway reflect the potential for significant opportunities for more efficient incident mitigation, weather events, and work zones through real time and predictive decision-making. There is also strong potential in using data to interact with vehicles during disruptions.
- The efforts to be conducted under this program area will achieve both safety and efficiency goals as the two are inextricably linked. In addition, the program will address longer-range resiliency issues as they pertain to operations and maintenance. To date, resource materials have been developed to introduce operating agencies to the concepts of climate resilience, and work will continue to inform them on actions they can take to better prepare for these types of disruptions.

Safety, Durability and Resiliency of Transportation Systems

There are some program dependencies and ongoing research:

- The extent to which connected and automated vehicles put new demands on the operating and responder agencies, particularly under disruptive conditions (i.e., through work zones, during incidents, under adverse weather) will drive the need for new approaches to effective management of non-recurring events.
- The availability of open data from connected and automated vehicles will significantly affect the success of advanced management tools.
- The willingness and ability of public agencies to share data (e.g., work zone activity data, road weather data, and crash data) will significantly affect the success of advanced management tools.

Program Objectives

- Understanding the operational impacts of these disruptions enables the development of predictive and real-time decision support systems that facilitate proactive operations and maintenance.
- Comprehending the opportunities that connected and automated vehicles present to better manage disruptive events (e.g., using connected vehicle data to track vehicles through work zones or using automated vehicle data to feed into block-level road weather forecasting), as well as to inform system owners of the actions they need to take to enable these vehicles to navigate through these difficult environments.
- Ensuring coordination across all the agencies that play a part in roadway safety and mobility (DOTs, law enforcement, fire, emergency medical services (EMS), etc.)
- Building the capability and capacity of operating agencies to optimize safety and system performance through the implementation of the capability maturity models for disruptive events.
- Understanding of the most effective messages to disseminate to the traveling public to educate and ultimately change driver behavior under these disruptive events.
- Provide necessary specialized expertise in Work Zone Management, Road Weather Management, Traffic and Incident Event Management to ensure proper integration of non-

recurring events in digital infrastructure supporting advanced transportation management functions as well as Connected and Automated Vehicles (Safety/Automation, Innovation/Enabling Technologies, Accountability/Deployment, Accountability/Data)

- In cooperation with IOOs and other national partners, establish consensus for national requirements and framework for Data Supporting Operations for Non-Recurring Events to encourage private sector innovation and development of technology within the scope of that framework (Infrastructure/Economic Competitiveness)

Key FY20 FHWA Managing Disruptions to Operations R&T Program Activities.

Activity	Period of Performance	Partners/Notes
Road Weather Management		
Develop tools, guidelines and strategies to enable more effective system management under adverse weather, including use of road weather data, standards, and weather-responsive decision support tools that build upon vehicle-based technology advancements and effectively change driver/operator behavior.	2020-2022	Intelligent Transportation Systems Joint Program Office (ITS JPO), American Association of State Highway and Transportation Officials (AASHTO)/State DOTs, private sector, Data Standards Organizations
Develop and apply performance measures and analysis tools for road weather management and develop strategies that consider resilience and long-term changes in weather trends.	2020-2022	AASHTO, State DOT's, Office of Environment and Planning, Private Sector, TRB, NOAA
Conduct targeted outreach and T2 of RWM products (i.e., VDT, IMRCP, WDE), reach out to various stakeholders (via Road Weather Management, Weather responsive management systems, Pathfinder and integrated mobile observations (IMO) Stakeholder meetings, regional roundtables, website, webinars), develop/deliver NHI RW courses, and support pooled fund programs and peer exchanges on RWM (Aurora, Clear Roads, TRB, AASHTO)	Ongoing	ITS JPO, Division Offices, Resource Center, AASHTO, State DOT's, Local Agencies, Pooled Funds, TRB, NOAA
Traffic Incident and Event Management		
Capture and use multi-discipline crash and responder fatalities and injury data, and integrate it with emerging technology connected and automated vehicle and other technologies (e.g., integrated Computer Aided Dispatch, Unmanned Aircraft Systems) to meet responders' needs and improve incident response and safety	2019-2022	State DOT's, Police and Fire agencies, private sector, NHTSA, FMCSA, International Association of Chiefs of Police, Federal Law Enforcement Training Center (DHS), Public safety community
Promote continued deployment of state and local traffic incident management (TIM) programs including continued capacity building and program maturity through extensive coordination across the TIM community, continued engagement with senior leaders through the executive leadership group.	Ongoing	State DOT's, NHTSA, FMCSA, Metropolitan Planning Organizations (MPOs), Towing and Recovering Association of America, Public safety community
Work Zone Management (WZM)		
Advance work zone management by focusing on work zone data collection, developing related analysis tools, and application of performance measures to promote	2020-2022	AASHTO/State DOTs, private sector

data driven decision-making and consideration of vehicle-based and other technology advancements.		
Analyze increase in work zone crashes, fatalities, and injuries and its impact on operations. Develop strategic plan and execute it, identify best practices, and conduct WZM research to reduce work zone impacts. Manage work zone grants to ensure products are effective and meet stakeholders' needs.	2020-2022	AASHTO/State DOTs, FMCSA, NHTSA, MPOs, American Road and Transportation Builders Association (ARTBA), American Traffic Safety Services Association (ATSSA), academia
Advance WZM state-of-the-practice through a range of stakeholder engagement activities that focus on gaps in implementation (e.g., commercial motor vehicle safety in work zones, state-specific Capability Maturity Framework and targeted engagement workshops, process reviews, regional round tables, etc.)	Ongoing	AASHTO/State DOTs, private sector, academia
Data System Framework for Non-Recurring Events		
Leverage prior efforts in developing data management platforms for non-recurring events (including the Work Zone Data Initiative & Work Zone Data Exchange, the Road Weather Data Environment, and TIM data strategies information on work zones) to assist development of an operational framework to address management of disruptions from non-recurring events in the context of traditional and emerging transportation management business processes. Technical assistance will be provided to assist IOO-led coalitions in further development and in deploying this framework in stakeholder workflows and integration with enterprise information systems.	2020 - 2022	Intelligent Transportation Systems Joint Program Office (ITS JPO), American Association of State Highway and Transportation Officials (AASHTO)/State DOTs, Standards Development Organizations, private sector

Statutory Requirements:

Is this program statutorily mandated (Y/N): Y

- The program is authorized in sections 502 and 503 of title 23, United States Code, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas to improve **highway safety**, improve infrastructure integrity, strengthen transportation planning and environmental decision-making, **reducing congestion**, and enhancing freight productivity, among others.
- This program supports implementation of other statutory mandates, specifically, Work Zone Safety and Mobility Rule (23 CFR 630 Subpart J), the Temporary Traffic Control Devices Rule (23 CFR 630 Subpart K), and the National Performance Management Measures (23 CFR 490).
- The Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) is the national standard for traffic control devices on any street, highway, bikeway, or private road open to public travel, in accordance with 23 U.S.C. §§ 109(d) and 402(a). It is incorporated by reference in 23 CFR Part 655, Subpart F. The MUTCD is administered by FHWA, which issues revisions and updated editions through the Federal rulemaking process. The last edition was published in 2009, with two revisions in 2012.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation

FHWA’s Managing Disruptions to Operations R & T Program supports the Department’s Safety, Infrastructure and Innovation Strategic Goals. Specific contributions are as follows.

Safety: The Managing Disruptions to Operations Program contributes to highway safety by providing tools, technologies/devices, resources, and training to minimize safety impacts (crashes, fatalities, injuries) of road construction, adverse weather, and traffic incidents on all road users including highway workers and emergency responders. The Manual on Uniform Traffic Control Devices improves safety by ensuring consistent use of traffic control devices in a way that accommodates road user expectancy. Additionally, program activities include various outreach, training and technology transfer activities to educate the practitioners and the public about the safety impacts of non-recurring events and how they can alleviate those impacts.

Infrastructure: The Managing Disruptions to Operations Program supports this goal by ensuring impact of these disruptions are appropriately considered during life cycle cost analysis and other infrastructure investment analysis and decisions. Rebuilding our infrastructure, including traffic control devices, must be done in a manner that minimizes the impacts to those who rely on the system every day. This program area finds that balance between reconstruction, safety, and mobility.

Innovation: The Managing Disruptions on Operations Program supports this goal by undertaking research and development in the areas of connected and automated vehicles; data driven technologies and decision-making; experimentation of novel traffic control devices, and safety, durability, and resiliency of transportation systems. This effort is vital to improving the state-of-the-practice and mitigating impacts resulting from road construction, adverse weather, and traffic incidents.

USDOT Research Priorities:

- The Managing Disruptions to Operations Program will promote performance based approach to improving safety of non-recurring events (incidents, work zones, adverse weather conditions). Research will be conducted in areas of crash causation, analytical techniques, and mitigating strategies.
- The Managing Disruptions to Operations Program will address asset recycling in the Data Supporting Operations for Non-Recurring Events activity through integration of I2x technologies that register the presence of crucial infrastructure assets such as sensors, traffic control devices, or integrated mobile data collection units as resources that may be repurposed for related applications (e.g., temporary utilization of a work zone Portable Changeable Message Sign by first responders to convey traffic control information during incidents near highway construction zones).

- The Managing Disruptions to Operations Program will address freight mobility by promoting the development of information resources for non-recurrent events to provide necessary information to freight management systems that assist with functions such as dispatch and routing of freight.
- The Managing Disruptions to Operations Program will address cybersecurity concerns in deploying non-recurrent event related data resources and communication of this data across various platforms.

Research Collaboration Partners:

The input obtained through these interactions is considered by program staff as they identify and formulate a program of research and technology initiatives that, in accordance with 23 USC 502(a)(3),

- Is of national significance;
- Delivers a clear public benefit and occurs where private sector investment is less than optimal;
- Supports a Federal stewardship role in assuring that State and local governments use national resources efficiently;
- Meets and addresses current or emerging needs;
- Addresses current gaps in research;
- Presents the best means to align resources with multiyear plans and priorities; or
- Presents the best means to support Federal policy goals compared to other policy alternatives.

Benefits of Partnership and Partner Contributions to FHWA (Managing Disruptions to Operations).

Partner Organization	User Perspective	Industry Perspective	Standard Setting	Field Trials	Deployment	Research Collaboration	Specialized Expertise or	Donation of Material or	Funding
American Association of State Highway and Transportation Officials (AASHTO)	X		X		X				
American Road and Transportation Builders Association (ARTBA)		X			X				
American Traffic Safety Services Association (ATSSA)		X			X				
State DOTs	X			X	X				X
International Association of Chiefs of Police (IACP)	X	X		X	X		X		
Towing and Recovery Association of America (TRAA)	X	X			X		X		
National Ocean and Atmospheric Administration (NOAA)					X	X			
National Volunteer Fire Council (NVFC)	X	X			X				

Transportation Research Board (TRB)	x					x			
American Public Works Association (APWA)	x	x		x	x	x	x		
Institute of Transportation Engineers (ITE)	x	x	x		x	x	x		
American Trucking Associations (ATA)	x	x			x	x	x		
Owner Operator Independent Drivers Association (OOIDA)	x	x			x	x	x		
American Meteorological Society (AMS)	x	x					x		
National Weather Association (NWA)	x						x		
National Transportation Safety Board (NTSB)	x						x		
Federal Motor Carrier Safety Administration (FMCSA)	x				x	x	x		
National Highway Traffic Safety Administration (NHTSA)	x						x		
Occupational Safety and Health Administration (OSHA, within Department of Labor)	x						x		
Society of Automotive Engineers (SAE International)	x	x				x	x		
Metropolitan Planning Organizations (MPO)	x				x				

Freight Management and Operations RD&T Program

\$3,080,000

Program Description/Activities/Objectives:

Program Description

Highway mobility and reliability affect our ability to visit family, get to work, deliver products to customers, live our lives, and grow the economy. FHWA's Office of Operations Freight Management and Operations Research, Development and Technology (RD&T) Program is developing innovative technology and processes that lead to system-wide improvements in how FHWA and its State and local partners and other stakeholders manage and increase the reliability of the National Highway System and the movement of people and goods throughout the transportation networks.

These innovations target the daily operations of transportation agencies and other stakeholders, and their planning for operations. Freight Management and Operations RD&T Research areas include performance management, efficient goods movement that enable freight to move where and when it needs to go, active transportation and demand management strategies, resources for transportation management and operations (TSMO) for scheduled or unscheduled events, and improved traffic analysis techniques. Research into new technologies and noteworthy management practices provide State and local agencies and other operations and freight entities with additional tools to implement the institutional changes that will allow them to meet operational challenges.

Program Objectives:

Moving goods safely and efficiently requires strategically located, adequate, and physically sound infrastructure along with efficient organization capabilities to support them. Within DOT, FHWA is aiming to promote a performance-based approach to transportation project delivery and management. The Freight Management and Operations RD&T Program addresses multiple needs both for DOT and for external stakeholders and leads to enhanced freight data and models that facilitate performance-based, data-driven analysis and decision-making, helping stakeholders more effectively incorporate freight infrastructure considerations into transportation planning and project development.

The objectives of the Freight Management and Operations RD&T Program include:

- assessing the condition and performance of key freight infrastructure.
- improving the understanding of the impact of freight movement on this infrastructure and vice versa.
- developing and bettering freight data analytical tools and data collection techniques and standards, and industry data analysis methods
- initiating stakeholder forums and outreach, peer exchanges, pilot implementations, and technology transfer to help ensure safe, durable, and high performing infrastructure.

These include initiatives focused on:

- improving of supply chain information representation into freight planning and modeling, by incorporating, industry dynamics, economic impacts, and commodities moved.

- enhancing the integration, standards, and consistency among public and private multimodal freight data sources, including accessing more timely data to accurately represent dynamic freight movements on the transportation network.
- bettering the understanding of local, regional, and national freight flows, including enhancements to the Freight Analysis Framework, through a sounder comprehension of freight data limitations and private industry constraints.
- understanding how freight flows impact the transportation system condition and performance to help support transportation performance management requirements and system planning research.
- assessing freight infrastructure requirements and demands by analyzing truck parking needs, identifying rural freight transportation issues, and designating critical urban and rural intermodal connectors.
- developing tools for integrating resiliency considerations into freight transportation planning, asset management, and project development. (Resiliency focuses on freight transportation system ability to move goods in the face of one or more major obstacles, such as extreme weather events, major accidents, and equipment or infrastructure failures.) Initiatives include identification of alternative truck routes and redundant facilities, implementation of USDOT Emergency Route Working Group recommendations, and continued coordination on truck parking issues.

Key FY20 FHWA Freight Management and Operations RD&T Program Activities.

Activity	Period of Performance	Partners/Notes
Industry Supply Chain and Economics Impacts	2016-2020	TRB/SHRP2
Freight Movement Data Integration	2015-2023	BTS
Freight Flow Model Improvements	2015-2023	BTS/TRB/SHRP2
Freight System Conditions and Performance Management	2016-2023	FHWA Offices of Operations and Infrastructure (HOTM and HIF)
Freight Infrastructure Needs Identification and Analysis	2016-2023	FHWA Office of Planning (HEPP)

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes. of Title 23, United States Code sections 502 and 503 authorizes this program, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topics to improve highway safety and infrastructure integrity, strengthen transportation planning and environmental decision-making, reduce congestion, and enhance freight productivity, among others.

In addition, the Fixing America’s Surface Transportation (FAST) Act established a National Highway Freight Program (NHFP) (FAST Act § 8001: 23 U.S.C. 167) along with a National Highway Freight Network (NHFN).

The FAST Act includes several provisions to enhance the national freight network condition and performance and to back freight-related surface transportation projects investment, including:

- establishing a National Freight Strategic Plan [49 U.S.C. 70102] in consultation with State DOTs, MPOs, and other appropriate public and private transportation stakeholders.
- launching a National Multimodal Freight Network [FAST Act § 8001: 49 U.S.C. 70103], to assess and support Federal investments to achieve the goals of both the National Multimodal Freight Policy established in 49 U.S.C. 70101 and of the National Highway Freight Program described in 23 U.S.C. 167.
- developing transportation investment data and planning tools [FAST Act § 8001: 49 U.S.C. 70203], requiring stakeholder-engaged efforts to: 1) create new tools and enhance existing instruments to support freight-related projects evaluation, 2) identify model freight data elements and sound evaluation methods to make transportation investment decisions, and 3) enrich freight demand forecasts and existing freight flow data collection efforts to reduce data gaps. .
- producing a Congressionally mandated biennial DOT National Highway Freight Network conditions and performance report [FAST Act § 1116; 23 U.S.C. 167(h)].

The Freight Management and Operations RD&T Program supports FAST Act NHFP-related goals and requirements and national policy on National Multimodal Freight Network condition, safety, security, efficiency, productivity, resiliency, and reliability.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation

Safety: The Freight Management and Operations RD&T Program strives to better understand and improve safe goods movement on the highway system.. These activities include:

- coordinating and investigating truck parking issues.
- researching freight transportation system resiliency through initiatives such as implementation of the USDOT Emergency Route Working Group recommendations.
- bringing together FHWA colleagues on safety and resiliency areas impacting freight, including the Office of Transportation Operations Road Weather and Workzone Management and the Traffic Incidents and Event Management Teams, Office of Transportation Management, Office of Infrastructure, Office of Planning, and Office of Safety.

The Freight Management and Operations RD&T Program will also continue to work with other USDOT modal agencies, such as MARAD, FRA, NHTSA, and FMCSA, and other stakeholders, such as the National Coalition on Truck Parking, the Emergency Route Working Group, and Transportation Research Board (TRB) to identify opportunities to investigate freight transportation safety. This program is particularly applicable to rural areas where the freight transportation network is more susceptible to weather or other disruptive events and alternate routes are less available to trucks.

Infrastructure: The Freight Management and Operations RD&T Program seeks to better the highway system physical components - including roads, bridges, pavement, parking facilities, and other elements - that support goods movement. This research area strives to better grasp how freight movement impacts—and is impacted by—this infrastructure.

The Freight Management and Operations RD&T Program also seeks to assess the condition and performance of key freight infrastructure, and to provide resources that permits States and other stakeholders to incorporate freight infrastructure improvement projects into transportation program delivery. Objectives include ensuring safe, durable, and high performing infrastructure, as well as identify solutions to mitigate or address the impacts of freight transportation.

Innovation: The Freight Management and Operations RD&T Program seeks to improve the reliability of travel and freight movement on the Nation's transportation systems by working with State DOTs and other stakeholders to identify data sources and models to assess overall system reliability. The Freight Management and Operations RD&T Program seeks to improve the ability to measure current and future conditions and operation of the freight transportation network through the incorporation of more accurate, real-time, and localized freight data. These activities include improvements to:

- data collection methodologies (e.g., data sharing collaboration with industry and dynamic freight data collection and analysis)
- travel demand models (e.g., incorporating urban and rural freight movements and improvements to the accuracy and scale of the freight flows along the transportation network)
- strategies to facilitate public-private sector data coordination and sharing (e.g., facilitating peer exchanges and stakeholder outreach)
- freight-focused performance measures (e.g., incorporating reliability, economic impacts/costs, freight investment analysis, etc.)

The Freight Management and Operations RD&T Program will also enhance freight data resources, such as the Freight Analysis Framework (FAF), which provide national level freight flows and projections critical to understanding the impact of freight movement on the transportation network.

USDOT Research Priorities:

Improving the Mobility of Freight - The Program identifies and supports the adoptions of innovative approaches to freight planning, freight infrastructure funding and development, and freight data collection and maintenance to enhance the movement of goods and support economic competitiveness. It supports research to assess the condition and performance of key freight infrastructure and develop and improve analytical tools, data collection techniques and standards, and industry data analysis methods. It develops information and tools for efficient permitting and enforcement systems to harmonize oversize and overweight permitting requirements across states.

Research Collaboration Partners:

Operations and freight programs have developed internal and external stakeholder groups or leveraged stakeholder associations to engage the various transportation and program area communities and modal partners in gathering input through methods such as in-person meetings, peer exchanges, virtual meetings, or web-based events. Examples of these collaboration initiatives are: DOT policy and ongoing research to help inform the Freight Management and Operations RD&T Program. For example, the draft National Freight Strategic Plan (NFSP) documented the need for improved

freight infrastructure to ensure efficient, safe, and reliable goods movement. The NFSP calls for research to review and evaluate the condition of National Highway System (NHS), Outside DOT, related research efforts include National Cooperative Freight/Highway Research Program (NCF/HRP).

- Ongoing USDOT research in this area includes continuation of Exploratory Advanced Research (EAR) Projects, as well as several efforts focused on freight performance measures and innovations in freight data collection, analysis, and dissemination.
- FHWA is also supporting follow-up activities to improve the utility of freight data and behavior-based freight modeling innovations and effective practices as part of the Second Strategic Highway Research Program (SHRP2) C20 suite of products.
- The Freight Operations RD&T Program builds on current and future research to improve the Freight Analysis Framework (FAF) in coordination with US DOT Bureau of Transportation Statistics (BTS). It also incorporates new approaches to economic and supply chain effects as identified from the SHRP2 C20 product and the FHWA Freight Fluidity initiative.
- Other USDOT research includes work to develop new, nationally focused port performance data and metrics as part of the BTS Port Performance Freight Statistics Program (PPFSP). The PPFSP is a FAST Act requirement and involves producing an annual report.
- The Multimodal National Freight and Passenger Analysis and Modeling Program is a joint effort between the FHWA Offices of Operations, Planning, and Policy (HOFM, HEPP, and HPPI). This program has three key components: passenger data, freight data, and network data. The passenger data component is part of the Office of Policy's overall support data program. Freight data is carried out by the Office of Operations' Freight Management and Operations Office. The multimodal routable network, which enables integrated analysis will be developed by the Office of Planning.
- The Performance Management Data Program (PMDP) is a joint effort with the Office of Infrastructure (HISM). It provides States and MPOs assistance (project planning and performance measurement requirements), completing the analytical elements of the State Freight Plans, and undertaking performance management and system planning. These include the Freight Analysis Framework (FAF), the Fluidity Analysis and Supply Chain and Cost Surveys, and data for Domestic Transport of International Trade.
- FHWA is finalizing research to update a 2015 Jason's Law truck parking survey/analysis to better understand where truck parking shortages exist and tactics to address these shortages. Specifically, Jason's Law requires the US DOT to conduct a survey and comparative assessment in consultation with relevant State motor carrier representatives to 1) evaluate the capability of [each] State to provide adequate parking and rest facilities for commercial motor vehicles engaged in interstate transportation; 2) Assess the volume of commercial motor vehicle traffic in [each] State; and 3) Develop a system of metrics to measure the adequacy of commercial motor vehicle parking facilities in each State. An update of the Jason's Law Survey is expected in 2019.
- The FHWA Office of Transportation Operations Road Weather Management Program seeks to better understand the safety, mobility, and reliability impacts of weather on roadways and promote strategies and tools to mitigate those impacts. Freight and trucking considerations are included in this program.

- The FHWA Office of Transportation Operations Traffic Incident and Events Management Program is a multi-disciplinary process to detect, respond to, and clear traffic incidents so that traffic flow may be restored as safely and quickly as possible. The Traffic Incident Management (TIM) Program of the Federal Highway Administration (FHWA) is part of a larger all-hazards program called Emergency Transportation Operations (ETO). The FHWA ETO team contributes to major program initiatives tied to FHWA and US DOT Strategic Implementation Plans. Major Initiatives related to this include TIM Performance Metrics, basic guidance for State and local TIM programs in promoting safe, quick clearance process and laws, and guidance on developing or improving Service Patrols.
- The U.S. Department of Transportation Organizing and Planning for Operations Program supports the integration of Transportation Systems Management and Operations (TSMO) strategies into the planning process and transportation organizations for the purpose of improving transportation system efficiency, reliability, and options. This program is led by the FHWA Office of Operations and Office of Planning, Environment, & Realty of the Federal Highway Administration (FHWA) in coordination with the Federal Transit Administration (FTA), which work with metropolitan planning organizations, State and local departments of transportation, transit agencies, and other organizations to maximize the performance of existing infrastructure through multimodal and multi-agency programs and projects. Freight and trucking considerations are included in this program.

Benefits of Partnership and Partner Contributions to FHWA Freight Management and Operations RD&T Program.

Partner Organization	User Perspective on Needs	Industry Perspective	Deployment	Research Collaboration	Specialized Expertise or	Funding
American Association of State Highway and Transportation Officials (AASHTO)	X			X		X
State Departments of Transportation	X		X	X	X	X
Metropolitan Planning Organizations (MPOs)	X		X	X		
Research and Educational Institutions, such as Massachusetts Institute of Technology (MIT), Texas A&M Transportation Institute (TTI), Oak Ridge National Laboratories, etc.			X	X		
Transportation Research Board (TRB)			X	X		
Trade Corridors Coalitions, such as I-95 Corridor Coalition, North America's Corridor Coalition (NASCO)	X	X	X	X	X	X
American Trucking Associations (ATA), including American Transportation Research Institute (ATRI)	X	X	X	X	X	
Owner-Operator Independent Driver Association (OOIDA)	X	X		X	X	

National Association of Truck Stop Operators (NATSO)	X	X		X	X	
Commercial Vehicle Safety Alliance (CVSA)	X	X		X	X	
Other DOT partners, including Bureau of Transportation Statistics (BTS), Maritime Administration (MARAD), Federal Motor Carrier Administration (FMCSA), Federal Railroad Administration (FRA), etc.	X	X	X	X	X	X
Department of Commerce (including U.S. Census)	X			X	X	
Department of Agriculture	X			X	X	
Department of Energy	X			X	X	

Truck Size and Weight RD&T Program

\$997,000

Program Description

The Truck Size and Weight (TSW) Research, Development and Technology (RD&T) Program will provide States and other stakeholders with information needed to create safe and efficient systems to ensure fluid freight movement across State borders. Activities will include research on effective truck size and weight data use across States and supporting States in harmonizing oversize and overweight (OS/OW) permitting requirements.

In addition, through the Truck Size and Weight RD&T Program, the FHWA Office of Operations (HOP) is supporting TSW-related research in other FHWA offices, including the Office of Highway Policy Studies (HPTS) and Office of Infrastructure (HIAP and HIPT) joint venture to develop a pavement distress evaluation model and the HPTS's current work to create disaggregating vehicle miles travelled (VMT) tools based on vehicle classifications, vehicle weight groups, vehicle registered weight, and vehicle operation weights.

Program Objectives:

The Truck Size and Weight RD&T Program will develop roadmaps and syntheses, improved analytical tools, resources, best practices, stakeholder forums and outreach, peer exchanges, and pilot implementations. The possibility of longer or heavier trucks on highways requires research on how these alternative truck configurations will affect freight operations, and vice versa. Research activities will also consider how to address increased freight demand.

The Transportation Research Board (TRB) of the National Academy of Sciences (NAS) was commissioned to develop a Truck Size and Weight Research Roadmap as a follow-up action to the DOT/FHWA Comprehensive Truck Size and Weight Limits (CTSWL) Study, submitted to Congress in April 2016. The five topic areas (pavement, bridge, mode shift, safety; and enforcement) included in the 2016 CTSWL Study provided the key focal areas for TSW research needs and activities. In November 2018, NAS/TRB finalized the . TRB Truck Size and Weight Research Roadmap, which outlined research topics and stakeholder coordination needed to develop a Truck Size and Weight Limits Research Program. This peer-reviewed roadmap described the activities, dependencies, sequencing, timelines, and cost estimates of a research program that aims to improve DOT's knowledge of potential impacts from trucks operating at, within, or legally in excess of Federal limits to inform potential policy-making.

A FHWA Truck Size and Weight Research Implementation Proposal developed in 2019 is intended to aid in guiding specific resources towards TS&W research projects that are topically cross-cutting and impact multiple agencies and departments. The Truck Size and Weight RD&T Program seeks to implement the highest priority elements of this implementation proposal. While these activities have not yet been determined, they would include research pertaining to the topic areas identified in the 2016 study. For example, activities could include development of enhanced bridge deterioration models that can account for impacts of alternative truck configurations, development of more accurate models that States and others can use to identify impacts of heavy trucks on pavements, analysis of truck types, and safety impact assessments.

The Truck Size and Weight RD&T Program also seeks to analyze the impact of alternative truck configurations on the highway system and highway operations. Activities will include cost-benefit

assessments of alternative truck configurations or OS/OW freight vehicles, and general analysis of alternative truck configuration impacts on freight infrastructure, safety, and operations.

The Truck Size and Weight RD&T Program also plans to gain a better understanding of the operational, safety, and infrastructure impacts associated with allowing widespread use of twin-33 foot trailers configuration on the national network, spurred by congressional legislation introduced in 2015 that would allow twin 33-foot trailers and 91,000 pound trucks on U.S. highways.

The Truck Size and Weight RD&T Program will additionally endeavor to support practitioners to plan for, prioritize, and implement projects that benefit goods movement. Activities will include producing resources to determine needed information for freight vehicle size and weight analysis, and examining methods for inventorying and applying these data.

Finally, the Truck Size and Weight RD&T Program will work to provide States and other stakeholders with the knowledge needed to create the safest and most efficient permitting and enforcement systems possible to ensure fluid freight movement across State borders. Activities will include research on effective truck size and weight data use across States and supporting States in harmonizing OS/OW permitting requirements.

Key FY20 FHWA Truck Size and Weight RD&T Program Activities.

Activity	Period of Performance	Partners/Notes
Completion and Execution of FHWA Truck Size and Weight Research Implementation Plan	2019-2023	TRB/FHWA program offices/US DOT program, Academic and Research Institutions, Industry Stakeholders, and State DOTs.
Analysis of Alternative Truck Configurations	2017-2023	While there are not specific partners envisioned for this research area; engaging stakeholders will be a key research element.
Analysis and Dissemination of Truck Size and Weight Data to Support Harmonization	2018-2023	AASHTO, Industry Stakeholders, and State DOTs

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes, the program is statutorily mandated. This program is authorized in title 23, United States Code sections 502 and 503, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas to improve highway safety, improve infrastructure integrity, strengthen transportation planning and environmental decision making, reducing congestion, and enhancing freight productivity, among others.

Senate Report 115–138 (accompanying the FY 2018 Department of Transportation Appropriations Act) contained requirements for two new FHWA Reports to Congress about a Comprehensive Truck Size and Weight Research Plan. The Report directed preparation of a status report by September 19, 2018 and a final report by April 23, 2019 for the House and Senate Committees on Appropriations. The

FHWA completed and sent a required interim status update to Congress, transmitting the interim report from NAS/TRB on the Research Roadmap as background. The final report is currently under developing.

Section 5502 of the Fixing America’s Surface Transportation (FAST) Act requires the Department of Transportation to create an Emergency Route Working Group (ERWG). The research program area will carry out research related to the recommendations and to the best practices advice the ERWG will provide to the Secretary of Transportation on expeditious State approval of special permits for vehicles involved in emergency response and recovery.

In addition, each State shall certify to the Federal Highway Administrator, before January 1 of each year, that it is enforcing all State laws respecting maximum vehicle size and weight permitted on what, prior to October 1, 1991, were the Federal-aid Primary, Secondary, and Urban Systems, including the Interstate Highway System, in accordance with 23 U.S.C. 127. The States must also certify that they are enforcing and complying with the ISTEA freeze on the use of LCV's and other multi-unit vehicles. The certification shall be supported by information on activities and results achieved during the preceding 12-month period ending on September 30 of each year. FHWA is responsible for certifying state compliance with Federal standards.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation

Safety: Today, approximately 12 States require Pilot Car Certification. States use the FHWA-developed guidelines to support their certification requirements; however, these requirements vary from State to State. As a result, U.S. pilot car operators have to navigate a complex web of requirements when making a multi-state move. FHWA research in this program area will support oversize/overweight state and local permits harmonization among States. The work outcome will improve safety on the national highways as well contribute to infrastructure preservation. Research activities will include research, review, and analysis of existing pilot/ escort vehicle operator (P/EVO) training materials, case studies, and other information focused on the oversize loads movement.

Infrastructure: The Truck Size and Weight RD&T Program addresses alternative truck configurations on the highway system and operations. Activities will include cost-benefit assessments of alternative truck configurations or OS/OW freight vehicles, and general analysis of alternative truck configuration impacts on freight infrastructure, safety, and operations.

The draft National Freight Strategic Plan (NFSP) provides important context for truck size and weight research. The NFSP acknowledges that lack of uniformity across State truck size and weight regulations may be a potential barrier to efficient freight movements. It also notes a need for truck size and weight research specifically to assess tradeoffs involved in raising weight limits or allowing longer combination trucks on national highways. Outside DOT, National Cooperative

Highway Research Program (NCHRP) analyses have provided a foundation for this topic area. The Truck Size and Weight RD&T Program supports addressing these research and data gaps..

Innovation: The Truck Size and Weight RD&T Program will provide States and other stakeholders with information needed to create the safest and most efficient permitting and enforcement systems possible to ensure fluid freight movement across State borders. Activities will include researching effective truck size and weight data use across States and supporting States in harmonizing OS/OW permitting.

The Truck Size and Weight RD&T Program will support practitioners to plan for, prioritize, and implement projects that benefit goods movement. Truck Size and Weight RD&T Program activities include producing resources on what information is needed for analysis of freight vehicle size and weight and examining methods for inventorying and applying these data.

The Truck Size and Weight RD&T Program efforts aim to better understand the impacts of alternative truck configurations on freight infrastructure, safety, and operations, through data collection and development of data-driven tools and analytical techniques. Additionally, there is an effort to identify key TSW-related research needs related to pavement, bridge, mode shift, safety, and enforcement. The combination of these activities will lead to improved technical and implementation resources for stakeholder decision-making and analysis.

USDOT Research Priorities:

Improving the Mobility of Freight - This program provides States and other stakeholders with information needed to create safe and efficient systems to ensure fluid freight movement across State borders. Activities include research on effective truck size and weight data use across States. The Truck Size and Weight RD&T Program will develop roadmaps and syntheses, improved analytical tools, resources, best practices, stakeholder forums and outreach, peer exchanges, and pilot implementations. Activities under the Truck Size and Weight RD&T Program include development of more accurate models that States and others can use to identify impacts of heavy trucks on pavements, commodity analysis of truck types, and safety impact assessments.

Research Collaboration Partners:

The draft National Freight Strategic Plan (NFSP) provides important context for the Truck Size and Weight RD&T Program. The NFSP acknowledges that lack of uniformity across State truck size and weight regulations may be a potential barrier to efficient freight movements. It also notes a need for TSW research especially to assess tradeoffs involved in raising weight limits or allowing longer combination trucks on national highways. Outside DOT, National Cooperative Highway Research Program (NCHRP) analyses have provided a foundation for this topic area.

A major Truck Size and Weight RD&T Program activity is the development of a FHWA Truck Size and Weight Research Implementation Proposal. The Truck Size and Weight Research Roadmap developed by the National Academy of Science (NAS) described the activities, dependencies, sequencing, timelines, and cost estimates of a research program that aims to improve US DOT's knowledge of potential impacts from trucks operating at, within, or legally in excess of Federal limits to inform potential policy-making. The FHWA is evaluating the material in the roadmap and is considering next steps, including the development of the Truck Size and Weight Research Implementation Plan. While these activities have not yet been determined, they would include research pertaining to the topic

areas (pavement, bridge, mode shift, safety; and enforcement) included in the 2016 Truck Size and Weight Limits Study.

Additionally, FHWA is conducting research on Twin 33-foot trailers, to better understand the operational, safety, and infrastructure impacts associated with allowing widespread use of this configuration on the national network.

Also, the FHWA Offices of HPTS, HIAP, and HIPT will be conducting research to develop a pavement distress evaluation model and HPTS is currently creating tools for disaggregating VMT based on vehicle classifications, vehicle weight groups, vehicle registered weight, and vehicle operation weights. Industry has proposed truck platooning as a technology solution that could bring significant improvements to the cost and efficiency of highway freight movements. However, it has raised concerns on the potential impact on pavements, bridges, and traffic operations. FHWA is collaborating with its DOT modal partners to develop a truck platooning research agenda that will be influenced by truck size and weight issues.

Benefits of Partnership and Partner Contributions to FHWA Vehicle Size and Weight R&T Program.

Partner Organization	User Perspective on Needs	Industry Perspective	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Funding
American Association of State Highway and Transportation Officials (AASHTO)	X			X		X
State Departments of Transportation	X		X	X	X	X
Metropolitan Planning Organizations (MPOs)	X		X	X		
Research and Educational Institutions, such as Massachusetts Institute of Technology (MIT), Texas A&M Transportation Institute (TTI), Oak Ridge National Laboratories, etc.			X	X		
National Academy of Sciences (NAS)			X	X		
Trade Corridors Coalitions, such as I-95 Corridor Coalition, North America's Corridor Coalition (NASCO)	X	X	X	X	X	X
American Trucking Associations (ATA), including American Transportation Research Institute (ATRI)	X	X	X	X	X	
Owner-Operator Independent Driver Association (OOIDA)	X	X		X	X	
National Association of Truck Stop Operators (NATSO)	X	X		X	X	
Commercial Vehicle Safety Alliance (CVSA)	X	X		X	X	
Specialized Carriers and Riggers Association (SC&RA)	X	X		X	X	
Pilot Car Industry Stakeholders	X	X	X	X	X	

Other DOT partners, including Bureau of Transportation Statistics (BTS), Maritime Administration (MARAD), Federal Motor Carrier Administration (FMCSA), Federal Railroad Administration (FRA), etc.	X	X	X	X	X	X
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Accelerating Project Delivery

\$2,718,000

Program Description/Activities/Objectives:

Program Description

The Accelerating Project Delivery research program expedites project delivery by improving environmental review and permitting and real property acquisition processes to reduce regulatory timeframes and costs. These efforts help FHWA deliver transportation projects more quickly and efficiently while safeguarding our communities and maintaining a healthy environment. This program supports improving the National Environmental Policy Act (NEPA) process and improves coordination and communication between Federal and State agencies, the public, and other stakeholders to create efficiencies in project review and development. This program supports work to accelerate project delivery through interagency collaboration, capacity building for environmental practitioners, integrating planning and environmental processes, and disseminating information about environmental program and process efficiencies.

Program Objectives

The main objectives of the Accelerating Project Delivery program are to build tools and collaborate on studies to reduce regulatory burden and increase efficiencies in the environmental review process by innovating new ways to expedite project delivery. Examples of programs and tools that the Volpe Center will support in FY20 to accelerate project delivery include activities related to regulatory reform, rulemaking, guidance, “planning and environmental linkages” (PEL), programmatic approaches, NEPA assignment program support and audit support, “Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects,” resource agency liaison program support, and the Environment Discipline Support System. Examples of tools FHWA will create in FY20 through interagency agreements include programmatic approaches to expedite permitting and regulatory review times and policy and guidance for stakeholder flexibilities.

The National Transportation Liaison Program has helped develop techniques that have expedited federally funded projects and permits: the programmatic agreements, memorandum of agreement, and other tools that result in increased efficiencies throughout the project development and the environmental review processes. Additionally, the use of dedicated agency liaisons was identified as a best practice in the “Recommended Best Practices for Environmental Reviews and Authorizations for Infrastructure Projects for Fiscal Year 2018” by the Federal Permitting Improvement Council, to meet the objectives for federal permitting process improvement. This arrangement provides the support of liaisons in the federal permitting agencies who ensure the efficient application of the relevant agency’s statutes and regulations. The research is conducted through continuous interaction between FHWA and the various liaisons.

The work that FHWA does under intra-agency and interagency agreements is inherently governmental and specific to the authorities and jurisdiction of each agency, and therefore these services are not available in the commercial market.

The Accelerating Project Delivery program will also increase the effectiveness and efficiency of acquisition and management of highway real property interests by developing methodologies, technology and systems to accelerate the Federal-aid real estate acquisition program with the

development and utilization of flexibilities. This research program will improve knowledge and provide tools necessary to ensure that effective stewardship and oversight is provided.

Key FY20 FHWA Accelerating Project Delivery R&T Program Activities

Activity	Period of Performance	Partners/Notes
Accelerating Project Delivery Services	FY19-FY24	Volpe Center, State DOTs, American Association of State Highway and Transportation Officials (AASHTO), Transportation Research Board (TRB), ACHP, NMFS, USACE, USCG, USFWS, USEPA, US Geological Survey (USGS), USIECR
National Liaison Program	FY19-FY25	ACHP, NMFS, USACE, USCG, USFWS, USEPA
PAPAI	FY20-FY24	State DOTs
eNEPA	FY19-FY24	NMFS, USACE, USCG, USFWS, USEPA, State DOTs
Studies on Historic Properties and Tribal Consultation	FY19-FY24	ACHP, State DOTs, tribes, State Historic Preservation Officers
NEPA Assignment Program	FY19-FY24	State DOTs, Volpe Center
Permitting and Mitigation Reform	FY19-FY24	ACHP, NMFS, USACE, USCG, USFWS, USEPA, USIECR, State DOTs
Planning and Environmental Linkages (PEL)	FY19-FY24	State DOTs, Volpe Center
NEPA document timelines	FY19-FY24	State DOTs
NPDES permitting reform studies	FY19-FY24	State DOTs, USGS, USEPA
Project Delivery Innovations (Tolling, Alternative Fuel Corridors)	FY19-FY24	Varies by project
Tools to implement Executive Order 13807	FY20-FY24	ACHP, NMFS, USACE, USCG, USFWS, USEPA, State DOTs
Acquisition Flexibilities for Real Property	FY19-21	State DOTs, AASHTO
Study on the Economic Benefit of Accelerating Project Delivery	FY19-FY20	Volpe Center

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes

The program supports several mandates for FHWA to accelerate and improve environmental reviews in statute under 23 U.S.C. 139, "Efficient Environmental Reviews for Project Decision Making," 23 U.S.C. 168, "Integration of Planning and Environmental Review," 23 U.S.C. 326, "State Assumption of Responsibility for Categorical Exclusions," and 23 U.S.C. 327, "Surface Transportation Project Delivery Program." The program also supports coordination, partnerships, regulation, policy, and guidance efforts to deploy innovations to meet the agency's statutory mandates under the National Environmental Policy Act (NEPA) at 42 U.S.C. 4321, the National Historic Preservation Act at 54 U.S.C. 300101, the Endangered Species Act at 16 U.S.C. 1531 et seq., the Clean Water Act at 33 U.S.C. §1251 et

seq., the Rivers and Harbors Appropriations Act of 1899 at 33 U.S.C. 401, the General Bridge Act of 1946 at 33 U.S.C. 525, and other environmental laws.

The Accelerating Project Delivery program is also responsible for the stewardship and oversight of the Federal-aid real estate acquisition program as well as the outdoor advertising and junkyard control programs on Federally controlled routes.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Infrastructure
Innovation
Accountability

Accelerating Project Delivery supports the Department’s Infrastructure, Innovation, and Accountability Goals. Specific contributions are as follows:

Infrastructure: The Accelerating Project Delivery research program addresses the DOT goals of Infrastructure and Innovation through strategies that accelerate project delivery and support stewardship, improve coordination and partnerships, update regulations, control regulatory costs, track and improve program performance, develop information technology, and develop a workforce trained to accelerate project delivery and expedite environmental and permitting processes and decisionmaking.

Through an intra-agency agreement with the Volpe Center and interagency agreements with resource and regulatory agencies, FHWA will work with its Federal partners in FY20 to leverage the expertise, skills, and capacity they have to support several ongoing efforts and to respond to future needs to meet DOT’s Strategic Goals in Infrastructure and Innovation. The Accelerating Project Delivery research program includes efforts that seek permitting efficiencies and reform through programmatic approaches under research-funded intra-agency agreements with the Volpe Center as well as interagency agreements with other agencies outside DOT.

FHWA maintains agreements with agencies that have permitting oversight or other jurisdiction under several environmental laws and regulations, and these agencies provide dedicated staffing positions that serve as national liaisons to develop policy, guidance, and programmatic approaches to expedite permitting and environmental review times. The National Transportation Liaisons program funds efforts that benefit FHWA projects by expediting the review of transportation projects. National Transportation Liaisons have developed guidance, best practices, programmatic approaches, permit synchronization, and other tools to accelerate the environmental review and permitting processes.

The program also initiates research on various topics as part of Project Delivery Innovations that support the overall program by responding to new and emerging issues in the environmental review, project development and real estate acquisition. Examples of past and ongoing innovations include studies on how to address topics such as tolling, automated connected vehicles, and alternative fuel corridors in the context of the environmental review

process. The FHWA may address emerging issues through interagency agreements or through commercial contracts, as appropriate.

Innovation: Accelerating Project Delivery research will develop and analyze technology and innovation to accelerate the environmental review and permitting processes. This research will leverage other Federal agency resources to provide tools, technologies, guidance and training to accelerate project deliver.

Accountability: Within the context of accelerating project delivery, these activities will support efforts to reduce regulations and control regulatory costs with other Federal agencies and with Volpe support to draft policy, guidance, rulemaking as well as develop tools such as programmatic approaches to expedite regulatory requirements. All activities will improve performance by accelerating and improving processes and maximizing employee performance, development, and engagement to make efficient and effective use of resources.

USDOT Research Priorities:

Accelerating Project Delivery supports the Department's Infrastructure, Innovation and Accountability Goals. Specific contributions are as follows:

- **Economic Impact of Regulatory Reform:** The Accelerating Project Delivery research program addresses the DOT goals of Infrastructure, Innovation, Improving Mobility, and Accountability through strategies that accelerate project delivery and support stewardship, improve coordination and partnerships, update regulations, control regulatory costs, track and improve program performance, develop information technology, and develop a workforce trained to accelerate project delivery and expedite environmental and permitting processes and decision making.

Through intra-agency agreements with the Volpe Center and interagency agreements with resource and regulatory agencies, FHWA will work with Federal partners in FY20 to leverage the expertise, skills, and capacity they have to support several ongoing and new efforts and to respond to future needs to meet DOT's Strategic Goals in Infrastructure, Innovation, and Accountability. This program meets DOT's Strategic Objectives by supporting project delivery, planning, environmental review process efficiencies, workforce development, updating regulations, reducing regulations, controlling regulatory costs, improving program performance, and advancing information technology to enhance mission performance and promote efficiency as they relate to environmental review and permitting processes. This program supports activities leading to technology development and transfer and introduces innovative ideas, practices, and approaches to inform training and technical support in environmental review and stewardship.

- **Economic Impact of Permitting Reform:** The Accelerating Project Delivery research program for FY20 will include efforts that seek permitting efficiencies and reform through programmatic approaches under research-funded intra-agency agreements with the Volpe Center as well as interagency agreements with other agencies outside DOT.

FHWA maintains agreements with agencies that have permitting oversight or other jurisdiction under several environmental laws and regulations, and these agencies provide dedicated staffing positions that serve as national liaisons to develop policy, guidance, and programmatic

approaches to expedite permitting and environmental review times. FHWA currently has agreements for national liaisons with the following agencies: the Advisory Council on Historic Preservation (ACHP), the National Marine Fisheries Service (NMFS), the US Army Corps of Engineers (USACE), the US Coast Guard (USCG), and the US Fish and Wildlife Service (USFWS). The National Transportation Liaisons program funds efforts that benefit FHWA projects by expediting the review of transportation projects. National Transportation Liaisons have developed guidance, best practices, programmatic approaches, permit synchronization, and other tools to accelerate the environmental review and permitting processes. Examples of tools that resource agencies (through their National Transportation Liaisons) have developed in coordination with FHWA are the bridge permitting 144(c) checklist for State Departments of Transportation (DOTs) to determine if a USCG permit is required pursuant to 23 U.S.C. 144, and the [“Red Book: Synchronizing Environmental Reviews for Transportation and Other Infrastructure Projects”](#).

Starting in FY19 and continuing through 2024, FHWA anticipates initiating a new agreement with USEPA to continue funding their existing National Transportation Liaison position for work to create efficiencies in the permitting process required under the Clean Water Act for National Pollutant Discharge Elimination System (NPDES) permits as well as accelerating the overall environmental review process. Also supporting NPDES permitting, in FY20 a new agreement with the US Geological Survey will include outreach and updates to tools that help DOTs meet permit requirements, such as the Stochastic Empirical Loading and Dilution Model. Beginning in FY20, FHWA will initiate a new agreement with NMFS and USACE for transportation innovation liaisons to accelerate project delivery.

Another interagency agreement that the FHWA uses to accelerate project delivery by addressing permitting and interagency coordination issues is with the US Institute for Environmental Conflict Resolution (USIECR). The USIECR provides third-party neutral collaboration, coordination, facilitation, and conflict resolution services to assist FHWA and State DOTs as they work through permitting and consultation processes with resource agencies and tribes. The USIECR also offers training to FHWA and stakeholders to improve workforce skills in coordination among different agencies and across jurisdictions. Beginning in FY18 and continuing through FY20, the USIECR is assisting the Arizona DOT with interagency collaboration for resource and permitting agencies and tribes for a large corridor study for Interstate 11. Starting in FY19 and continuing in FY20, USIECR will facilitate a tribal summit in Illinois to assist the Illinois DOT and FHWA Division office with requirements under section 106 of the National Historic Preservation Act.

Other program areas that support the overall Accelerating Project Delivery program include Environmental Review Information Technology (IT) Development and Project Delivery Innovations. The program’s IT solutions include the Project and Program Action Information System (PAPAI) tool to track projects and integrate with the Federal Infrastructure Permitting Dashboard and the eNEPA tool for online collaboration among FHWA and the resource agencies in the environmental decision making process. In FY20, FHWA will update PAPAI with technology that interfaces with the internal PAPAI system and the online permitting dashboard at <https://www.permits.performance.gov/>. The rollout of this technology will be a bold and transformative way to support transparency in permitting and environmental review processes.

The Accelerating Project Delivery program also initiates research on various topics as part of Project Delivery Innovations that support the overall program by responding to new and emerging issues in environmental review, project development, and real estate acquisition. Examples ongoing innovations include studies include:

- Efforts to improve the NEPA Assignment Program
- Efforts to examine processing times for all NEPA classes of action
- Tools to implement Executive Order 13807, “Establishing Discipline and Accountability in the Environmental Review and Permitting Process for Infrastructure.”
- Responses to changes in environmental review law and policy
- Improvements to implementation and use of early acquisition flexibilities for real property

Research Collaboration Partners:

Accelerating Project Delivery research would not be possible without collaboration with Federal and Non-Federal partners. As the Operating Administration responsible for delivering the Federal aid program, FHWA and its Federal partners focus on program activities that are outside the purview of these non-Federal entities, such as research to implement and inform policy, guidance, and regulations. The FHWA works with Federal partners on program activities that seek permitting efficiencies and reform through programmatic approaches under an intra-agency agreement with the Volpe Center as well as interagency liaison agreements with resource agencies. The FHWA maintains agreements with agencies that have permitting oversight or other jurisdiction under several environmental laws and regulations, and these agencies provide dedicated staffing positions that serve as national liaisons to develop policy, guidance, and programmatic approaches to expedite permitting and environmental review times. FHWA currently has agreements for national liaisons with the following agencies: the ACHP, the NMFS, the USACE, the USCG and the USFWS. In FY19, FHWA will execute a new five-year inter-agency agreement with the USEPA to improve NPDES permitting and environmental review. Beginning in FY20, FHWA will initiate a new agreement with NMFS and USACE for transportation innovation liaisons to accelerate project delivery. The National Transportation Liaisons program funds efforts that benefit FHWA projects by expediting the review of transportation projects.

As a partner within USDOT, Volpe will support the FHWA’s efforts to accelerate project delivery is flexible enough to respond to emerging issues from the public and stakeholders. Volpe will assist with responding to public comments on policy, guidance, and rulemaking. Volpe will also help the FHWA engage stakeholders such as State DOTs and other transportation agencies through workshops and interviews on various topics. Volpe will synthesize stakeholder input into case studies and other materials for FHWA to consider in developing policies to address issues the public and stakeholders raise. Public and stakeholder input will also inform the products that FHWA develops with other Federal agencies under this program. State DOTs and other transportation agencies will collaborate on activities under this program in FY20. A summary of the benefits to FHWA and its stakeholders from working with various partners in implementing this program is outlined in the table below.

Non-governmental input on this program usually comes from public comments and stakeholder engagement related to projects and draft policies, guidance, and rulemaking. Additionally, transportation organizations such as the AASHTO, TRB, and University Transportation Centers (UTCs) will contribute to this program by providing in-kind services and by funding research that compliments the Federal side of the program. AASHTO and TRB will also support stakeholder

engagement in the program to facilitate technology transfer between FHWA, its Federal partners, and the transportation industry.

Benefits of Partnership and Partner Contributions to FHWA Accelerating Project Delivery R&T Program.

Partner Organization	User Perspective on Needs	Industry Perspective	Programmatic Approaches	Field Trials	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Provide Services	Technology Transfer
AASHTO	X	X	X			X	X	X	X
TRB	X	X	X			X	X	X	X
State DOTs	X	X	X	X	X	X	X	X	X
ACHP			X	X	X	X	X	X	X
NMFS			X	X	X	X	X	X	X
USACE			X	X	X	X	X	X	X
USCG			X	X	X	X	X	X	X
USEPA			X	X	X	X	X	X	X
USFWS			X	X	X	X	X	X	X
USGS			X	X	X	X	X	X	X
USIECR			X	X	X	X	X	X	X
UTCs		X		X	X	X	X	X	X
Volpe Center	X	X	X	X	X	X	X	X	X

Performance-Based Planning

\$1,903,000

Program Description/Activities/Objectives:

Program Description

The statutory planning requirements of 23 USC 134 and 135 and implementing regulation of 23 CFR 450 require the United States Department of Transportation (USDOT) to work with States and Metropolitan Planning Organizations (MPOs) to implement a performance-based planning process. The USDOT is responsible for assisting States and MPOs to identify performance measures and associated targets related to national highway and transit performance goals. The Department also provides risk-based oversight and stewardship on performance measures and targets as well as providing technical assistance to States and MPOs to ensure consistent implementation of the performance-based planning requirements.

FHWA will work with States and MPOs to implement performance-based planning and programming (PBPP) and provide a strategic, data-driven approach to decision-making that enables transportation agencies to efficiently allocate resources, maximize the return on investments, and achieve desired performance goals while increasing accountability and transparency to the public. The PBPP supports the connection between performance measures and performance target levels that lead to data-driven, effective transportation solutions. These measures and targets are connected through transportation plans and programs developed at the statewide and metropolitan levels.

Program Objectives

FHWA's mission is to improve mobility on our nation's highways through national leadership, innovation, and program delivery. Performance-based planning will support this through the application of performance management within the planning and programming processes and work with States and MPOs to achieve desired performance outcomes for the multimodal transportation system. Performance-based planning ensures that transportation investment decisions are made (both in long-term planning and short-term programming of projects) based on their ability to meet established targets. This research will support USDOT's strategic goals and promote more informed transportation decision-making that improves transportation planning, programming, operations, and coordination.

To advance performance-based planning and analysis, FHWA will conduct research focused on collecting and providing quality data; analysis; and information to FHWA Divisions, States, MPOs, transportation partners, and decision-makers. FHWA will also work with other Federal, State, and local agencies to develop methods and tools to analyze transportation system performance to develop effective transportation solutions. This will develop and implement strategies and activities that will advance comprehensive international, interstate, state, metropolitan, rural, regional, multi-modal, and tribal planning processes. Other planning research initiatives that will support the performance-based planning process and links planning data to the National Environmental Policy Act (NEPA) process includes: environmental justice, public engagement, transportation safety planning, forecasting project benefits and impacts, exploratory modeling, scenario planning, and transportation land use.

Key FY20 FHWA Performance Based Planning R&T Program Activities:

Activity	Period of Performance	Partners/Notes
Partner with key agencies (domestic and international) to market and coordinate products and technologies to meet planning research needs.	2020	FHWA Division Offices, State DOTs, MPOs, RTPOs, AASHTO, TRB, AMPO, NARC, NADO, APTA NACO, APA
Benchmark planning capacity needs with key stakeholders to identify strengths, weaknesses, and risks of existing processes and opportunities for a more coordinated and connected process.	2020	FHWA Division Offices, State DOTs, MPOs, RTPOs, AASHTO, AMPO, NARC, NADO, APTA
Develop robust decision-making techniques to gain insight of the impact of disruptive forces on the transportation system and be proactive in performance, safety and mobility planning.	2020	FHWA Division Offices, State DOTs, MPOs, RTPOs, AASHTO, AMPO, NARC, NADO
Promote innovative tools and strategies to enhance traditional public involvement strategies to increase accessibility for all transportation users.	2020-2022	FHWA Division Offices, State DOTs, MPOs, RTPOs, AASHTO, TRB, AMPO, NARC, NADO, APTA NACO, APA
Identify and deploy innovations for the efficient movement of people and goods in all areas of the state, including metropolitan, rural, and tribal areas.	2020-2021	FHWA Division Offices, State DOTs, MPOs, RTPOs, AASHTO, AMPO, NARC, NADO, AMPO, Private Sector
Deliver technical support to Divisions, States, and MPOs through the development of trainings, peer reviews, peer exchanges, workshops, and other discussion forums that promote innovative planning practices	2020	FHWA Division Offices, State DOTs, MPOs, RTPOs, AASHTO, AMPO, NARC, NADO, AMPO, NACO
Apply innovative analytical tools and data resources in the transportation planning decision-making process.	2020	FHWA Division Offices, State DOTs, MPOs, RTPOs, AASHTO, AMPO, NARC, NADO, ITSJPO
Assess the effectiveness of the implementation of PBPP in transportation decision-making for State and MPOs.	2020	FHWA Division Offices, State DOTs, MPOs, RTPOs, AASHTO, AMPO, NARC, AMPO
Share State and MPO notable practices for making investment decisions based on a data driven performance based planning process and identify the associated benefits and cost savings to performance based decision-making processes.	2020	FHWA Division Offices, State DOTs, MPOs, RTPOs, AASHTO, AMPO, NARC, NADO, AMPO

Activity	Period of Performance	Partners/Notes
Work with States and MPOs to identify notable multimodal practices to identify and prioritize projects for transportation improvement program consideration.	2020	FHWA Division Offices, State DOTs, MPOs, AASHTO, AMPO, FTA, FLH, RTPOs
Work with key stakeholders, States, and MPOs to establish consistent documentation of performance measures, targets in the decision-making processes.	2020	FHWA Division Offices, State DOTs, MPOs, RTPOs, AASHTO, AMPO, TRB, AMPO, NARC, NADO, APTA, NACO, APA
Identify innovative visualization methods to effectively analyze, map, display, and report a wide range of information to support planning functions.	2020	FHWA Division Offices, State DOTs, MPOs, RTPOs, AASHTO, TRB, AMPO, NARC, NADO, APTA NACO, APA
Develop and demonstrate methods in the planning process to further reduce regulatory burdens.	2020	FHWA Division Offices, State DOTs, MPOs, AASHTO, AMPO, FTA, FLH, RTPOs
Assess the technology readiness of strategic planning models SHRP2 for performance based planning applications	2020	FHWA Division Offices, State DOTs, MPOs, RTPOs, AASHTO, TRB, AMPO, NARC, NADO, APTA NACO, APA
Explore tipping points in regional household travel behaviors and demonstrate methodologies of disruptive technologies on performance	2020	FHWA Division Offices, State DOTs, MPOs, RTPOs, AASHTO, TRB, AMPO, NARC, NADO, APTA NACO, APA

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes, 23 USC 134 and 135 and FHWA's implementing regulation of 23 CFR 450 requires the USDOT to work with States and MPOs to implement a performance-based planning process. To conduct research, FHWA's research program is authorized in sections 23 USC 502 and 503. This statute requires the Secretary of Transportation to carry out highway research, development, and technology deployment activities covering a broad range of topics to improve highway safety and infrastructure resiliency, strengthen transportation planning and environmental decision making, reduce congestion, and enhance freight productivity, among others.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

Performance based planning supports each of the Department's strategic goals. Specific contributions include:

Safety: States are required to use a performance-based process through the development of data-driven, Strategic Highway Safety Plans (SHSPs), which involve tracking safety indicators, analyzing data, and identifying emphasis areas and strategies. Each State's Highway Safety Improvement Program (HSIP) should be consistent with the SHSP, and includes collecting and maintaining data, conducting studies, establishing priorities, and implementing and evaluating the effectiveness of safety improvements. This research will provide tools, technologies, guidance, and training to support States, MPOs, and other transportation agencies (including rural communities) to achieve desired performance outcomes for the multimodal transportation system.

Infrastructure: Research will highlight the emphasis on performance management within the Federal-aid highway program, and requires use of performance-based approaches in statewide, metropolitan, and nonmetropolitan transportation planning. Research will share examples of effective practices to help practitioners advance these approaches in their own planning and programming activities; promote and maintain the highway infrastructure asset system in a state of good repair; identify tools, technologies, and guidance for States and MPOs; offer capacity building opportunities that plan and prioritize investments, accelerates project delivery; and effectively improve connectivity, accessibility, safety, and convenience for all users, including those in rural areas.

Innovation: Within the context of performance based planning, the scenario planning approach visualizes and demonstrate, in both qualitative and quantitative terms, how the combination of various strategies would help meet performance targets. Research will allow for the consideration of how various factors, such as revenue constraints, demographic trends, economic shifts, or technological innovation can affect a state or region and its transportation system performance. Potential regional investment strategies for the planning horizon include packages of investments in transit, virtual public involvement, highway capacity, Intelligent Transportation Systems (ITS), and travel demand management strategies, or system preservation. Research will also assess new modes and technologies, notably automated vehicles and automated driving systems linked to data-driven decision-making.

Accountability: This research ensures that the goals are achieved in accordance with the performance-based planning process. Societal needs, e.g. safety, accountability, asset preservation, and the environment will also be addressed. Performance-based planning allows planners to evaluate and recommend strategies, projects, and programs to policy-makers based on anticipated system-wide impacts and support for goals. This research will provide tools, technologies, guidance, and training to support States, MPOs, and other transportation agencies (including rural communities) to improve mobility while preserving the natural and human environments.

USDOT Research Priorities:

Performance-based Regulations and Safety - Performance-based Planning provides tools, technologies, guidance, and training to support FHWA Divisions, States, MPOs, RTPOs, and other transportation agencies to achieve desired performance outcomes for the multimodal transportation system.

Economic Impact of Regulatory Reform - Performance-based Planning provides examples of effective practices to help practitioners advance these approaches in their own planning and programming activities; promote and maintain the highway infrastructure asset system in a state

of good repair; identify tools, technologies, and guidance for States and MPOs; offer capacity building opportunities that plan and prioritize investments, accelerates project delivery; and effectively improve connectivity, accessibility, safety, and convenience for all users.

Improving Mobility for Underserved Communities - Performance-based Planning promotes economic revitalization, job growth, and affordable transportation options (especially in underserved and rural communities).

Research Collaboration Partners:

Collaboration on performance-based planning involves FHWA’s continuous engagement with key stakeholders in both formal and informal settings to gather input on planning opportunities and challenges. Stakeholders include representatives of individual State DOTs, MPOs, RTPOs, pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB), universities engaged in related work, and professional organizations such as the American Planning Association. Interactions with AASHTO, TRB, and professional organizations generally occur at regular intervals (at least annually, and as often as quarterly). Non-government groups also partner and contribute with FHWA in support of performance based planning through planning conferences, symposiums, and relevant workshops.

Benefits of Partnership and Partner Contributions to FHWA for Performance-based Planning includes:

Partner Organization	Implementer Perspectives	Stakeholder Perspective
FHWA Division Offices	X	
Federal Transit Administration	X	
ITSJPO	X	
State DOTs	X	
MPOs	X	
RTPOs	X	
AASHTO and Associated Standing Committees		X
TRB		X
Association of Metropolitan Planning Organizations (AMPO)		X
National Association of Regional Councils (NARC)		X
National Association of Development Organizations (NADO)		X
American Public Transportation Association (APTA)		X
National Association of Counties (NACO)		X
American Planning Association (APA)		X
General Public		X

Modeling and Analysis Tools

\$1,903,000

Program Description/Activities/Objectives:

Program Description

The “Modeling and Analysis Tools” research program focuses on the development of new analytical tools and refines existing tools to help decision makers understand how highway projects improve the performance of our nation’s highway system in terms of improving air quality, reducing noise, and addressing congestion caused by the high demand to travel on the highway system. This research supports the efficient delivery of highway projects by accelerating the environmental review and permitting process while at the same time maintaining a healthy environment. The goal of the research program is to provide stakeholders at State DOTs and MPOs with the best tools, data, and regulatory framework for efficiently conducting analysis that is required by law to protect the environment (see Statutory Requirements below).

The research explores and adapts modeling methodologies for transportation planning to allow State DOTs and MPOs to better understand their transportation systems and to provide decision-makers actionable techniques and tools to better understand how a complex transportation system reacts to investments and policy changes and efficiently make trade-offs between performance metrics.

Program Objectives

This research program supports the mission of the Federal Highway Administration and the Strategic Goals of the U.S. Department of Transportation in the following areas:

- **Environmental Stewardship: Develop innovative approaches to preserve the environment and to expedite the environmental review process.** Modeling for air quality and noise impacts is required by law and regulations. Modeling and analytical tools are essential for State DOTs and MPOs to demonstrate that their plans and projects comply with the applicable legal standards and projects can therefore move forward. Developing and deploying new and innovative tools and methods make these analyses simpler and more efficient, thereby reducing analytical burdens on transportation plans and projects, accelerating the environmental review process and expediting the delivery of infrastructure projects. Research results also support the updating and streamlining of regulations, guidance, and analytical practices to further simplify analysis requirements for projects with more reliable results.
- **Technology Transfer/Deployment: Disseminate tools and research products to transportation stakeholders.** Timely dissemination of new and refined analytical tools, data, and other research products to stakeholders for application. Models and tools and research results will be deployed and shared with the public using a wide range of methods including published reports, workshops, webinars, pilots and demonstration projects, technical assistance and peer exchanges.
- **Data: Provide data to the public and stakeholders to assess air quality and noise impacts and the performance of the highway system and to support evidence-based decisions making.** New sources of data and innovative applications of that data to air quality and noise analysis provides an opportunity to communicate to the public the impacts of highway projects on air quality and noise to a level of detail and availability that was not possible before.

Improving current air quality and noise modeling tools to produce more accurate and reliable

results would provide decision makers with the best possible information to understand the expected air quality and noise impacts of proposed highway projects when making infrastructure investment decisions. Accurate predictions of these impacts are critical to avoid costly mitigation or legal challenges that may result in slowing down project delivery.

Key FY20 FHWA Modeling and Analysis Tools R&T Program Activities.

Activity	Period of Performance	Partners/Notes
Examine emissions impacts of connected and autonomous vehicles (CAV), vehicle to infrastructure (V2I), and vehicle to vehicle (V2V) technologies	FY20-FY21	Partner with ITS JPO, Volpe Center and FHWA Offices of Operations and Planning; FY20 will focus on emissions reductions from a CMAQ project eligibility perspective; FY21 focus on impacts to the modeling chain from a transportation conformity perspective
Identify projects with minimal impacts on emissions for transportation conformity purposes and create a list of projects that are exempt or “presumed to conform”	FY20	Partner with EPA and FTA.
Conduct sensitivity analysis of emissions modeling details to eliminate inputs with minimal emissions changes and to streamline modeling practices for transportation conformity	FY20-FY21	Partner with EPA and FTA
Analyze freight datasets to identify strategies that simultaneously improve freight mobility, reduce emissions, lower noise impacts, and increase energy efficiency.	FY20-FY21	Partner with EPA, Volpe Center, FHWA Freight Office; Utilize new freight emissions datasets from source like NCHRP 8-101 project and ATRI data in USDOT Secure Data Commons; Investigate rail and port data for possible application to the CMAQ Emissions Calculator Toolkit.

Activity	Period of Performance	Partners/Notes
Provide state-of-the-art models, tools and methods to enhance air quality and noise analyses and to support the acceleration of highway project environmental review process	FY19-FY21	Partner with EPA, Volpe Center; Includes activities started in FY19 such as 1) update CALINE air quality dispersion model; 2) develop additional modules of CMAQ Emission Calculator Toolkit; 3) release of final traffic noise model (TNM3.0), and; 4) research to support noise regulation update that will reduce and simplify noise requirements. New activity for FY 20 includes the optimization of the traffic noise model (TNM 3.0) to improve user experience.
Enhance data collection and analytical tools development to support and improve project level air quality and noise analysis	FY19-FY21	Includes activities started in FY 18-19 such as 1) develop applications tools using national traffic database to improve accuracy of air quality and noise analysis, and; 2) develop process to collect and analyze meteorological data to help streamline project-level air quality analysis
Improve quality of data inputs for emissions reductions estimations to support the CMAQ program and Transportation Performance Management among states and MPOs	FY19-FY20	In coordination with TPM office
Initiate a Pilot study to assess the synergy of various CMAQ project types to enhance cost effective implementation and improved performance management	FY20-21	Partner with state DOTs and MPOs

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes.

This research is needed to ensure that modeling and analysis required by several statutory mandates is conducted in the most efficient and least time-consuming manner possible. The statutory mandates include: the Transportation Conformity provisions of the Clean Air Act and its implementation regulations (see Section 176(c) of the Clean Air Act (42 U.S.C. 7506(c)); 40 CFR Parts 51.390 and 93); the promulgation of highway noise levels and standards (23 U.S.C. 109(i); 23 CFR 772); the implementation of the Congestion Mitigation and Air Quality Improvement (CMAQ) program (23 U.S.C. 149) and the CMAQ program performance measures (23 U.S.C. 150(c); 23 CFR 490); the statewide and metropolitan planning process (23 U.S.C 134 and 135; 23 CFR 450) and the integration of planning and environmental review (23 U.S.C. 168).

This research is authorized in sections 502 and 503 of title 23, United States Code, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topics to improve highway safety and infrastructure integrity, strengthen transportation planning and environmental decision making, reduce congestion, and enhance freight productivity, among others.

Program Alignment with Strategic Goals:

This research supports three of DOT’s Strategic Goals and three research topic areas described in the DOT RD&T Strategic Plan. These goals are shown in the following table:

DOT Strategic Goal
Infrastructure
Innovation
Accountability

The following bullets describe how this research program supports these two DOT Strategic Goals and topic areas:

Infrastructure - Modeling research will develop tools, methods and guidance to support a clearer understanding of the complex relationship between transportation and the environment, especially in the areas of air quality, highway traffic noise, transportation planning, land use and travel demand forecasting process. It will promote more informed transportation decision making that improves transportation planning, programming, operations, and coordination. This research will provide tools and methods to identify approaches in reducing regulatory burden of air quality and highway noise analyses and accelerating the project development processes.

Accountability– Modeling research will advance the state-of-the practice in environmental analysis by developing and deploying analytic methods and tools for air quality, highway traffic noise, and considering the impact of uncertainty, such as vehicle automation, on travel demand forecasts for plans and projects. A wide range of approaches will be used to ensure timely deployment and transfer of models, tools, technologies, guidance, and training developed to support state departments of transportation, metropolitan planning organizations, and other transportation agencies. These new models and tools can assist transportation stakeholders in conducting more efficient and effective analysis in air quality, highway traffic noise, transportation planning, land use and travel demand forecasting

Air quality, highway traffic noise and land use and travel forecasting modeling research will focus on technologies, tools, analysis methods, and performance management approaches to accelerate the environmental review process, and to effectively and efficiently analyze the impacts of projects to meet the statutory and regulatory requirements cited above. This research will incorporate latest data and technologies in developing new and refining existing models and analytical tools and methods to support state departments of transportation, metropolitan planning organizations, and other transportation agencies so that transportation projects, will be delivered more quickly and efficiently while maintaining a healthy environment, safeguarding our communities and

stimulating economic growth. The research will also provide tools and other resources to assist state and local transportation partners to measure the performance of the transportation system.

The models and tools developed in the research would benefit both urban and rural areas. During the development process, special attention will be given to incorporate data and other information to reflect unique characteristics that differentiate urban and rural areas such as population density, meteorology, traffic pattern, land use and vehicle fleet mix.

USDOT Research Priorities:

This research program addresses the following two research priorities from the DOT RD&T Strategic Plan:

- Economic Impact of Regulatory Reform – This research will support activities to remove unnecessary regulator barriers and help streamline compliance activities. We will develop data-driven tools and methodologies to evaluate whether these regulations and guidance documents are outdated, can be scaled back or eliminated while still providing adequate environmental protections. Our research would use noise modeling techniques to support regulatory reform of FHWA’s noise regulations by showing that some of the existing requirements do not have a meaningful impact on noise levels. For air quality, this research would expand the number of project types that have minimal air quality impacts which allow project sponsors to avoid having to conduct complex air quality modeling.
- Economic Impact of Permitting Reform – This research aims to develop tools, data, and methods that will make the models simpler to use, reducing the time and resources needed to run them. This will help reduce delays and accelerate the delivery of highway projects, including freight and port projects, by expediting the air quality and noise analyses in the environmental review process. The delivery of these projects will help achieve freight mobility, congestion reduction, safety improvement, and other goals for our nation’s highways.

Research Collaboration Partners:

Collaboration on modeling research regularly involves engagement with key stakeholders in both formal and informal settings to gather input concerning challenges and opportunities that might be addressed through the program, as well as information on work undertaken by other organizations both nationally, and internationally. Stakeholders include representatives of individual State departments of transportation, regional planning agencies, pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO), the Association of Metropolitan Planning Organizations (AMPO) and the Transportation Research Board (TRB), universities engage in related work, and professional organizations such as the Institute of Transportation Engineers, and the American Planning Association. Interactions with AASHTO, AMPO, TRB, and professional organizations generally occur at regular intervals (at least annually, and as often as quarterly). Other Federal agencies including EPA and other non-government groups, such as the Health Effects Institute, partner and contribute to modeling research through both formal (interagency agreements, FACA workgroups) and informal (workshops, modeling staff workgroups) arrangements.

Benefits of Partnership and Partner Contributions to FHWA Modeling and Analysis Tools Research Program.

Partner Organization	User Perspective on Needs	Demonstration/ Field Testing	Deployment	Research Collaboration/ Coordination	Stakeholder Perspective	Subject Matter Expertise	Jointly Funded Research
AASHTO Environment & Sustainability	X				X		
AASHTO Air Quality, Climate Change, and Energy					X		
AASHTO Highway Traffic Noise Working Group	X				X		
TRB Committee on Transportation and Air Quality	X				X	X	
TRB Committee on Transportation Related Noise and Vibration	X	X	X		X	X	
State DOTs	X	X	X		X		X
Metropolitan Planning Organizations	X	X	X		X		
Associations of Metropolitan Planning Organizations					X		
US EPA				X		X	X
Health Effects Institute				X		X	
USDOT Volpe Center		X	X	X		X	

Resiliency **\$1,178,000**

Program Description/Activities/Objectives:

Program Description

The Resiliency research program focuses on development and deployment of tools, techniques, strategies and methodologies for assessing the resiliency, efficiency, and sustainability of transportation plans, projects and programs. Addressing the risk of damage and service interruption and increases in lifecycle cost of infrastructure caused by extreme weather events and natural hazards is essential in ensuring the continued integrity, safety and function of the highway system. To better address these risks and vulnerabilities, FHWA will conduct research and development activities to integrate resiliency, efficiency, and sustainability into transportation planning, project development and design. FHWA will also work with other Federal agencies to better predict and estimate the future levels of exposure of infrastructure to extreme weather events, including changes in precipitation patterns, temperature, and cyclonic storm surge and waves.

This program will also support the expansion of alternative fuel use, and encourage the development of alternative fuels through the designation of alternative fuel corridors, technical assistance, training, and research. In addition, the program will accelerate project delivery by developing tools and techniques to inform more balanced decision making among economic, environmental, and social outcomes. Finally, this program will explore opportunities in right-of-way use and assist states in identifying what right-of-way could be utilized for alternative uses such as energy generation.

Program Objectives

The goal of this program is to integrate consideration of resiliency and sustainability into the transportation planning, project development and design processes. The program objectives are:

- Develop and deploy tools, techniques, strategies and methodologies for assessing the resiliency and sustainability of transportation plans, projects, programs, and infrastructure (jointly with Infrastructure programs).
- Identify, share, and promote best practices for assessing and addressing system vulnerabilities
- Develop and update training on engineering resilient highways in coastal and riverine environments (jointly with Infrastructure programs)
- Conduct studies with other Federal agencies to improve predictions and estimates of future levels of extreme weather exposure for use in planning and design of highways and bridges (jointly with Infrastructure programs)
- Provide tools to help decision makers simultaneously analyze impacts on economic, social, and environmental considerations, smoothing interactions with stakeholders and resulting in more efficient project delivery.
- Reduce costs in highway construction by researching opportunities for increased material efficiency and material recycling.
- Reduce costs for highway users and agencies by conducting research on tools, evaluation techniques, and best practices to increase fuel efficiency and reduce fuel use in construction, operations, and maintenance.
- Increase energy security by creating opportunities for domestically sourced alternative fuels; conducting research on best practices, usage, behavior, stakeholder needs; designating alternative fuel corridors; and providing technical assistance and training to state DOTs and MPOs.

- Explore opportunities to use highway right-of-way to generate additional benefits that are consistent with operational and safety concerns, restrictions on right-of way use, and address relevant technical analysis and data needs to inform decision making.

Key FY20 FHWA Resiliency R&T Program Activities.

Activity	Period of Performance	Partners/Notes
Partner with State DOTs and others to improve processes, tools and methods through developmental and applied research and demonstration projects for incorporating resiliency	FY20 – FY21	State DOTs, MPOs, AASHTO
Create technical assistance on resilience for all stages of highway planning, design, construction, operations and maintenance, and asset management in multiple geographic settings, with a particular focus on coastal and riverine environments	FY20 – FY21	HIF, TFHRC
Accelerate project delivery by developing tools and techniques to more quickly inform balanced decision making among economic, environmental, and social outcomes,	FY20 – FY21	State DOTs, MPOs, AASHTO
Reduce costs in highway construction by researching opportunities for increased material efficiency and material recycling.	FY20 – FY21	HIF, State DOTs, AASHTO
Support expansion of alternative fuels through designation of alternative fuel corridors, technical assistance, training, and research	FY20 – FY21	USDOE, AASHTO
Explore opportunities in alternative right-of-way uses to generate additional benefits which are consistent with operational and safety concerns.	FY20 – FY21	State DOTs, AASHTO

Activity	Period of Performance	Partners/Notes
Reduce costs in highway construction by researching opportunities for increased material efficiency and material recycling.	FY20 – FY21	HIF, State DOTs, AASHTO

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes

This program is generally authorized in sections 502 and 503 of title 23, United States Code, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas. More specifically:

- 23 U.S.C. § 503(b)(3)(B)(viii) states that “the Secretary shall carry out research and development activities...to study vulnerabilities of the transportation system to ... extreme events and methods to reduce those vulnerabilities”, and 23 U.S.C. § 503(b)(3)(C)(xvii) specifies that research activities may include “studies of infrastructure resilience and other adaptation measures”.
- In addition, 23 U.S.C. § 503(b)(3)(C)(x) states that research activities may include “sustainable infrastructure design and construction”.

Other sections of 23 U.S.C. address the resiliency of the highway system in the conduct of FHWA programs and activities, including:

- 23 U.S.C. § 109 (preserve and extend the service life of highways)
- 23 U.S.C. § 116 (preventive maintenance)
- 23 U.S.C. § 119(d)(2)(B) and (C) and 23 U.S.C. § 133(b)(2) (funding eligibility for “protection against extreme events”)
- 23 U.S.C. § 134 (a)(1) (management, operation, and development of surface transportation systems)
- 23 U.S.C. § 150(b) (state of good repair)

Furthermore, the Omnibus Appropriations Bill of 2018 conference report (S. Rept. 115-138 – Transportation, and Housing and Urban Development, and Related Agencies Appropriations Bill, 2018, pp52-53) instructs FHWA to:

- Submit a report to the House and Senate Committees on Appropriations that includes “recommendations for States, MPOs, and cities to plan for and develop resilient Federal-aid highways,” and to
- “Expand its technical assistance and training workshops to help coastal States, MPOs, and cities to revise their practices...with the goal of improving the resiliency of our coastal highways and reducing the life-cycle costs.”

Finally, the FAST Act Section 1413 requires the Secretary to solicit nominations and designation of national alternative fuel corridors.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Infrastructure
Innovation

Resiliency supports the Department’s Infrastructure and Innovation Goals. Specific contributions are as follows:

Infrastructure Goal

- **State of Good Repair:** Our research supports the State of Good Repair strategic priority within the Infrastructure Goal, particularly the components pertaining to Risk-Based Asset Management and Infrastructure System Resilience. Our program supports research, pilots, and other projects focused on incorporating resilience considerations into all aspects of the highway life cycle, particularly asset management, planning, and engineering. The improved practices and tools developed and disseminated under this research program will extend the life of infrastructure and improve its performance. Conducting research on resiliency of highways particularly supports geographically isolated rural communities that are served by networks with less redundancy and have greater need to find ways to ensure that their highway connections are not severed or degraded by extreme events or other conditions.
- **Environmental Stewardship:** Our research also supports the Environmental Stewardship strategic priority within the Infrastructure Goal, in two primary ways:
 - *Alternative Fuels and Fuel Efficiency:* The development of Alternative Fuel Corridors and related research and demonstration projects on alternative fuels directly meet the goal stated in the DOT RD&T Plan to “advance the use of alternative fuels in transportation” (p.13). In addition, our research on reducing fuel and material use in construction, as well as research on efficiencies in operations, maintenance, and freight travel, all contribute to finding ways to reduce costs for transportation agencies and highway users.
 - *Accelerated Project Delivery:* Our research supports performance-based decision making in project delivery by providing tools to help decision makers simultaneously analyze impacts on economic, social, and environmental considerations, smoothing interactions with stakeholders and resulting in more efficient project delivery. Our past work in this area performed as part of the Sustainable Highways Initiative is highlighted as an example in support of the Life Cycle and Preventative Maintenance objective in the DOT Strategic Plan.

Innovation Goal

- **Mobility Innovation:** Our research supports the overall goal of mobility innovation to support economic growth by creating tools to balance decision making among economic and social outcomes simultaneously, allowing better consideration of underserved communities that may otherwise not have their needs adequately addressed in transportation projects. For instance, one

of our pilots in Ohio resulted in improved dialogue with underserved communities that were facing impacts from a major bridge project, defusing an adversarial relationship and turning it into a collaborative one that allowed the project to proceed smoothly. It also specifically addresses the *Needs of Rural Americans* focus by providing new methodologies for geographically isolated communities with little network redundancy to assess their vulnerability to extreme weather events and develop solutions to strengthen their resilience to such events. For instance, our pilot program will fund an effort to develop a more resilient alternative to a winter ice corridor on Alaska's Kuskokwim River, which is currently the only transportation connection for several communities but is increasingly dangerous and unreliable as warmer winters and more frequent extreme weather events have led to increases in freeze-thaw cycles. Another effort will revise guidelines on soil stabilization to improve resilience of dirt reservation roads in New Mexico.

USDOT Research Priorities:

This research program addresses three DOT Research Priorities:

- Potential Impact of Value Capture: Our research includes exploring alternate uses of the right-of-way that may generate benefits for state DOTs (such as the feasibility of electricity generation in the ROW to offset utility bills)
- Improving the Mobility of Freight: Our research's contribution to improved asset management, resilience, and state of good repair for highways are directly beneficial to truck travel. In addition, our modeling of opportunities for reducing fuel use in the trucking sector will save money for trucking companies.
- Improving Mobility for Underserved Communities: Our research provides new methodologies for geographically isolated communities with little network redundancy to assess their vulnerability to extreme weather events and develop solutions to strengthen their resilience to such events. For instance, our pilot program will fund efforts to improve rural winter snowmobile routes in Alaska and dirt reservation roads in New Mexico. It also creates tools to balance decision making among economic and social outcomes, allowing better consideration of underserved communities that may otherwise not have their needs adequately addressed in transportation projects.

Research Collaboration Partners:

Collaboration on resiliency and sustainability involves engagement with key stakeholders in both formal and informal settings to gather input concerning research challenges and opportunities that might be addressed through the program, as well as information on work undertaken by other organizations both nationally, and internationally. Primary stakeholders include representatives of individual State DOTs and metropolitan planning organizations, Federal land management agencies (FLMAs), and pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB). Interactions with AASHTO, TRB, and professional organizations generally occur at regular intervals (at least annually, and as often as quarterly), but are not formally tracked or measured.

In addition, resiliency and sustainability research is conducted in coordination and partnership with several other FHWA program offices. Non-governmental groups also partner with this program. In particular, AASHTO provides stakeholder perspective and collaborates on research projects.

Benefits of Partnership and Partner Contributions to FHWA Resiliency Program

Partner Organization	User Perspective on Needs	Demonstration/ Field Testing	Deployment	Research Collaboration/ Coordination	Stakeholder Perspective	Subject Matter Expertise	Jointly Funded Research
AASHTO Environment & Sustainability				X	X		
AASHTO Committee on Transportation System Security & Resilience				X	X		
TRB Executive Task Force on Resiliency				X	X		
TRB Special Task Force on Climate Change and Energy				X	X		
TRB Committee on Hydrology and Hydraulics				X	X		
TRB Transportation System Resilience				X	X		
State DOTs	X	X	X				
Metropolitan Planning Organizations	X	X	X				
FLMAs	X	X	X				
Other FHWA Offices (Infrastructure, Operations, Federal Lands)					X	X	X
NOAA				X		X	X
USGS				X		X	
DOE and National Labs				X		X	

Planning for Bicycle and Pedestrian Safety, Connectivity, and Multimodal Mobility, including for Underserved Communities

\$1,178,000

Program Description/Activities/Objectives:

Program Description

The goals of this program are to lower the number of pedestrian and bicyclist fatalities and serious injuries because of traffic crashes, and to improve the connectivity of the multimodal transportation system to allow travelers improved mobility options. The program will integrate improved pedestrian and bicycle systemic safety analysis techniques and design into transportation planning and project development. The program will also support economic growth and the competitiveness of the American economy by improving mobility options, including underserved communities such as people with disabilities and rural communities, and by efficient multimodal transportation planning for the National Highway System (NHS).

Program Objectives

This research seeks to promote transportation policy that supports multimodal transportation by assisting transportation agencies to build capacity to support an integrated, safe, and convenient transportation system for all users, in urban, suburban, and rural areas. The objectives are:

- Identify, share, and promote effective and successful tools and information necessary to integrate systemic pedestrians and bicycle analysis into transportation planning and project development.
- Research, develop, and promote proven pedestrian and bicycle infrastructure designs that improve safety and reduce fatalities and serious injuries.
- Research and technology deployment to support a connected surface transportation system for all users that is efficient, equitable, safe, environmentally sustainable, and supports economic revitalization.
- Improve the way transportation contributes to economic development and communities' quality of life. Research, develop, and promote strategies that encourage multiagency collaboration that supports successful economic development outcomes.
- Identify and promote strategies that strengthen national security and economic development through transportation planning, programming, operations, and management.
- Identify and promote strategies that support mobility options, equity, access, and public engagement to strengthen the ability of States and communities to respond to citizens' needs.

Key FY20 FHWA Planning for Bicycle and Pedestrian Safety, Connectivity, and Multimodal Mobility, including for Underserved Communities R&T Program Activities.

Activity	Period of Performance	Partners/Notes
Operate a national pedestrian and bicycle information center (PBIC); conduct pedestrian and bicycle safety and connectivity research, and provide technology transfer and technical assistance. Address emerging technologies such as micro mobility and automation and the impact of new transportation providers on the transportation system.	Ongoing; throughout FY 2021	State DOTs MPOs Local Governments Federal Land Management Agencies Supports agencies by completing research on innovations in planning and design and providing training materials and technology transfer reflecting those innovations.
Research and implement the integration of pedestrian and bicycle network connectivity performance measurement and scalable risk analysis with transportation planning and project development.	FY 2020-2021	State DOTs MPOs Supports agencies by developing and piloting research on integrating innovations in safety and connectivity planning and design.
Research and deploy innovations in the financing, development, and implementation of multimodal transportation projects that improve connectivity, accessibility, safety, and convenience for all users, including underserved communities.	Ongoing; throughout FY 2023	State DOTs MPOs Local Governments Federal Land Management Agencies Supports agencies by completing research on innovations in planning and design and providing training materials and technology transfer reflecting those innovations.
Research and deploy innovations to support improved context sensitive solutions and design, community impact assessment, and public engagement to accelerate project decision-making and improve mobility options for underserved communities.	FY 2019-2020	State DOTs MPOs Local Governments Federal Land Management Agencies Supports agencies by completing research on innovations in planning and design and providing training materials and technology transfer reflecting those innovations.

Activity	Period of Performance	Partners/Notes
Administration of the National Highway System Official Record and GIS Database	Ongoing; throughout FY 2021	State DOTs MPOs Rural planning agencies Federal Land Management Agencies Department of Defense Supports agencies by establishing eligibility for Federal-aid funding; necessary for agencies to meet performance management requirements.
Evaluation of National Highway System (NHS) Intermodal Connector threshold criteria established in the 1990s are relevant and valid to meet current NHS stakeholder needs	Through FY 2020	State DOTs MPOs Rural planning agencies Federal Land Management Agencies Department of Defense Freight shippers and carriers Transit agencies Supports agencies by establishing eligibility for Federal-aid funding; necessary for agencies to meet performance management requirements.
Research into State Economic Development and Transportation	Through FY 2021	State DOTs MPOs Rural planning agencies Local governments Supports agencies by completing research on innovations in economic development and transportation planning and providing training materials and technology transfer reflecting those innovations. Innovative practices would include inclusion of value capture opportunities.

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes

This program is authorized in sections 502 and 503 of title 23, United States Code, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas to improve highway safety, improve infrastructure integrity, strengthen

transportation planning and environmental decision-making, reducing congestion, and enhancing freight productivity, among others.

The goal of this research is to support States and MPOs in planning for new bicycle and pedestrian facilities on highways and bridges per the metropolitan and statewide planning statutes (23 U.S.C. 134(c)(2) and 23 U.S.C. 135(a)(2)). These provisions require States and MPOs to provide for the planning, development, and integrated management and operation of transportation systems and facilities (including accessible pedestrian walkways, bicycle transportation facilities, and intermodal facilities).

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation

This program supports the Department’s Safety and Infrastructure Goals, as follows:

Safety: This research will provide tools, technologies, guidance, and training to support State DOTs, MPOs, and other transportation agencies in ensuring that pedestrian and bicycle transportation facilities are systematically planned and designed to safely accommodate all users, including pedestrians and bicyclists. We need to reduce pedestrian and bicyclist fatalities and serious injuries while improving access to jobs and other important destinations. Through this investment, we will develop and implement products to support data-driven, systemic safety improvements.

Infrastructure: Multimodal connectivity research will provide tools, technologies, guidance, and training to support State DOTs, MPOs, and other transportation agencies to plan and prioritize multimodal investments on the NHS, accelerate the delivery of multimodal infrastructure more efficiently and effectively, and improve connectivity, accessibility, safety, and convenience for all users, including those in rural areas.

Innovation: Mobility research will study technologies, tools, analysis methods, and performance management approaches to promote mobility options for all users, while safeguarding communities, maintaining a healthy environment, and stimulating economic growth. This research will address mobility innovations that involve emerging technology, such as shared mobility, mobility as a service, and the interaction of automation with pedestrians and bicyclists. In addition, the research will analyze the accessibility of the transportation system for underserved populations, public involvement, and economic development.

This program will support economic growth and the competitiveness of the American economy by improving mobility options, including in rural communities.

USDOT Research Priorities:

Improving Mobility for Underserved Communities: This research will improve mobility options, including safer and more connected pedestrian and bicycle options, for all users, including underserved communities such as people with disabilities and rural communities. This research will address mobility innovations that involve emerging technology; such as shared mobility, mobility as a service, and new mobility options that automation may provide.

Research Collaboration Partners:

Collaboration on planning for bicycle and pedestrian safety, connectivity, and multimodal mobility, including for underserved communities regularly involves engagement with key stakeholders in both formal and informal settings to gather input concerning challenges and opportunities that might be addressed through the program, as well as information on work undertaken by other organizations both nationally, and internationally. Stakeholders include representatives of individual State DOTs, MPOs and other regional planning agencies.

FHWA partners regularly with nongovernment groups on this research, such as with the pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB), universities that engage in related work, and professional organizations such as the Institute of Transportation Engineers, the Association of Pedestrian and Bicycle Professionals, the National Association of City Transportation Officials, and the American Planning Association. Interactions with AASHTO, TRB, and professional organizations generally occur at regular intervals (at least annually, and as often as quarterly), but are not formally tracked or measured.

Benefits of Partnership and Partner Contributions to FHWA Planning for Bicycle and Pedestrian Safety, Connectivity, and Multimodal Mobility, including for Underserved Communities

Partner Organization	User Perspective on Needs	Demonstration/ Field Testing	Deployment	Research Collaboration/ Coordination	Stakeholder Perspective	Subject Matter Expertise	Jointly Funded Research
AASHTO Active Transportation Council					X		
AASHTO Center for Environmental Excellence				X	X	X	
TRB Standing Committee on Pedestrians					X		
TRB Standing Committee on Bicycle Transportation					X		
TRB Standing Committee Environmental Justice in Transportation					X		
TRB Standing Committee on Transportation and Economic Development				X	X	X	
TRB Standing Committee on Public Involvement					X		
State DOTs	X	X	X				X
Regional Transportation Planning Agencies	X	X	X				

National Association of City Transportation Officials					X		
Association of Metropolitan Planning Organizations				X	X	X	
Association of Pedestrian and Bicycle Professionals					X		
University of North Carolina Highway Safety Research Center				X		X	
Portland State University's Transportation Research and Education Center				X		X	
National Association of Development Organizations					X		
Institute of Transportation Engineers				x		x	

Policy Analysis and Global Outreach

\$4,222,000

Program Description/Activities/Objectives:

Program Description

The domestic component of the Policy Analysis and Global Outreach program provides empirical assessments of the potential for national transportation strategies and policies to improve the overall value of transportation investments to the American people.

This research provides empirical analysis of potential (de)regulatory economic impacts, policy options, and strategic planning and performance measures. Specifically, it uniquely integrates economic, public policy, geography, and statistics disciplines, to: 1) model travel behavior within the context of changing transportation technologies, costs, benefits, and markets; 2) improve FHWA and U.S. DOT forecasting and policy analysis capabilities; 3) expand the types of policy tools modeled to improve ability to identify cost-effective strategies; 4) provide ‘what if’ empirical and risk-based sensitivity analyses of future transportation needs, policy, and strategic options; and 5) facilitate transportation policy and strategy dialogue. Two broad lines of policy research address supply and demand considerations in enhancing transportation access, system performance, and competitiveness:

- *Transportation Investment*
 - Impacts of Investment on Conditions and Performance
 - Macroeconomic Impacts
 - Benefit-Cost Analysis
 - Highway Costs and Funding Options
- *Emerging Trends, Policy, and Strategy Analysis*
 - Emerging Trends and Future Performance
 - Geo-Economics of Transportation
 - Strategic and Performance Management
 - Future Policy Symposia

Transportation Investment research provides the methodological, modeling, and empirical basis for evaluating the competitiveness of future highway investments in the context of changing construction costs, travel demand, and modal options. Conditions and performance (C&P) analysis of cost-effective highway investments for future vehicular travel also serves as an anchor for assessing the role of transportation investments in the economy, including gross domestic product (GDP) and employment returns on investments. The FY2020 AMRP includes a new research element to better understand the economic competitiveness tension between the value of agglomeration to the economy (firms co-locating in denser areas) and the congestion costs that entails. Sensitivity analyses of the impact of future changes in construction costs on cost-effective levels of highway investments are also being developed.

Emerging Trends, Policy, & Strategy research assesses the potential for emerging transportation technologies, modal options, and socio-demographic factors to reshape future travel demand and performance. An area of focus for this ‘demand side’ research addresses the potential value, costs, and system performance implications of AVs and on-demand modes for future travel behavior and associated future system needs and performance. Building off of previous research on rural access, this

research program also explores issues pertaining to system access, with a focus on underserved communities; in particular, rural communities.

Integrating these supply & demand pictures will help us to evaluate transportation strategies that might enable more effective use of existing highway capacity to reduce the overall costs of future transportation investments. Modeling efforts nearing completion this year lay the foundation for evaluating alternative funding or financing strategies with the potential to improve transportation market performance and reduce future investment costs. A unique geo-economic modeling framework initiated in FY2018 will enable FHWA, for the first time, to assess the potential to enhance the capacity of existing highway rights of way, including through the use of new technologies and modal options. This geo-spatial approach recognizes that the economics of transportation, on both the supply and demand side, are fundamentally different across differing urban, suburban, exurban, town, and country environments.

This domestic policy research is enabled through the development and use of a selected suite of analysis tools and models focused heavily on understanding the role of transportation policy and investments in furthering economic competitiveness. They include benefit-cost analysis models aimed at performance-based investment prioritization; broader-based macroeconomic tools that consider a broader range of investment impacts; and models that improve understanding of market failures, such as congestion externalities. Other tools under development will facilitate the analysis of user-pricing strategies. A major focus of this research program is the identification of new approaches to link data from multiple sources to support policy analysis and provide the basis for more informed policy decision-making.

The international component of the Policy Analysis and Global Outreach program seeks to gather, promote, and disseminate global policy, best practices, and technical innovations to ensure a safe and efficient United States (U.S.) highway transportation infrastructure. Three main international program elements – Global Benchmarking, Multilateral, and Bilateral – facilitate the exchange of innovative ideas, best practices, and technologies that can have a direct and practical impact on improving the highway system. Through collaboration with international and domestic partners, this program works to address the Department's and FHWA's priorities. The three program elements also work together and cross-pollinate, with developments in one area sometimes leading to opportunities in others. For example, a one-time visit to a country for Global Benchmarking may lead to a long-term exchange as part of a bilateral relationship. A successful bilateral exchange may lead to a multilateral research project. Information or developments gleaned during a multilateral meeting may attract the interest of FHWA subject matter experts and lead to a Global Benchmarking study. In this way, the programs work in complementary ways to address different aspects of FHWA's international efforts, all while focusing on U.S. priorities and the objectives of the Agency. This research program identifies and supports opportunities for innovation on a variety of topics cutting across FHWA organization units and strategic goal areas.

Program Objectives

The domestic component of this research program informs decisions concerning highway infrastructure investments, policies, and strategies at all levels of government by providing assessments of their impacts on the future condition and performance of our highways and transportation systems, as well as the impacts of these investments on transportation users and our broader national economy.

The domestic program objective is to provide improved empirical analysis to inform policy and strategic decision-making. Specifically:

- Identify cost-effective strategies and investment levels for the nation's highways overall, for regulatory or programmatic actions, and to support grant programs.
- Provide empirical estimates and base forecasts of the factors shaping highway investment cost-effectiveness, including construction costs and user cost impacts and broader economic returns on investment.
- Provide the insights and forecasts necessary to develop efficient and effective policies and strategies reflecting emerging transportation trends in technology, costs, travel behavior, and economic vitality at the national, regional, and local levels.
- Identify cost-effective strategies for using the value of existing highway rights of way to enhance effective capacity, travel options, and access based on geography, demographics, technology, and markets.
- Identify additional future policy options and considerations through the inclusion of outside expert perspectives through means such as organized symposia.

Key anticipated FY 2020 accomplishments in the Impact of Investment on Conditions and Performance emphasis area include completion of the next biennial "Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance" report to Congress (C&P report). This document provides critical information documenting the state of the nation's infrastructure and projecting prioritized long-term infrastructure investment needs, which in turn supports informed performance-based decisions regarding future infrastructure investment levels. Analyses generated from two BCA analysis models, the Highway Economic Requirements System (HERS), and the National Bridge Investment Analysis System (NBIAS), are used to identify and prioritize potential future investments in these reports.

Accomplishments under the Macroeconomic Impacts emphasis area will include the completion of an enhanced USAGE-Hwy v1.1 model and its application in quantifying the macroeconomic impacts from highway investment. This new model will incorporate continuous improvements in the parameters of HERS and USAGE-Hwy models, update macroeconomic variables from other Federal agencies and BTS, and include more detailed and dynamic reporting at the industry level. Another accomplishment will be the completion of a Congressionally-directed update to the JOBMOD software to measure job creation from investment in the Federal-aid highway system. These products address the Agency's strategic goal of Infrastructure by linking investment in infrastructure to economic growth and productivity and by informing decisions concerning the impacts of these investments on our broader national economy.

Planned FY 2020 accomplishments in the Benefit-Cost Analysis (BCA) emphasis area include the completion of regulatory impact analyses as directed by FHWA's Office of Chief Counsel, in cooperation with program offices.

In FY 2020, three key accomplishments are anticipated in the Highway Cost and Funding Options emphasis area. The first key accomplishment is the development of an analytical tool for determining and monitoring the National Highway Construction Cost Index (NHCCI). The analytical tool will help understand the key factors, such as construction inputs, and track the contribution of those factors to the changes in the NHCCI on a quarterly basis. The second key anticipated accomplishment is the adaptation of pavement analysis models and the development of software requirements specification for a Unified Pavement Distress Analysis and Prediction Systems (UPDAPS) for FHWA. The UPDAPS ~~will be implemented in a computer shared library accessible for use by different FHWA offices. The~~

third key anticipated accomplishment is the development of procedures and estimates of marginal costs of highway infrastructure. This will provide marginal cost measures by vehicle type, highway type, and rural and urban roads.

Planned FY 2020 accomplishments for the Emerging Trends and Future Performance emphasis area include the development of an annual Emerging Trends and Transportation Report, which documents key demographic, geographic, and technological trends impacting system supply, demand, and performance. Another planned accomplishment is the continued development and improvement of methods, analysis, and estimation tools of user impacts of emerging technologies, including mobility access, benefits, and barriers, with an emphasis on underserved populations, consistent with the Department's efforts to develop new models for access and to understand and meet the transportation needs of rural populations. This effort is coordinated with FHWA program offices and OST research working groups to identify outcomes, assess gaps and needs, and present policy alternatives. Several topical policy briefs and summary reports will also be developed to synthesize cross-cutting issues and communicate technical research, findings, and alternatives to leadership and stakeholders.

The key FY 2020 accomplishment in the Geo-Economics of Transportation area will be the completion of a study of rural transportation exploring opportunities and barriers for rural mobility, economic growth, and safety.

Key FY 2020 objectives for Strategic & Performance Management research include: 1) Support for leadership discussions in defining strategic risks, objectives, and performance targets for policy making; 2) Identification of new data sources for performance indicators (e.g., people throughput); and, 3) Use of program evaluation methods and techniques to test underlying assumptions about program effectiveness and efficiency, which may lead to the development of new performance indicators. The focus of this emphasis area is to support FHWA's evaluation and performance measurement activities.

Main FY 2020 accomplishments for the Future Policy Symposia emphasis area include the implementation of 3-4 policy symposiums on critical transportation policy topics to support improved understanding of emerging issues, including potential outcomes, impacted groups, and policy options. Potential symposia topics include rural transportation, emerging theories in travel behavior incentives, federal roles in funding and investment, and other emerging trends. Each symposium gathers national experts and delivers summary white papers for use in strategic planning, research planning, and leadership decision-making.

The international activities conducted as part of this program fall within FHWA's role as a national leader and facilitator of innovation in the highway transportation industry, which is a governmental, rather than a private sector, role. Bringing these innovations and best practices to the U.S. for industry, while potentially opening access for U.S. companies abroad, provides benefits for the entire industry and the traveling public.

International program objectives include:

- Identifying, evaluating, and adapting innovative foreign technologies and practices that have the potential to significantly improve highway transportation in the U.S.
- Enabling U.S. stakeholders to access and accelerate deployment of technology, best practices, and information relevant to domestic transportation priorities.
- Promoting global awareness of U.S. technologies and best practices, which improves market access for U.S. transportation firms, whose services are based on U.S. standards.

Much of the policy research and analysis conducted as part of this program is intended to inform inherently governmental policy, regulatory, and strategy decisions, for which the private sector is not positioned to provide objective analytics or alternatives. Policy options can significantly shape the efficiency of transportation networks and the availability of transportation service to people and businesses. While FHWA taps the results of privately-funded research, effective stewardship of highway resources requires the availability of core data and analysis reflecting the full, broader public interest, as well as the quality control and transparency needed to be able to provide consistent and well-documented assumptions and methods behind the information used in making public decisions.

In FY 2020, the Global Benchmarking Program (GBP) will continue its mission of seeking and adapting foreign innovations that directly support U.S. DOT strategic goals. Specifically, the GBP plans to schedule two new studies on priority topics that will be identified by FHWA’s leadership. Additionally, activities to initiate implementation of findings and recommendations from GBP studies on Highway Tunnel Fire Systems and Shared Mobility will be completed.

The Multilateral Program’s mission to impart the United States’ knowledge and experience and promote ways of doing business on a global scale will remain the same. In FY 2020, the plan is to disseminate domestically the technical work produced by State and U.S. government representatives to the World Road Association technical committees and task forces. The products in the form of reports, guidelines, and other information tools, capture the U.S. perspectives and are invaluable tools for the professional roads community worldwide. State DOTs are leading the effort to promote and disseminate these products beyond the Federal sphere, including to counties, locals, and rural communities. In addition, several projects undertaken under the EC-USDOT Twinning Initiative will share findings on research performed in priority areas, such as automated and connected vehicle applications.

In FY 2020, the Bilateral Program will continue partnerships with other countries whose advances in highway research and practices are beneficial to FHWA’s priority goals and objectives, while supporting Departmental priority relationships and topics and looking for new opportunities. Examples include the U.S.–Japan Bridge Workshop planned for 2020, as well as the annual U.S.–Korea Roads Workshop. Coordination is underway for a possible Twinning research project with Japan, as well. Information from these activities will be disseminated to relevant programs, offices, and audiences. The Bilateral Program will also provide support for U.S. DOT efforts in furtherance of the Federal Government’s initiatives in the Indo-Pacific region.

Key FY20 FHWA [Policy Analysis and Global Outreach] R&T Program Activities.

Activity	Period of Performance	Partners/Notes
Impact of Investment on Conditions and Performance <ul style="list-style-type: none"> • Develop NBIAS version 5.4 • Develop HERS version 5.6 • Develop 25th C&P Report • Convert HERS from FORTRAN to modern program language 	2019-2021 2019-2021 2019-2021 2018-2021	FTA, FHWA program offices

Activity	Period of Performance	Partners/Notes
<p>Macroeconomic Impacts</p> <ul style="list-style-type: none"> Develop USAGE-Hwy v1.1 and analyze the macroeconomic impacts from highway investment Develop USAGE-Hwy v1.2 with additional updates in macroeconomic structure and engineering and economic model parameters Assess the intertemporal and spatial distribution of land value appreciation attributable to highway investment Update JOBMOD analysis tool and analyze the employment impact from highway construction 	<p>2018-2020</p> <p>2020-2022</p> <p>2020-2022</p> <p>2019-2020</p>	<p>Federal agencies, Volpe</p> <p>Federal agencies, Volpe</p> <p>Academia; Federal, State and local agencies; policy and research organizations; private sector</p> <p>Academia; Federal, State and local agencies; Congress</p>
<p>Benefit-Cost Analysis</p> <ul style="list-style-type: none"> Conduct economic analysis in support of FHWA proposed changes to regulations and in support of OST initiatives 	<p>2018-2024</p>	<p>FHWA program offices and OST Office of Chief Economist</p>
<p>Highway Costs and Funding Options</p> <ul style="list-style-type: none"> Produce National Highway Construction Cost Index Develop framing paper on modeling strategies for reflecting demand response to tolled and priced lanes Conduct study of highway construction cost factors Study implementation costs and other economic impacts of mileage-based user fees 	<p>Ongoing</p> <p>2019-2020</p> <p>2020-2022</p> <p>2020-2022</p>	<p>FHWA Office of Operations</p>

Activity	Period of Performance	Partners/Notes
<p>Emerging Trends and Future Performance</p> <ul style="list-style-type: none"> • Expand the understanding of performance measures and emerging mobility trends through demand analysis and prediction modeling. • Examine potential modeling and projection techniques to be used in the forecasting of these trends and performance measures. • Utilize trend analysis and forecasting to understand how uncertainties in emerging technologies and other mobility factors will affect user travel behavior and future mobility trends. • Support departmental analysis of policies related to automated vehicles. 	<p>2017 - 2023</p> <p>2017 - 2023</p> <p>2018 - 2021</p> <p>2017 - 2021</p>	<p>NHTSA, FHWA program offices, TRB, Census Bureau, BLS, university research centers, private industry, DOE, nonprofit and special interest groups</p>
<p>Geo-Economics of Transportation:</p> <ul style="list-style-type: none"> • Develop a set of geo-types to represent the categorization of regions that have similar potential system performance. • Develop a multi-modal decision support model to support impact analysis of different transportation policies, such as right-of way allocation, on transportation system performance within each geo-type. • Develop multi-modal macroscopic fundamental diagrams (MFDs) of the empirical relationship between the number of vehicles on a network and the average speed of vehicles on that network • Analysis of rural mobility, employment, and safety. 	<p>2018-2023</p> <p>2018-2023</p> <p>2020-2022</p> <p>2019-2020</p>	<p>FHWA program offices, U.S. DOT, university research centers, U.S. national laboratories, DOE</p>

Activity	Period of Performance	Partners/Notes
<p>Strategic and Performance Management:</p> <ul style="list-style-type: none"> Support Department efforts to implement requirements of the Foundations for Evidence-Based Policymaking Act of 2018 Provide technical and peer review support for policy research program coordination Provide program analysis support and cross-cutting research facilitation 	<p>2020-2024</p> <p>2017-2020</p> <p>2019-2021</p>	<p>U.S. DOT, FHWA program offices, OMB</p>
<p>Future Policy Symposia:</p> <ul style="list-style-type: none"> Host transportation symposia to provide a formalized information resource for FHWA to gain insight and perspectives on key transportation policy questions in the context of emerging trends. 	<p>2016 - 2021</p>	<p>Academia; Federal, State and local agencies; policy and research organizations; industry; private sector</p>
<p>Global Benchmarking Program (GBP)</p> <ul style="list-style-type: none"> Initiate two new GBP studies on priority topics identified by FHWA leadership. Complete initial implementation activities for GBP studies on Highway Tunnel Fire Systems and Shared Mobility. Continue activities to initiate implementation of findings and recommendations for 2019 GBP studies on Building Information Modeling for Infrastructure and Electrically Isolated Tendon Technology for Bridges. 	<p>2020-2023</p> <p>2018-2020</p> <p>2019-2021</p>	<p>Other FHWA HQ and field offices; AASHTO, NCHRP, TRB, State DOTs, U.S. academic institutions, occasional private sector partners, U.S. State Department, foreign national ministries of transport, foreign research institutes</p>
<p>Multilateral</p> <ul style="list-style-type: none"> Engage with the World Road Association, the Forum of European National Highway Research Laboratories (FEHRL), the Conference of European Directors of Road (CEDR), and the International Transport Forum (ITF), as well as strategically targeted collaborations, such as the EC-USDOT Transportation Research Project Twinning Initiative. 	<p>2016-2022</p>	<p>World Road Association, TRB, FEHRL, ITF, EU/EC, CEDR, State DOTs</p>

Activity	Period of Performance	Partners/Notes
Bilateral <ul style="list-style-type: none"> Continue FHWA's prioritized bilateral engagements, which cover topics, such as innovative financing, freight, infrastructure resilience, safety, bridges, binational planning and coordination, and pavement, among others. Bilateral partnerships currently include: Japan, Korea, the Netherlands, Australia, Mexico, Brazil, and Israel. 	2018-2021	U.S. State Department, U.S. Department of Commerce, U.S. Trade Development Agency, academic institutions, World Bank, Inter-American Development Bank, foreign ministries and embassies, State DOTs

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes (Partially)

The program is authorized in 23 USC §502 and 23 USC §503, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas to improve highway safety, improve infrastructure integrity, strengthen transportation planning and environmental decision-making, reducing congestion and enhancing freight productivity, among others. Research conducted under this program cuts across these areas, supporting the development of transportation policies and assessing the impacts of proposed and implemented policies. Policy research provides the foundation for the development of new policies and legislative actions, assists decision-makers in the evaluation and selection of policy options, and facilitates subsequent policy implementation. The international component of this program has a strong emphasis on technology and innovation development and deployment.

Within the domestic component of this research program area, one major focus is addressing the requirement under 23 U.S.C. §503(b)(8) for the submission of a biennial report to Congress that describes estimates of the future highway and bridge needs of the U.S and the backlog of current highway and bridge needs. Meeting the expectations of Congress requires an ongoing research investment to support model development, data analysis, and communication of results.

This research program supports the development of economic impact analysis of the regulations issued by the Federal agencies required under Section 6(a)(3)(c) of Executive Order (E.O.) 12866, "Regulatory Planning and Review," the Regulatory Right-to-Know Act, a variety of related authorities and the January 30, 2017, Presidential E.O. 13771, "Reducing Regulation and Controlling Regulatory Costs."

This program directs resources towards FHWA strategic and performance planning efforts, in accordance with the Government Performance and Results Act Modernization Act of 2010 (P.L. 111-352) and the Program Management Improvement Accountability Act (P.L. 114-264).

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

The Policy Analysis and Global Outreach program supports all four Department. Specific contributions are as follows.

Safety: This research program contributes to a systematic safety approach by developing data-driven baseline forecasts of crash and fatality rates reflecting changing economic and socio-demographic factors and travel behavior (including modal choices). This research provides a context for assessing the impacts of a range of broad policy options, as well as specific safety options, identified through participation in the U.S. DOT Safety Data Initiative, which is supported by this research program. Predictive methods and analysis, as well as socio-economic factors affecting rural travel safety, are being explored.

International safety-related activities include examples, such as supporting the development and dissemination of the Road Safety Manual for the World Road Association, collaboration with Japan and Korea on bridge and tunnel safety, and bridge and road safety, respectively, and U.S.-Mexico border States regarding incident management and first-responder operations.

Infrastructure: This research program supports the development and application of tools and techniques for evaluating the relative contributions of types of transportation investments, including specialized and priced lanes and multimodal applications. This research includes tracking and assessment of highway construction costs, baseline forecasts of system performance, and estimates of cost-effective investment levels that can be used in setting performance targets intelligently. Risk assessment is also addressed in this research area to support investment decisions and planning during an environment of uncertainty as is with rapid technology change. Transportation system investment, performance, and associated travel mobility are assessed for rural areas as well as for the nation. A major focus of the research program are issues pertaining to economic competitiveness, in general, and in performance-based infrastructure investments, in particular.

International infrastructure-related activities include supporting the (1) development and dissemination of World Road Association products in the form of reports, guidelines, and other information tools, capturing the U.S. perspectives on topics, such as asset management, bridges, and pavements; (2) implementation of findings and recommendations for GBP studies on Building Information Modeling for Infrastructure and Electrically Isolated Tendon Technology for Bridges; (3) exchanges with Korea on bridges, geotechnical topics, inspection techniques, infrastructure resiliency, and pavements; and, (4) collaboration with Japan on Intelligent Transportation Systems and bridge issues. These topics and the information learned have applicability to rural, suburban, and urban settings.

Innovation: This research program focuses heavily on the identification of emerging policy issues and support for the Agency's development of strategies for addressing them. This includes extensive coordination among stakeholders and exploration of emerging data analytic

and methodological approaches for assessing the impacts of policies and strategies, including FHWA's first use of Artificial Intelligence data fusion techniques to understand emerging travel behavior. This program takes innovative approaches to assessing the various ways in which transportation investments and economic development affect each other, including GDP, employment, and land use. This research program is also exploring multi-modal geo-economic variations in transportation infrastructure costs, travel demand, and transportation services to better understand how technology and socio-economic changes may be reshaping future transportation system performance and policy opportunities. This geo-economic approach includes specific consideration of the differing travel needs of rural communities. A major focus of the research program is mobility innovation, including new models for access and the needs of rural Americans.

The Global Benchmarking Program obtains and adapts foreign innovations that directly support U.S. DOT strategic goals and critical Research Development and Technology areas. Instead of re-creating advances already developed by other countries, the GBP facilitates the acquisition and adoption of technologies and best practices already available and used abroad. The FHWA is supporting dissemination and implementation efforts of web-based versions of the World Road Association's Road Safety, the Road Network Operations, and Asset Management manuals. The FHWA led the development of these products for the Association. Bilateral program activities directly address Agency priorities. The FHWA's Office of International Programs works closely with various Agency and Departmental offices to ensure that international topics and activities are geared to Strategic Goals and topics. The specific areas addressed by each bilateral relationship depend on the expertise of the country involved and the interests of our partners, both internal and international. Two examples are Japan, with whom FHWA has a long-standing collaboration on bridge and seismic issues that has been very beneficial, and Korea, with whom FHWA has worked on long-span and other bridges, pavements, road safety, and infrastructure resilience. Topics currently being addressed (and will continue into 2020) with Korea include robotics, nondestructive evaluation techniques, the use of Unmanned Aerial Systems related to roads, and resilience to severe weather events, such as hurricanes/typhoons.

Accountability: This program supports economic regulatory impact analyses conducted on behalf of the Office of Chief Counsel for all significant regulatory and deregulatory actions under consideration within FHWA. It enables more consistent and methodologically-sound application of lifecycle-cost and related economic-impact analysis for policy, strategic, programmatic, and project decision-making. This program's baseline forecasting also serves as an anchor for supporting accountable strategic planning and development of measurable performance targets within the context of longer-term transportation trends, supporting program evaluation and performance management.

The domestic portion of this program includes targeted research on rural communities, in particular measuring rural transportation access and identification of potential strategies for improvements. Past efforts include the development of access measures for all rural counties in the U.S., documenting distance to transportation facilities, work/shop centers, and broadband access. Current efforts include the development of rural technology research briefs on topics including the impacts of automated vehicle technology on rural communities, broadband internet access on rural transportation, and impacts of agricultural automation on rural areas. A separate set of rural economic research briefs and white papers covers topics on boom and bust cycles of rural infrastructure investment, level of investment in rural highways, and trends in rural transportation finance. Another white paper

discusses the migration patterns in and out of rural areas and factors influencing population growth and decline in these areas.

The international component of this program has supported investment in the development and implementation of the World Road Association products (noted above) that adapt well to the U.S. rural transportation arena. U.S. representatives from State DOTs are leading the effort to promote and disseminate these products beyond the Federal sphere, including to counties, locals, and rural communities. While the Bilateral program does not specifically target rural areas, the benefits from the exchanges are applicable to rural, suburban, and urban areas.

USDOT Research Priorities:

This program supports economic regulatory impact analyses conducted on behalf of the Office of Chief Counsel, including those for all deregulatory actions under consideration within FHWA. This supports the Economic Impact of Regulatory Reform research priority.

New FY 2020 research activities include a study to assess the intertemporal and spatial distribution of land value attributable to highway investment. The results will improve understanding of the relationship between Federal transportation policies and investments and community mobility, access, and economic characteristics. The findings will support U.S. DOT research priorities Potential Impacts of Value Capture and Improving Mobility for Underserved Communities.

Two emphasis areas, Emerging Trends and Future Performance and Future Policy Symposia, support the Mobility of Freight, Micro-Transit, and Mobility of Underserved Communities research priorities. The research conducted under these emphasis areas focuses on the transportation demand and system performance outcomes of emerging trends for both passenger and freight travel. Modeling, statistical, and policy analysis conducted under these emphasis areas provides for the identification of potential outcomes, estimation of transportation and system demand impacts, and the analysis of policy gaps and alternatives to support policy development, stakeholder engagement, and strategic planning.

The Geo-Economics of Transportation emphasis area supports the Feasibility of Micro-Transit, Improving Mobility for Underserved Communities, and Improving Mobility of Freight research priorities. FY 2020 research activities include the continuation of developing geo-typologies and a multimodal tool to analyze impact of different ROW allocation strategies.

A rural transportation study exploring opportunities and barriers for rural mobility, economic growth, and safety will be completed in FY 2020 and relates directly to the Improving Mobility for Underserved Communities research priority. The results of this study may lead to additional research products related to this topic.

The Office of International Programs (OIP) supports U.S. DOT research priorities, such as the Performance Based Safety Rules and Freight Mobility. One of many mechanisms used to support these priorities has been OIP's Global Benchmarking Program. The program focuses on acquiring and adopting proven foreign technologies and best practices that have the potential to significantly improve highway transportation in the U.S. For example, FHWA is in the implementation phase of the 2017 GBP study on *Tunnel Fixed Fire Fighting Systems (FFFS)*. Study findings – including evidence, noteworthy practices, and positive international experiences with FFFS – have not only prompted interest in safety initiatives that have fixed firefighting as a cornerstone but have also energized the U.S. tunnel community. Several tunnel-related research proposals are being considered by the

Transportation Research Board and an upcoming special issue of TRNews will focus on tunnels. Further evidence of the effectiveness of FFFS was recently demonstrated in Colorado's Eisenhower/Johnson Tunnel (which had been retrofitted with a FFFS system) in February 2019. On February 4, 2019, the technology was used for the first time in a real-life situation when a car burst into flames inside the tunnel. As firefighters raced to put out the flames, the fire suppression technology went into action. The system's fire suppression capabilities were instrumental in keeping the tunnel fire to a minor incident. The Colorado Department of Transportation stated that the fire suppression technology did exactly what it was supposed to do – control the fire.

U.S. DOT research priorities are further supported by OIP with its involvement in the World Road Association (WRA). The OIP's Multilateral Relations Program coordinates for FHWA's top management in all preplanning needs and support operations for the annual WRA meeting. In addition, FHWA provides support to FHWA's participation in the Association's technical bodies. Over the years, FHWA has led a broader U.S. commitment and enhanced involvement. This has afforded the U.S. the opportunity to exert influence globally on recent key road related issues, such as *Good Practices on Multi Freight Transport Policies and Truck Management on Highways*. These practices highlight projects, initiatives, and policies that have been utilized by member countries to provide increased efficiency within their respective freight transportation systems. Strategies and solutions from Austria, Belgium, Canada, Czech Republic, Finland, Italy, Japan, Norway, Switzerland, and the U.S. offer good practice ideas on a variety of topics, such as heavy vehicle charges, long combination vehicle programs, national highway freight programs, speed management of vehicles at work zones, Intelligent Transportation Systems based data collection and sharing of truck movement programs to promote the development of intermodal terminals and private sidings, and incentives for modal shift from road to rail transport.

Another example of OIP supporting the U.S. DOT research priorities of Performance Based Safety Rules and Freight Mobility is FHWA's relationship with South Korea. For over 20 years, OIP's Bilateral Relations Program has been working with its South Korean transportation counterpart to explore opportunities in highway engineering and safety, as well as in highway engineering innovations. Among the results is the Annual USA-Korea Roads Workshop. The 18th USA-Korea Roads Workshop was held in Seoul from December 4-8, 2018. In this workshop, there was agreement for the next two-year workplan to continue with road safety, extreme weather resilience, non-destructive robotic inspections for bridges, freight management, and geohazard impacts as they related to extreme weather.

Additional examples of OIP supporting research priorities include many years of exchanges related to freight management and movement with Australia, a world leader on the subject. Upcoming exchanges will also address Asset Recycling, another area in which Australia is a trailblazer, as well as truck platooning and parking issues.

Research Collaboration Partners:

FHWA policy staff regularly engage with key stakeholders in both formal and informal settings to gather input concerning challenges and opportunities that might be addressed through the program, as well as information on work undertaken by other organizations both nationally and internationally. A key tool for gathering stakeholder input are future policy symposia, a dialogue series that facilitates discussion with external experts and practitioners to frame future policy considerations and options. The information gathered via the symposia helps to broaden the relevance of future policy research and to avoid duplication with research being conducted by other entities. Input received via this mechanism are documented in summary reports.

Research collaboration is also undertaken through evaluations of proposed modeling improvements and interim research results by technical experts. For example, FHWA facilitated discussion of potential improvements to its HERS model by external users of the model.

The input obtained through these interactions is considered by program staff as they identify and formulate a program of research and technology initiatives that, in accordance with 23 USC 502(a)(3),

- Is of national significance;
- Delivers a clear public benefit and occurs where private sector investment is less than optimal;
- Supports a Federal stewardship role in assuring that State and local governments use national resources efficiently;
- Meets and addresses current or emerging needs;
- Addresses current gaps in research;
- Presents the best means to align resources with multiyear plans and priorities; or
- Presents the best means to support Federal policy goals compared to other policy alternatives.

Primary partners for the domestic portion of this program area include:

- FHWA Headquarters Program Offices (FHWA HQ)
- Federal Transit Administration (FTA)
- National Highway Traffic Safety Administration (NHTSA)
- Federal Aviation Administration (FAA)
- Office of the Secretary of Transportation, Bureau of Transportation Statistics (BTS)
- Department of Labor, Bureau of Labor Statistics (BLS)
- Department of Commerce, Bureau of the Census (Census)
- Transportation Research Board (TRB)
- Professional Societies
- Academic institutions (Academia)
- State and local agencies

Primary partners for the international portion of this program area include:

- FHWA (Headquarters and field offices)
- Office of the Secretary of Transportation, multiple offices (OST)
- U.S. Department of State, headquarters and embassies (State Dept.)
- U.S. Department of Commerce (Commerce Dept.)
- U.S. Trade and Development Agency (USTDA)
- American Association of State Highway & Transportation Officials (AASHTO)
- State Departments of Transportation (State DOTs)
- Academic institutions
- The Transportation Research Board
- Private sector partners (limited)
- Foreign national ministries of transport, foreign provincial/state ministries of transport, foreign ministries of foreign affairs/embassies (Foreign agencies)
- International Organizations – The World Bank, the World Road Association, the Forum of European National Highway Research Laboratories (FEHRL), the Inter-American Development Bank, the International Transportation Forum

Benefits of Partnership and Partner Contributions to FHWA Policy Analysis and Global Outreach Program

Partner Organization	User Perspective on Needs	Industry Perspective	Standard Setting	Field Trials	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Donation of Material or Services (Including Data)	Funding
FHWA HQ						X	X		X
FHWA Field		X		X	X		X	X	
FTA						X			
NHTSA				X		X			
FAA	X	X	X			X	X	X	
BTS						X	X	X	
Other OST			X						X
BLS	X		X	X		X		X	
Census	X		X	X		X		X	
Commerce	X	X	X		X		X	X	X
State Dept.							X	X	X
USTDA		X	X		X		X		X
NCHRP		X	X			X	X	X	X
TRB	X	X	X			X	X	X	
AASHTO	X	X	X		X	X	X	X	X
Academia	X		X	X	X	X	X	X	
State & Local agencies	X	X	X	X	X	X	X	X	X
Policy and Research Organizations		X				X	X		
Other Private Sector	X	X		X	X	X	X	X	X
World Road Association	X		X		X	X	X	X	X
FEHRL	X	X	X	X	X	X	X	X	X
EU/EC	X	X	X	X	X	X	X	X	X
CEDR	X	X	X	X	X	X	X	X	X
Inter-American Development Bank							X	X	X
Foreign Ministries and Embassies				X		X	X	X	X

Highway and Transportation Data

\$5,834,000

Program Description

The Highway & Transportation Data (H&TD) program is a set of activities covering research, development, and technology focused on supporting and advancing both current and future state of transportation data collection, processing, analysis, modeling, dissemination, and visualization.

The H&TD program directly supports policy and program activities and decision-making across the FHWA and the U.S. DOT. The H&TD program offers data and information that enable the U.S. DOT to carry out the RD&T strategic goals covering Safety, Infrastructure, Innovation, and Accountability. The H&TD program provides the foundation for the entire transportation community, which includes public entities, private businesses, and researchers for data and information. The H&TD program also provides support to data providers at State DOTs and MPOs through policy and technical guidance.

The Foundations for Evidence Based Policymaking Act of 2018 codifies the need for data to be more accessible both to the Department as well as the public. This increased access to data is intended to enable evidence based policy making and improve transparency. As part of an intermodal collaboration across the Department, all new projects funded in 2020 under the research plan will be examined to identify if they are producing data and whether or not the data can be shared. To meet this end, FHWA shall work with its partners in the other modes to establish common guidance related to data management plans, data discoverability, and technical assistance to project managers and awardees.

The H&TD program encompasses 8 key data areas as listed below:

- **A – FHWA 500 Series Data** include (a) fuel consumption (gasoline and special fuel), (b) licensed drivers, (c) registered vehicles, and (d) highway financing, including local, State, and Federal spending, revenue, tolls, and bonds. These data results enable integrated analysis to support the Federal-aid highway program.
- **B - Policy Information Data Portal (PIDP)** offers a single stop for all State agencies to submit required data to the FHWA and provides office- and agency-wide programmatic and analytic support.
- **C- Highway Performance Management System (HPMS)** provides the foundation for all Federal-aid highway programs.
- **D - Integrated Transportation Information Platform (ITIP)** offers a mechanism for integrated data analysis throughout the FHWA.
- **E - Data Visualization Center (DVC)** activities benefit the entire FHWA through its data analysis and visualization expertise and products.
- **F - Traffic Monitoring** collects and disseminates consistent traffic volume, class, and weight data for both motorized and nonmotorized vehicles and provides technical guidance for the transportation community.
- **G - National Household Travel Survey (NHTS)** provides the only national-level demographic, behavior, and origin/destination transportation data for the entire transportation community. NHTS enables future demand analysis and a wide range of project, program, and policy analysis and evaluation.
- **H - National Performance Dataset (NPD)** covers both the National Performance Management Research Dataset (NPMRDS) and the Performance Vehicle Occupancy data on an annual basis.

The NPD delivers travel time data for all NHS highways, as well as vehicle (truck, bus and POV) occupancy data for all States and urban areas, enabling transportation performance management for accountability and transparency. The annual NPD program enables trending analysis, detects new issues, increases data quality, and lowers the cost and the data reporting burden.

The above key data areas are supported by the H&TD research program with the following strategies:

- Develop and deploy effective policy and technical guidance and provide hands-on training and coaching to States and local MPOs on data acquisition and analysis.
- Develop and deploy effective IT technology to process data collected by States.
- Explore new alternative methods, approaches, and strategies to acquire needed data in a cost-effective, quality-driven, and timely manner.

The goal of the H&TD program is to ensure the FHWA, the U.S. DOT, and the transportation community will have access to timely, consistent, quality, and integrated data to enable informed decision-making by overcoming data source, data method, data integration, and data analytic challenges.

The goal of FHWA's H&TD program is to serve as the national source of surface transportation data. It is essential that it provides the U.S. DOT, Congress, and the transportation community with accurate information in a timely manner for the development and implementation of policies, legislation, programs, and performance goals, while constantly striving to improve the efficiency and effectiveness of data collection and analysis on travelers and the physical, operational, and financial condition of our transportation system.

Specifically, the H&TD data offer insight into (a) Safety strategy development in areas of human factors and behavior; (b) Infrastructure strategy covering areas of accelerated project delivery, risk based asset management, and system resilience; (c) Economic competitiveness in areas of performance based infrastructure investments, innovative freight practices, and Transportation Systems Management and Operations (TSMO); (d) Innovation in areas of new models for access and the needs of rural America; and, (e) Accountability strategies covering technology transfer, technology deployment, and data.

In addition, the H&TD program provides national leadership on transportation data through the development of national specifications and guidance and ongoing support and training for State data providers, as well as internal and external customers. The program's research addresses weaknesses or gaps in relevant technologies, knowledge, and analyses due to a lack of capabilities and/or interest from private entities. The focus has been on integrating public and private data, new data method development and deployment, and efficient data analytics.

Anticipated accomplishments in FY20 are listed below.

- **The Driver License, Finance and Motor Fuel, and Vehicle Data** initiative will enable better quality, consistency, and prompt submission of data through training and education to States and local agencies on how their data are being used for safety, financial, economic, and research purposes, as well as impacts their agencies may experience in the attribution and allocation process due to poor quality and untimely data submission.

With the U.S. transportation system in a transformative state, this initiative will also explore other ways the data can be used and any additional driver license, finance and motor fuel, and

vehicle data attributes needed to determine and trend safety concerns, emerging economic markets, and research needs.

- **The Policy Information Data Portal (PIDP)** initiative establishes and operates an on-line platform where State and local governmental agencies can upload data in this one-stop location. PIDP reduces burdens to State and local agencies and improves data quality and timeliness.

The first part of PIDP's coverage of transportation performance target data proves the concept is working. In FY20, PIDP will deploy a nexus sub-platform for submittal of driver license, finance and motor fuel, and vehicle data by State and local agencies with reduced errors and duplications of effort in a more user-friendly environment. This effort will also provide contractual onsite and offsite office- and agency-wide programmatic and analytic support to improve data quality, timeliness, and program efficiency.

- **The Highway Performance Monitoring System (HPMS)** initiative will implement the results of the recent HPMS Reassessment effort. The HPMS Reassessment developed new approaches to decrease data provider burdens related to data collection, submission, and management, while providing more timely, complete, and accurate data for end users.

This effort will (a) develop a system integration plan, (b) purchase any needed commercial off the shelf (COTS) software, (c) deploy and configure existing and new software, and (d) enhance or improve the existing graphical user interface (GUI).

- **The Integrated Transportation Information Platform (ITIP)** initiative will transform the existing server-based custom coded data warehouse into a cloud-based COTS solution with minimal custom coding. Initial testing determined this transformation to be cost-effective and will greatly improve our ability to integrate, analyze, and disseminate data.

Additional software will supplement existing software and capabilities to ensure ITIP is positioned to serve FHWA's future data needs. This effort will also involve adding data linkages to other FHWA and U.S. DOT data systems and data sets.

- **The Data Visualization Center (DVC)** will provide new visualization services using data from both FHWA and others for effective communication. Future services will continue to be driven by user needs and are expected to include developing charts, maps, reports, dashboards, infographics, and timelines. The work on weekly FHWA and bi-weekly OST Safety Data Initiative social media factoids will continue. Based on customer feedback, there continues to be a strong desire to use data to communicate effectively at FHWA.
- **The National Performance Dataset (NPD)** program offers travel time and occupancy data to all State DOTs and MPOs, enabling performance based infrastructure investments, innovative freight practices, and TSMO strategies.

The program will deliver (a) a year 2020 integrated performance dataset, including 5-minutes travel time, traffic volume, and vehicle class information, and (b) year 2020 vehicle occupancy data for passenger, bus, and truck covering all States and urban areas.

- **The Traffic Monitoring** program performs research on methods to improve traffic data collection and integration to increase data quality, utilization, and timeliness. The program will deliver a highly anticipated method on the utilization of passive data (e.g., cellular, GPS, location based service APP) as input to derive traditional traffic data (e.g., volume). Passive data is currently only being used to derive travel speed information. This effort, which is anticipated to be completed in 2020, will significantly reduce the traffic data collection burden for States while greatly increasing the data coverage. In addition, the traffic monitoring program will attempt to develop a national database covering empty truck weight information to improve freight analysis with documented methods, as an anticipated 2020 deliverable.
- **The National Household Travel Survey (NHTS)** serves as the only source of national-level travel behavior data and is used extensively for demographic, behavior, and human factor analysis related to transportation program and project development. The NextGen NHTS will deliver the year 2020 travel behavior data and travel origin/destination data, enabling corridor, regional, and national integrated passenger and freight analysis in partnership with over a dozen State DOTs, MPOs, and private entities. These 2020 data will also enable travel behavior trend change detection, pro-active transportation program and project planning, and policy and program scenario analysis.

Key FY20 FHWA H&TD R&T Program Activities.

Activity	Period of Performance	Partners/Notes
<p>Driver License, Finance and Motor Fuel, and Vehicle Data</p> <ul style="list-style-type: none"> • Transition from State reporting of aggregate motor vehicle registration and licensed driver data, to bulk reporting of unaggregated VIN and driver license data • Develop methodology for aggregating and reporting new motor vehicle and licensed driver data • Collect data at a national level on State laws, taxes, and fees pertaining to motor fuels, licensed drivers, motor vehicle registrations, and State and local financing 	<p>2019-2021</p> <p>2020-2021</p> <p>2021-2022</p>	<p>All State DOTs, DC, PR, and MPOs</p>
<p>Policy Information Data Portal (PIDP)</p> <ul style="list-style-type: none"> • Convert the current State data submission of 500 Series Forms (driver license, finance and motor fuel, and vehicle data) to the Data Portal platform • Transition the current driver license, finance and motor fuel, and vehicle data 	<p>2020-2022</p> <p>2020-2020</p>	<p>All State DOTs, DC, PR, and MPOs</p> <p>FHWA Offices of Operations, Infrastructure, Safety, and Planning</p>

<p>processing system (Fuels and FASH) to the Data Portal platform</p> <ul style="list-style-type: none"> • Deliver TPM target data • Provide onsite and offsite data and program support for all data and program areas for the office and agency 	<p>2020-2020</p> <p>2020-2020</p>	
<p>Highway Performance Monitoring System (HPMS) v8.0</p> <ul style="list-style-type: none"> • Implement priority highway performance data through enhanced IT system to control data quality • Collect, analyze, and release highway inventory, annualized traffic data and pavement data through enhanced methods • Deliver full set of data for Apportionment, C&P Report, Freight, Congestion, and TPM usages • Carry out National Data Quality Initiative 	<p>2019-2023 (continuous on a calendar year data cycle)</p> <p>2019 - 2020</p>	<p>All State DOTs, DC, and PR</p>
<p>Highway Performance Monitoring System (HPMS) v9.0</p> <ul style="list-style-type: none"> • Procure services of system integrator to develop integration plan • Purchase and deploy needed COTS software • Configure software and begin developing business rules • Enhance and improve GUI and develop standard reports, visualizations, and other data products • Incorporate purchased NHS speed limit data in HPMS 	<p>2019-2020</p> <p>2019-2020</p> <p>2020-2022</p> <p>2020-2023</p> <p>2019-2020</p>	<p>All State DOTs, DC, and PR</p>
<p>Integrated Transportation Information Platform (ITIP)</p> <ul style="list-style-type: none"> • Update the ITIP and deploy it with one-third of Division Offices • Explore partnerships with other Federal and quasi-governmental agencies to acquire alternative roadway data to expand our knowledge of the nation's roadway infrastructure • Initiate a project to acquire additional roadway attribute data from public or private data sources 	<p>2019-2023</p> <p>2020-2022</p> <p>2020-2023</p>	<p>Other FHWA system owners; potential DOT data owners; other Federal agencies such as Census, USGS, and FLMAs; quasi-governmental agencies such as US Postal Service and Amtrak; and private sources such as Google, Inrix, Streetlight, etc.</p>

<p>Data Visualization Center (DVC) 2.0</p> <ul style="list-style-type: none"> • Provide analysis and skilled visualization service for FHWA and others 	<p>2019 - 2023</p>	<p>FHWA-wide</p>
<p>National Performance Data – the NPD program is on an annual cycle with efforts to improve data method and quality while reducing collection cost and reporting burden.</p> <ul style="list-style-type: none"> • Collect, process, analyze, and release the 2020 NPMRDS data covering all NHS roadways in partnership with all State DOTs and MPOs through improved and enhanced methods • Integrate the 2020 NPMRDS data with 2019 HPMS data, enabling integrated analysis • Deploy the big data analytical method to derive 2020 Performance Vehicle Occupancy Data for all States and urban areas enabling transportation performance management • Publish machine-readable versions of all public data 	<p>2017 – 2023 (continuous on a calendar year data cycle) Effort listed in the left pane are for 2020</p>	<p>All State DOTs, DC, PR, and MPOs</p>
<p>Traffic Monitoring and Traffic Data</p> <ul style="list-style-type: none"> • Deliver big data analytical methods based on passive data for AADT data computation • Collect and process monthly traffic volume data • Generate the monthly Traffic Volume Trend (TVT) report • Develop national truck tear (empty) weight database, improving freight movements: methods for 2020 • Update and debug the current IT data processing codes • Improve current codes in processing vehicle weight data 	<p>2019-2023 (continuous on a monthly data cycle) Effort listed in the left pane are for 2020</p>	<p>All State DOTs, DC and PR</p> <p>On the passive data AADT method effort, the following 16 States have contributed financially: Alaska, California, Colorado, Idaho, Illinois, Maryland, Minnesota, Nebraska, New Jersey, North Carolina, North Dakota, Ohio, Pennsylvania, South Carolina, Texas and Virginia</p>

<p>National Household Travel Survey (NHTS)</p> <ul style="list-style-type: none"> • Test out the passive data for passenger origin destination (OD) data • Deploy the passive OD method to obtain 2020 OD data • Deliver national core behavior data answering why, how, and when people travel • Execute appropriate agreements with State DOTs and MPOs for data gathering and cost sharing 	<p>2020-2024</p> <p>Effort listed in the left pane are for 2020</p>	<p>All State DOTs, DC, PR, MPOs and others</p> <p>The following entities have contributed financially to the 2020 data collection and method development effort: Metropolitan Washington COG, AAA foundation for Traffic Safety, Arizona DOT, Georgia DOT, Michigan DOT, New York DOT, Ohio DOT, Oklahoma DOT, Oregon DOT, and Virginia DOT</p>
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Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes___

The highway and transportation data programs are authorized by various statutes. The current FAST Act Section 6028 provides the most recent authorization to all eight areas.

In addition, the H&TD programs are directly and indirectly statutorily mandated by the following:

- 23 USC § 143 – Directly authorizes the Highway Use Tax Evasion Program, which is one of the H&TD programs.
- 23 USC § 315 – Authorizes the Secretary to prescribe and promulgate all needful rules and regulations for the carrying out of the provisions of title 23, which broadly covers the rules and regulations of the various data programs.
- 23 USC § 104 – Authorizes the apportionment factors. Several of the data programs, by their data being cited specifically as Apportionment factors, are authorized directly by this section.
- 23 USC § 503 – Directs FHWA to conduct the biennial Condition & Performance (C&P) Report to Congress. The Highway Performance Monitoring System (HPMS) is specifically cited in this section, and the remaining data programs are indirectly mandated since they provide needed data for the C&P Report.
- 23 USC § 103 – The HPMS and ITIP are indirectly mandated since they serve as systems of record for many of the national performance measures.
- 23 USC § 150 – The HPMS is indirectly mandated since it will soon serve as the system of record for the National Highway System.
- 23 USC § 167 – The HPMS is indirectly mandated since it will soon serve as the system of record for the National Highway Freight Network.
- 23 CFR § 420.105 (b) – Requires State DOTs to provide data that support FHWA’s responsibilities to Congress and to the public.
- 44 USC § 3506 – Requires Federal agency to make data open by default.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

FHWA's H&TD program serves a foundational role in achieving all the DOT's Strategic Goals. Specific contributions are as follows:

DOT Strategic Goals

Safety: The H&TD program contributes directly to highway safety and the Department's Systematic Safety Approach by providing mission critical human factor and exposure data on personal and commercial travel, highway system performance and use, traveler demographics and use, weigh-in-motion and vehicle classification, vehicle registrations, and licensed drivers. The H&TD program continues to enhance and offer innovative tools and techniques for analyzing, visualizing, and disseminating transportation data to support Department-wide safety programs.

Infrastructure: The H&TD program provides mission critical data on the nation's infrastructure to support the infrastructure strategy covering areas of accelerated project delivery, risk based asset management, and system resilience, in addition to supporting the Federal-aid program performance management initiative and several Agency-wide programmatic needs. These data include: highway system condition, performance, and use; personal and commercial travel; traveler demographics and use; weigh-in-motion and vehicle classification; and highway finances. The program continues to enhance training and support for data providers, while also expanding the tools and techniques used to quality check, analyze, visualize, and disseminate past, present, and future data. Several of the data programs are undergoing reassessments to ensure their ability to meet current and future Department-wide needs.

Innovation: The H&TD program continues to be a hotbed for testing and deploying new technologies and techniques for data collection, processing, analysis, and visualization. The program developed a generic data portal using commercial off the shelf software (COTS) for any program or office to use for collecting form based data, thus eliminating the need to build new systems every time an office or program wants to collect new data. The program developed statistical big data methods to derive vehicle occupancy factors versus the time-intensive and expensive traditional survey method. The program manages the Data Visualization Center (DVC), which is an Agency-wide service providing customized data visuals, assistance with existing data visualizations, and consulting services. Since its inception, the DVC has received over 150 requests for services from 40 offices throughout FHWA and the U.S. DOT. In addition, on the data application front, significant effort has been devoted to cooperating and partnering with private businesses on adopting and using private data.

Accountability: The H&TD program serves a critical role in implementing the Transportation Performance Management (TPM) requirements of MAP-21 and the FAST Act that were codified in 23 USC § 103. The HPMS serves as the system of record for the travel, pavement, National Highway System (NHS), adjusted urbanized boundaries, and speed data. The Integrated Transportation

Information Platform (ITIP), which is the name of the data warehouse, will serve as the central repository for all TPM data. The NPMRDS offers State and local agencies the data needed for the TPM. The program also provides information on how much States and locals spend annually on transportation by various categories of improvements, including, but not limited to: capital improvements, restoration and rehabilitation, maintenance, and safety.

The passive data methods explored will significantly improve rural traffic data collection efficiency and coverage.

USDOT Research Priorities:

The H&TD R&D program offers data covering infrastructure inventory, traffic flow and traffic conditions (volume, speed, weight), travel behavior, pavement conditions (pavement roughness), demand data on licensed drivers, registered vehicles, fuel consumption, and financing data covering local, State, and Federal expenditure and revenue. The H&TD data are the foundation to carry out all the U.S. DOT research priorities.

Mobility of Freight - The next version of ITIP, along with HPMS v9.0, will greatly improve data timeliness, decrease the burden on States, explore the inclusion of purchased data, include MIRE data items, and include the National Highway Freight Network and any associated data. The new HPMS v9.0 data model will greatly improve the spatial accuracy of the HPMS data, enhance the ability to perform temporal analysis, and improve the ability to spatially integrate HPMS with other FHWA and U.S. DOT data, all of which will greatly strengthen the ability to conduct mission critical performance, safety, and freight analysis.

Cybersecurity - The FHWA Chief Data Officer and FHWA security and enterprise architect staff are closely consulted on all system enhancements and new development. The Foundations for Evidence Based Policymaking Act of 2018 codifies the need for data to be more accessible both to the Department and the public. This increased access to data is intended to enable evidence based policy making and improve transparency. As part of an intermodal collaboration across the Department, all new projects funded in 2020 under the research plan will be examined to identify if they are producing data and whether the data can be shared. To meet this end, the Office of Highway Policy Information will work with its partners in the other modes to establish common guidance related to data management plans, data discoverability, and technical assistance to project managers and awardees.

Research Collaboration Partners:

The H&TD program staff regularly engage with key stakeholders in both formal and informal settings to gather input concerning challenges and opportunities that might be addressed through the program, as well as information on work undertaken by other organizations, both nationally and internationally.

Stakeholders include representatives of individual highway agencies (State DOTs), metropolitan planning organizations (MPOs), pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB), industry organizations, such as the American Trucking Associations, American Bus Association, and others, and private businesses, such as GOOGLE, Inrix, Airsage, Streetlight, CitiLabs, Caliper, SAS, and Teralytics. The H&TD staff also partner with researchers from universities and other public and private entities.

Formal interactions with AASHTO, TRB, and industry organizations generally occur at regular intervals (at least annually, and as often as quarterly). Interactions with States and MPOs tend to be on a more frequent, but ad hoc, basis. Inputs obtained through these interactions are considered by program staff

as they identify and formulate the research program and technology initiatives that, in accordance with 23 USC 502(a)(3):

- Are of national significance;
- Deliver a clear public benefit and occur where private sector investment is less than optimal;
- Support a Federal stewardship role in assuring that State and local governments use national resources efficiently;
- Meet and address current or emerging needs;
- Address current gaps in research;
- Present the best means to align resources with multiyear plans and priorities; and
- Present the best means to support Federal policy goals compared to other policy alternatives.

Program partners (both government and non-government), benefits derived from partnerships, and partner contributions are summarized in the following table.

Benefits of Partnerships and Partner Contributions to FHWA Highway and Transportation Data R&T Program

Partner Organization	User Perspective on Needs	Data Provider Perspective	Industry Perspective	Standard Setting	Testing	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Donation of Data or Services	Funding
Internal DOT Partners: NHTSA, FMCSA, FTA, BTS, Volpe, and OST	X			X	X	X	X	X	X	X
Other Federal Partners: FMLAs, DOE, DOD, Census, and USGS	X			X		X	X	X	X	X
Data-related AASHTO Committees		X		X	X	X	X			
State Departments of Transportation		X		X	X	X	X	X		X
Metropolitan Planning Organizations		X		X		X	X			
National Laboratories			X	X				X		
Universities	X							X	X	
American Trucking Associations			X			X				

American Bus Association			X			X			
American Association of Retired Persons			X						
Association of Motor Vehicle Administrators			X						
Vendor Community			X				X	X	

Driver License, Finance and Motor Fuel, and Vehicle Data – Driver license, finance and motor fuel, and vehicle data are currently collected and submitted by State and local public entities. The quality and timely submission are dependent on a strong partnership between FHWA and the States. The benefactors of this collaboration are the States themselves, the safety community, researchers, the insurance industry, and economic and policy decision-makers.

Policy Information Data Portal – The establishment of the Policy Information Data Portal is based on feedback from State agencies seeking a one-stop place for Federal data submittal. The portal development is led by the Policy Information office and supported by several other offices within FHWA. The eventual goal is to convert all data collection mechanisms to this platform.

HPMS 9.0 – Having completed the latest HPMS Reassessment, FHWA will develop HPMS 9.0 based on the Reassessment findings. The Reassessment effort involved a direct solicitation of stakeholder data needs and data collection and management capabilities, with the goal of achieving the highest quality data in a timely and complete manner without increasing the burden on the data providers.

ITIP 2.0 – ITIP 2.0’s migration to the cloud will allow for increased data integration capabilities, allowing for better and more complete data analysis. It is envisioned that ITIP 2.0 will have a public facing component, making available integrated accepted data for use by the public. Currently, the public would need to make data requests from each of the system owners and find a way to combine the data on their own.

Historically, data has been collected and reported by State DOTs. In 2018, for the first time, private data was purchased for inclusion in HPMS. Purchasing the speed limit data on the NHS was not as straightforward or easy as anticipated, so future efforts are going to explore additional sources and methods for acquiring or collecting these data. This includes pursuing possible partnerships with the US Postal Service and Federal agencies like the Census Bureau, US Geological Survey, and the Federal Lands Management Agencies.

DVC 2.0 – The DVC 2.0 will provide new analytical and expanded visualization service to FHWA and others. Because of the DVC visualizations, FHWA has grown its capability and interest in analytical software. For example, the DVC just provided FHWA and others with two days of hands-on training in Tableau. FHWA uses the DVC services to better communicate with traditional stakeholders and now with the public through social media. State DOTs have been inspired by the DVC weekly social media output to create their visualization products to help them communicate with their stakeholders.

National Performance Data Program – All State highway agencies and MPOs are partners in improving data quality via different specifications. Interactions among partners are carried out through regularly scheduled quarterly webinars, where issues are addressed and good practices are shared and promoted. In addition, the NPMRDS relies on knowledge and data that reside with private businesses.

In this case, instead of collecting such data by FHWA or via State agencies, the FHWA gains such data from Inrix/UMD/TTI through a contract. Because of the engagement of private business and contract competition, costs are reduced and the preparedness of the data is improved.

Travel Monitoring Program – The proposed research to explore passive data to derive AADT information and deploy such methods is a partnership among FHWA and 16 State highway agencies (Alaska, California, Colorado, Idaho, Illinois, Maryland, Minnesota, Nebraska, New Jersey, North Carolina, North Dakota, Ohio, Pennsylvania, South Carolina, Texas and Virginia). All involved partners contribute financially to the research, provide feedback to research activities, and champion the deployment of new methods and approaches. The effort will rely on private data owners to carry out the research activity given that no governmental entities have such input data.

National Household Travel Survey (NHTS) – The proposed NHTS core behavior data and origin destination data method development and deployment program is an FHWA-led national data program. The following entities have committed to provide financial support to the program: Metropolitan Washington COG, AAA Foundation for Traffic Safety, Arizona DOT, Georgia DOT, Michigan DOT, New York DOT, Ohio DOT, Oklahoma DOT, Oregon DOT, and Virginia DOT. The Atlanta Regional Council, Arkansas DOT, Rhode Island DOT, and Tennessee DOT have also expressed interest in joining the program.

Every Day Counts Program

\$5,889,000

Program Description

The Every Day Counts (EDC) Program (*On-Ramp to Innovation*) is a State- and Local-based program that identifies and rapidly deploys proven, yet underutilized innovations to enhance roadway safety, shorten the project delivery process, reduce roadway congestion, and integrate automation. Proven innovations promoted through EDC facilitate greater efficiency at the State and local levels, saving time, money, and resources that can be used to deliver more projects.

Program Objectives

The ultimate objective of the program is for innovations that enhance safety, accelerate project delivery, improve mobility, and integrate automation into the State and local transportation agencies' business practices. The EDC program has made a significant positive impact in accelerating the deployment of innovations and in building a culture of innovation within the transportation community. Since its inception, each State has used 14 or more of the 43 innovations promoted through EDC, and some States have adopted more than 30. Many of these innovations are now mainstream, standard practices across the country.

Key FY20 Program Activities.

Activity	Period of Performance	Partners/Notes
EDC-5 Innovation Deployment	Ongoing (January 2019- December 2020)	
Stakeholder engagement to identify innovations for inclusion in EDC-6	Fall 2019-Spring 2020	

Statutory Requirements:

Is this program statutorily mandated (Y/N): Y

FAST Act § 1444, 6002-6004; 23 U.S.C. 502-503

The FAST Act requires FHWA to continue its innovation partnership, Every Day Counts, and work with stakeholders to identify a new collection of target innovations, best practices, and data at least every two years. [FAST Act § 1444]

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

The EDC Program accelerates the deployment of innovations, which support all four goals of the DOT Strategic Plan. In addition, many of the innovations advanced under this program are having a significant positive impact on rural communities (e.g., the Reducing Rural Roadway Departures initiative in EDC-5).

USDOT Research Priorities:

The EDC Program supports many of the USDOT Research Priorities through the individual innovations that are advanced by the program. For example, [Value Capture](#) is one of the current EDC initiatives.

Examples of EDC innovations which directly support **Regulatory Reform and/or Permitting Reform** include but are not limited to:

- [Clarifying the Scope of Preliminary Design](#) (*)
- [Community Connections](#)
- [Enhanced Technical Assistance with ongoing Environmental Impact Statements](#) (*)
- [Flexibilities in Right-of-Way](#) (*)
- [Flexibilities in Utility Accommodation and Relocation](#) (*)
- [Improving Collaboration and Quality Environmental Documentation \(FOIL and IQED\)](#) (*)
- [Improving DOT and Railroad Coordination](#) (*)
- [Implementing Quality Environmental Documents](#) (*)
- [Integrating NEPA and Permitting](#) (*)
- [Locally Administered Federal-Aid Project: Stakeholder Partnering](#) (*)
- [Locally Administered Federal-Aid Projects](#) (*)
- [Planning and Environmental Linkages](#) (*)
- [Programmatic Agreements](#) (*)
- [Project Bundling](#) (*)
- [Regional Models of Cooperation](#) (*)
- [Use of In-Lieu Fee and Mitigation Banking](#) (*)
- [Virtual Public Involvement](#) (*)

(*) – Innovations that have a direct, positive impact on rural communities.

Examples of EDC innovations which directly support **Performance Based Regulations and Safety:**

- [Adaptive Signal Control](#)
- [Automated Traffic Signal Performance Measures \(ATSPMs\)\(*\)](#)
- [Data-Driven Safety Analysis\(*\)](#)
- [High Friction Surface Treatment\(*\)](#)
- [Intersection and Interchange Geometrics](#)
- [National Traffic Incident Management Responder Training](#)
- [Reducing Rural Roadway Departures\(*\)](#)
- [Road Diets*](#)
- [Road Weather Management – Weather-Savvy Roads\(*\)](#)
- [Safe Transportation for Every Pedestrian \(STEP\) \(*\)](#)
- [Safety EdgeSM \(*\)](#)
- [Smarter Work Zones](#)
- [Using Data to Improve Traffic Incident Management](#)
- [Weather-Responsive Management Strategies](#)

(*) – Innovations that have a direct, positive impact on rural communities.

T2 Collaboration Partners:

Every two years, FHWA issues a public Request for Information to seek input and suggestions from State Transportation Departments, local governments, tribes, private industry and other stakeholders to identify a new collection of innovations to champion that merit accelerated deployment. FHWA refines the list of suggestions received to include the innovations with the greatest potential to have transformative impact on transportation, and engages with key transportation organizations to ensure the list of innovations is most reflective of stakeholder demand. After selecting the EDC innovations for each new round, FHWA convenes transportation leaders from across the country at regional summits to discuss and identify opportunities for implementing the innovations that best fit the needs of their respective State transportation programs. Following the summits, States and Locals finalize their selection of innovations, establish performance goals for the level of implementation and adoption over the upcoming two-year cycle, and begin to implement the innovations with the assistance of the technical teams established for each innovation.

Benefits of Partnership and Partner Contributions to FHWA.

Partner Organization	Stakeholder Engagement	Suggest Topics for Inclusion in Program	Participation on EDC deployment teams	Raise Education and Awareness	Innovation Deployment
American Association of State Highway Transportation Officials (AASHTO)	X	X	X	X	X
American Road & Transportation Builders Association (ARTBA)	X	X		X	X
American Society of Civil Engineers (ASCE)	X	X		X	X
American Public Works Association (APWA)	X	X	X	X	X
Associated General Contractors (AGC) of America	X	X		X	X
Association of Metropolitan Planning Organizations (AMPO)	X	X	X	X	
National Association of County Engineers (NACE)	X	X	X	X	X
American Traffic Safety Services Association (ATSSA)	X	X	X	X	X
Institute of Transportation Engineers (ITE)	X	X		X	X
National LTAP Association (NLTAPA)	X	X	X	X	X
National Asphalt Pavement Association (NAPA)	X	X	X	X	X
The Portland Cement Association (PCA)	X	X	X	X	X
ITS America	X	X	X	X	X
Transportation Research Board (TRB)				X	

**State Transportation Innovation Council (STIC) Incentive Program
\$5,074,000**

Program Description

Key components to the success of innovation deployment programs such as EDC are the State- and Local-based approach and the State Transportation Innovation Council (STIC) concept. A STIC or other equivalent task force, committee or group brings together public and private transportation stakeholders to evaluate innovations and spearhead their deployment in each State. Each State operates its innovation deployment council, task force, committee or group based on its unique business needs and approaches to meeting those needs. The STIC or an equivalent group puts the transportation community in each State in the driver’s seat to comprehensively and strategically consider sources of innovation, select those innovations that best fit its unique program needs, and then quickly put those innovations into practice. A formalized council or group affirms a State’s commitment to institutionalize innovations, ensuring innovation deployment will continue as a business practice for years to come—establishing a culture of innovation. The FHWA STIC Incentive program provides resources to help foster a culture for innovation and make innovations standard practice in their States. Through the program, funding up to \$100,000 per State per Federal fiscal year is made available to support or offset the costs of standardizing innovative practices in a State transportation agency or other public sector STIC stakeholder

Program Objectives

The STIC Incentive Program provides resources to advance innovations into standard practices in a State transportation agency or other public-sector stakeholder and foster a culture of innovation. States with a strong culture of innovation leverage the resources of the transportation community within the state to get the appropriate innovations into practice quickly. The establishment of a well-organized STIC or equivalent group, defined processes and procedures, and engaged leadership serve as the foundation for fostering a culture of innovation within a state. The STIC structure is essential to ensure that innovation deployment remains a State-based initiative. Each STIC has established a Charter to defines its mission, scope, membership, and administration (Template Charter available [here](#)).

Key FY20 FHWA STIC Incentive Program Activities.

Activity	Period of Performance	Partners/Notes
STIC Incentive project awards	Ongoing	
National STIC Network Meeting(s)	Fall 2019 and Spring 2020	FHWA-facilitated review of national-level initiatives and highlight of individual STICs’ achievements
2020 STIC Excellence Awards Program	Summer/Fall 2020	Partnership with AASHTO Innovation Initiative

Statutory Requirements:

The STIC Incentive program is advanced under the Technology and Innovation Deployment Program (TIDP) (as specified in 23 USC 503(c)), which includes four initiatives:

- accelerated innovation deployment (AID);

- implementation of future strategic highway research program (SHRP2) findings and results;
- accelerated implementation and deployment of pavement technologies; and
- advanced transportation innovation deployment.

The TIDP relates to all aspects of highway transportation, including planning, financing, operation, structures, materials, pavements, environment, construction, and the duration of time between project planning and project delivery. Per 23 U.S.C. 503(c)(1), the goals of TIDP are as follows:

- significantly accelerate the adoption of innovative technologies by the surface transportation community;
- provide leadership and incentives to demonstrate and promote state-of-the-art technologies, elevated performance standards, and new business practices in highway construction processes that result in improved safety, faster construction, reduced congestion from construction, and improved quality and user satisfaction;
- construct longer-lasting highways through the use of innovative technologies and practices that lead to faster construction of efficient and safe highways and bridges;
- improve highway efficiency, safety, mobility, reliability, service life, environmental protection, and sustainability; and
- develop and deploy new tools, techniques, and practices to accelerate the adoption of innovation in all aspects of highway transportation.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

The STIC Incentive Program supports all four goals of the DOT Strategic Plan. In addition, many of the innovations advanced under this program are having a significant positive impact on rural communities.

A summary of all STIC Incentive Projects to date is provided at:

https://www.fhwa.dot.gov/innovation/stic/incentive_project/

USDOT Research Priorities:

To the extent that STICs pursue further adoption and standardization of EDC innovations previously identified, the STIC Incentive Program supports many of the USDOT Research Priorities through individual projects.

T2 Collaboration Partners:

Each STIC is comprised of a diverse membership; the broader the diversity of the transportation industry represented on the STIC, the greater the opportunity to be comprehensive in performing the actions noted above. STIC membership typically includes the following:

- State DOT

- Federal Highway Administration (FHWA)
- Local Technical Assistance Program (LTAP)
- Local Public Agencies (LPAs)
- Industry Associations (APWA, NACE, NACO, etc...)
- Tribal representation (if applicable)
- Research liaison or Research Advisory Committee (RAC)
- Metropolitan Planning Organizations (MPOs)
- Contractors
- Consultants
- Federal Resource Agency
- University Transportation Center (if applicable)

Partner Organization	STIC Membership	Project Identification	Education and Outreach	Recognition Program
State DOT	X	X	X	X
Federal Highway Administration (FHWA)	X		X	
Local Technical Assistance Program (LTAP)	X	X	X	
Local Public Agencies (LPAs)	X	X		
Industry Associations (APWA, NACE, NACO, etc...)	X	X		
Tribal representation (if applicable)	X	X		
Research liaison or Research Advisory Committee (RAC)	X	X		
Academic Institutions	X	X		
AASHTO Innovation Initiative			X	X

Accelerated Innovation Deployment (AID) Demonstration Program \$5,889,000

Program Description:

The Accelerated Innovation Deployment (AID) Demonstration Program provides funding to State DOTs, federal land management agencies, tribal governments, metropolitan planning organizations, and local governments to offset the risks associated with the initial deployment of an innovation by that agency. Innovations funded by AID can come from EDC or other sources. Funds are available to cover the full cost of implementation of an innovation on a project, up to the maximum amount of \$1 million per each individual award, in areas such as planning, financing, operations, pavements, structures, materials, environment, and construction.

The AID Demonstration Program provides funding to support the pilot/demonstration of innovations on projects by State DOT, federal land management agencies, tribal governments, metropolitan planning organizations, and local governments. Funding recipient reports on experiences and lessons learned from each innovation deployment are shared via the program web site to provide technology transfer.

Program Objectives:

The objective of the AID Demonstration program is to accelerate the deployment and adoption of proven innovative practices and technologies, and through enhanced technology transfer encourage a more widespread rate of adoption. FHWA established the AID Demonstration program to provide transportation agencies the resources to mitigate risks associated with first-time or early adoption of innovations on transportation projects. The AID Demonstration Program helps infrastructure owners overcome the conservative culture found within the transportation industry by offsetting some of the financial risks associated with first-time adoption of new technologies or practices.

Key FY20 FHWA AID Demonstration Program Activities.

Activity	Period of Performance	Partners/Notes
Award the maximum number of grants commensurate with the available funding.	Ongoing	
Prepare a new NOFO to enable continuation of program in FY 2021; current NOFO references program availability through the end of FY 2020	1 st Quarter preparation of draft	

Statutory Requirements:

This program is authorized in section 503(c)(2)(B)(i) of title 23, United States Code, which requires the Secretary to establish and carry out demonstration programs.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

The FHWA AID Demonstration Program supports the Department’s Safety, Infrastructure, Innovation and Accountability Strategic Goals. Specific contributions are as follows:

Safety: The AID Demonstration Program contributes directly to highway safety, on a project-by-project basis, by providing resources to infrastructure owners to implement innovative safety projects that improve the safety of the traveling public. Examples include, but are not limited to, design and construction of roundabouts, diverging diamond interchanges, or other proven interchange geometrics, and implementing road diets.

Infrastructure: Numerous AID Demonstration grant awards have supported infrastructure related goals. These include projects incorporating Accelerated Bridge Construction (ABC) technologies; the use of compacted concrete pavement, ultra-high-performance concrete, intelligent compaction, warm mix asphalt and e-Construction.

Innovation: The AID Demonstration Program directly contributes to the advancement of innovative technologies and practices by transportation agencies. AID Demonstration projects must pilot practices or technologies which the applicant has not yet used as conventional practice, but intends to implement and adopt as a significant improvement. Through the AID Demonstration Program, applicants are also able to pilot and demonstrate innovations that have not been traditionally used in a surface transportation context. The program then encourages institutionalization of the piloted practice or technology. One example of this is the use of a nanocoating to more rapidly conduct bridge painting operations.

Accountability: A number of AID Demonstration Program awards have supported the advancement of greater efficiency and effectiveness within transportation programs, including the implementation of Business Process Management systems and “Practical Solutions” strategies. Additionally, e-Construction tools directly support the overall efficiency of the implementing transportation agencies.

This program impacts and is of benefit to transportation agencies throughout the nation, including those in rural communities. Local governments may apply for the AID Demonstration Program, through the State DOT as a sub-recipient. Consistent with other FHWA funding provided to tribes, any federally recognized tribe is eligible to apply to AID Demonstration Program.

USDOT Research Priorities:

To the extent that grant applicants pursue a pilot of EDC innovations previously listed, the AID Demonstration program supports many of the USDOT Research Priorities through individual projects.

T2 Collaboration Partners:

State DOTs, federal land management agencies, tribal governments, metropolitan planning organizations, and local governments submit applications for funding to support deployment of innovations on projects of their choosing. Depending on the nature of the individual AID Demonstration projects, consultants and contractors are engaged through their services provided (e.g., design, construction, inspection, operations, etc.).

Accelerating Market Readiness (AMR) Program

\$2,265,000

Program Description:

The Accelerating Market Readiness (AMR) program supports promising innovations that have the potential to be considered for accelerated deployment. The AMR program provides resources for the rapid, national assessment of emerging innovations and for the development of objective, written documentation of these assessments. The AMR Program is intended to help advance the innovations to a more complete market-ready status, which in turn should accelerate the adoption of the innovations by transportation agencies under the EDC Program or by other initiatives.

FHWA has historically administered AMR as an internal program to support innovations recommended by program offices or the Turner Fairbank Highway Research Center. While FHWA will continue to use the AMR Program to foster selected innovations suggested from within the agency, FHWA expanded the program in FY 2019 to include innovations from external stakeholders (including but not limited to State DOTs, local and tribal transportation agencies, the private sector, and institutions of higher education), solicited through a Broad Agency Announcement (BAA). Initial awards from this BAA are anticipated late in FY 2019 and early in FY 2020; FHWA intends to issue a second BAA in FY 2020 to further expand the program.

The AMR Program is intended to address longstanding challenges that exist in the transportation industry that impede the integration of new innovations into widespread practice. The initial “hand off” of innovative products from the research community to implementers, and the subsequent adoption of these products into practice, can take many years. Once in the domain of the implementers, the products may be piloted, and the results of the pilot documented, but the benefit data compiled is often limited at best and the dissemination of the findings has not traditionally occurred in a fashion that encourages wider piloting (and later adoption) of a product in the transportation community.

The inclusion of patented and proprietary products (P&PP) on transportation projects has been a long-standing challenge for private sector/industry stakeholders: Federal and/or State rules and regulations are often cited as a barrier to obtaining an opportunity to obtain objective perspective on the effectiveness of P&PP. The AMR Program will afford the opportunity for P&PP to be assessed and evaluated in a fair and objective manner, thereby potentially affording private sector/industry stakeholders a “foot in the door” to advancing the readiness of their P&PP.

Program Objectives:

The AMR program is intended to stimulate and spur the advancement of **emerging and transformative innovations** in the transportation industry by matching these innovations to the transportation organizations interested in testing and evaluating them. The innovations to be supported by AMR program resources are those that:

- significantly advance conventional practice;
- address knowledge and technology gaps;
- significantly advance the state-of-the-art; or
- constitute a sea change in the development and delivery of transportation projects and programs.

Key FY20 FHWA AMR Program Activities.

Activity	Period of Performance	Partners/Notes
AMR project awards	TBD; tentative Q1	
Issuance of Broad Agency Announcement for 2 nd AMR project solicitation	TBD; tentative Q3	

Statutory Requirements:

This program is authorized in section 503(c)(2)(B)(iii) of title 23, United States Code, which requires the Secretary to develop improved tools and methods to accelerate the adoption of proven innovative practices and technologies as standard practices.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

The AMR Program supports the Department’s Safety, Infrastructure and Innovation Strategic Goals. Examples of recent initiatives (from within FHWA) supported through AMR include the development of an in-situ scour testing device and the “Mobile Solution for Assessment and Reporting” ([MSAR](#)) app to support survey and inspection activities required with the FHWA Emergency Relief (ER) and Emergency Relief for Federally Owned Roads (ERFO) programs.

FHWA prepared the BAA for the AMR program to enable awards to support key U.S. Department of Transportation and FHWA goals in safety, accelerating project delivery, and infrastructure performance. For example, FHWA is seeking AMR proposals for innovative technologies to be used at any stage during the project development and delivery cycle to address the following:

- How can highway design, infrastructure, and traffic control devices be changed to address safety risks?
- How can safety data analysis be improved upon or used in better ways to guide transportation agencies’ decisions?
- How can the disproportionate transportation safety risks on State and locally owned roads in rural communities be mitigated?
- How should the infrastructure be changed to facilitate faster deployment of automated vehicles?

FHWA is seeking AMR proposals for innovative technologies to be used at any stage during the project development and delivery cycle to address the following:

- How can project development and delivery processes be improved or streamlined to provide timely benefits to users while safeguarding our communities and maintaining a healthy environment?
- How can Federal investments be better targeted toward transportation projects that address high priority infrastructure needs?
- How can State and local resources and private sector engagement be better leveraged?

Lastly, to preserve mobility and accessibility of the traveling public and freight movements, FHWA is seeking AMR proposals for innovative technologies to address the following:

- How can our transportation system's operations and performance be improved through the entire life cycle of the infrastructure facilities?
- How can the use of innovative maintenance and preservation strategies help restore the transportation infrastructure and assets to a state of good repair?
- How can the infrastructure be planned, constructed and maintained using best operational and risk management practices?

This program impacts and benefits transportation agencies throughout the nation, including those in rural communities. Past AMR projects have supported innovations that benefit all transportation stakeholders, and as the program is expanded this will continue to be the case.

Local governments may apply for the AMR Program through the State DOT as a sub-recipient. Consistent with other FHWA funding provided to tribes, any federally recognized tribe is also eligible to apply for AMR Program funding.

T2 Collaboration Partners:

FHWA has used considerable stakeholder input in the development of the AMR Program in its expanded (from internal to include external) form. The regional stakeholder summits held as part of the launch of the fourth cycle of the Every Day Counts Program featured a town hall session, where transportation leaders ---including representatives from the AASHTO Innovation Initiative (AII) and the National State Transportation Innovation Council (STIC) Network---discussed how they made innovation part of the everyday operation of their organizations. To address the feedback received during the round table discussions, FHWA committed to working with its transportation partners to enhance ways for emerging innovations to be fairly evaluated and more rapidly accelerated into use in transportation programs and projects.

The internal DOT and external partners in the AMR Program, and the benefits associated with these partnerships, are summarized as follows:

Partner Organization	Benefits of Partnership and Partner Contributions								
	User Perspective on Needs	Industry Perspective	Potential External Program Applicant	Potential Internal Program Topics	Conduct of Field Assessments, etc.	Documentation of Findings	Technology Transfer Activities	Advance widespread Adoption of Innovations	
AASHTO Innovation Initiative	X					X	X	X	
State Departments of Transportation	X		X		X	X		X	
Local and Tribal Transportation Agencies	X		X		X	X	X	X	
Institutions of Higher Education	X	X	X		X	X	X		
Transportation Industry/Private Sector	X	X	X		X	X	X	X	
National STIC Network	X	X					X	X	
FHWA Program Offices/Resource Center/TFHRC				X	X	X	X		

Innovative Program Delivery

\$806,000

Program Description/Activities:

Innovative Program Delivery (IPD) provides tools, training and technical assistance that support the transportation community's use of cutting-edge financial and procurement strategies to deliver critical infrastructure projects. FHWA's efforts in this area are primarily led by the Center for Innovative Finance Support (CIFS), whose products are often marketed and deployed under the brand of the Secretary's Build America Bureau. These research and technology deployment efforts focus on revenue generation (tolling and value capture), procurement (public-private partnerships and other alternative contracting methods), and innovative finance (Federal project finance tools such as GARVEE Bonds and State Infrastructure Banks). Support for our partners include (1) technical resources, guidebooks and analytical tools, (2) capacity building and outreach, and (3) technical assistance for project implementation.

Technical resources:

- In-depth database of detailed information on selected major projects advanced via alternative contracting methods (ACMs). This would build upon an initial database of basic information for more than 130 major US highway projects and detailed information on 9 major projects representing different alternative delivery methods, an effort funded in FY 2018.
- Public policy research into potential organizational structures for newly-established P3 offices within State DOTs. This research would address the opportunity in section 133(b) of title 23, United States Code, which makes Surface Transportation Block Grant Program dollars available to fund a P3 office and pay stipends to private bidders seeking long-term concessions.
- Suite of tools for use by State DOTs to evaluate alternative contracting opportunities when selecting the appropriate delivery method for costly, complex and significant projects, an effort funded in FY 2018.
- Educational materials describing the successful implementation of "value capture" techniques to help finance transportation projects via the incremental property value generated by the project itself. Value capture enables new local funding sources that, in turn, can attract new public or private investment.
- White paper on issues related to incorporation of surety and insurance requirements in public-private partnership agreements.

Capacity building activities:

- Training for state and local partners on the appropriate use of Federal project finance tools, with an emphasis on opportunities for rural communities.
- Financial and organizational support for the Center for Excellence in Project Finance (CEPF) via a cooperative agreement to be awarded per a new competitive solicitation. The current CEPF, the [BATIC Institute: An AASHTO Center for Excellence](#), offers a program of training, sharing of best practices, and technical assistance to all State Departments of Transportation and their local partner agencies.
- Intensive training for public project sponsors on critical aspects of public-private partnerships (P3s), including life-cycle cost comparisons between alternative delivery methods (Value for Money analysis), model contract provisions for long-term concession agreements, and best

practices for competitive procurements. Each training course is based on material developed by the CIFS in recent years with research funding.

- Training for state and local partners on best practices for achieving efficiencies of scale on multiple small projects, such as bridges, via their “bundling” into consolidated design and construction packages. This training is based on research funded via FHWA’s Accelerated Market Readiness program.

Technical assistance activities:

- Project-specific assistance to public sponsors assembling financial plans for Federal-aid projects. Building on research conducted in FY 2018 and 2019, the CIFS will focus on two opportunities for using SIBs: (1) to borrow from the TIFIA credit program to create a rural projects fund that would loan to rural communities, and (2) to enable local and rural communities to finance the non-Federal share of project costs, which can present an inordinate challenge for small public budgets.
- Project-specific assistance to public sponsors implementing a P3 delivery method for a project seeking credit assistance via the TIFIA loan program and/or Private Activity Bonds (PABs). All such assistance would be coordinated through the Build America Bureau (see below) as established via the FAST Act.
- Independent advisory services to State DOTs seeking to establish consistent methods for evaluating alternative contracting methods (ACMs), using the suite of tools as described above under “Technical Resources.”

Statutory Requirements:

This program is authorized in sections 502 and 503 of title 23, United States Code, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas in order to improve highway safety, improve infrastructure integrity, strengthen transportation planning and environmental decision-making, reduce congestion, and enhance freight productivity, among others.

Several IPD research activities support the authorizations in sections 116(e) and 116(g) of title 49, United States Code, which direct the National Surface Transportation and Innovative Finance Bureau (the “Build America Bureau”) to work with DOT modal administrations, including FHWA, to develop and promote best practices for innovative financing and public-private partnerships. These include development of procurement benchmarks based on data collected from projects receiving Federal credit assistance. Given that most P3 and user-financed loans are for highway projects, the IPD support is essential to the Bureau’s implementation of this initiative.

Several IPD capacity building activities support the authorization in section 504(h) of title 23, United States Code, which establishes a center for excellence in project finance to provide strategic assistance to State Departments of Transportation.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Infrastructure

Innovation

Infrastructure: Construction and maintenance of critical national infrastructure lies at the core of the IPD mission. The condition and performance of our nation’s roads, bridges and tunnels demand that State and local agencies spend more on infrastructure than their budgets allow. Scarce Federal funds, therefore, must be used efficiently to attract both public and private investors. In looking at rural communities, FHWA seeks to emulate Federal financing programs in sectors such as agriculture and housing, which play significant roles in rural development. Research into FHWA financing opportunities to leverage local participation in Federal-aid projects may open doors for this type of assistance.

Innovation: Regardless of how it is funded or financed, infrastructure will always require proficiency in project delivery. The IPD research on public agency best practices in evaluating innovative (alternative) contracting methods seeks to expand the range of appropriate delivery methods among all States. Alternative contracting methods typically are used less frequently in States with a higher proportion of rural communities, which could benefit from access to contracting approaches that enhance quality as well as cost and schedule reliability.

Program Objectives:

The IPD program begins with the recognition that public infrastructure resources at all levels of government are perpetually under stress, and thus the effectiveness of our project finance and delivery practices are paramount. These practices, in turn, must persistently evolve to exploit the opportunities of a dynamic economy. Given the sprawling number of public agencies in the United States, a potential “market failure” exists each time a project sponsor fails to look beyond its local environs for beneficial new practices. Federally-sponsored research and technology deployment can ease adoption by State and local jurisdictions of unused methods tested elsewhere by their peers.

Specific objectives:

- To increase consideration of innovative finance project revenue options, such as user fees and value capture, via research, training and technical assistance.
- To increase consideration of the P3 delivery option for major projects by providing the U.S. transportation community with the most complete, up-to-date body of knowledge on P3s.
- To support the accrual of P3 knowledge by industry practitioners and advisors in the areas of planning/evaluation, procurement, and monitoring/oversight.

Key FY20 program activities are identified in Table 1.

Table 1 Key FY20 FHWA Innovative Program Delivery Activities

Activity	Period of Performance	Partners/Notes
In-depth database of selected major projects advanced via ACMs.	Jun 2018 – Nov 2019	Contract funded in FY 18.
Value Capture – Innovation Every Day Counts, Round 5 (EDC-5)	Jan 2019 – Dec 2020	Technology transfer funding from Center for Accelerating Innovation.
Project Bundling – Innovation Every Day Counts, Round 5 (EDC-5)	Jan 2019 – Dec 2020	Technology transfer funding from Center for Accelerating Innovation.
Research grants to State DOTs that evaluate ACMs.	Oct 2019 – Mar 2020	Funded by Turner-Fairbank HRC
Organizational structures for new P3 offices within State	Oct 2019 – May 2020	Discussion paper.
P3 intensive training for public sponsors.	Oct 2019 – Sep 2020	Customized using material developed by CIFS
Project-specific financial assistance to State, local and rural communities.	Oct 2019 – Sep 2020	Building on work conducted in FY 18 and FY19.
Project-specific assistance to P3s seeking TIFIA and/or PABs.	Oct 2019 – Sep 2020	Coordinated through the Build America Bureau.
Newly solicited Center for Excellence in Project Finance	May 2020 – Apr 2021	Agreement will have 3 additional option years.

Research Collaboration Partners:

The relevance of the IPD program is a direct function of engagement with its stakeholders, the State and local public sponsors seeking the needed technical resources, capacity and information to deliver critical infrastructure. Whether in response to structured CIFS inquiries or via informal but frequent dialogue with FHWA, these practitioners largely shape the research and deployment agenda. This engagement is often facilitated by the network of FHWA Division Offices, which interact daily with public sponsors throughout the nation.

The IPD program partners provide regular communication channels, again both formally and informally:

Table 2 FHWA Innovative Program Delivery Partners

Partner Organization	Benefits of Partnership and Partner Contributions								
	User Perspective on Needs	Industry Perspective	Standard Setting	Field Trials	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Donation of Material or Services	Funding
Office of the Secretary of Transportation: Build America Bureau					X	X	X		
Transportation Research Board (TRB), Revenue and Finance Committee	X	X				X	X		
American Association of State Highway & Transpo. Officials (AASHTO)	X				X	X	X		
American Road and Transportation Builders, P3 Division		X					X		
Association for the Improvement of American Infrastructure (AIAI-Infra)		X					X		
National Governors Association (NGA)	X				X		X		
National Council of State Legislatures (NCSL)	X				X		X		
Association of Metropolitan Planning Organizations (AMPO)	X				X		X		

Research Infrastructure, Technology Transfer and Partnerships

\$12,684,000

Program Description/Activities/Objectives:

Program Description

The FHWA Research Infrastructure, Technology Transfer, and Partnerships Program supports the goals of the USDOT Strategic Plan by supporting strategic investment in transportation infrastructure, safety, operations, planning, policy, and innovation development and deployment. The program monitors legislative developments, helps to coordinate the R&T budget allocation, maintains the Turner Fairbank Highway Research Center, organizes strategic Research and Technology (R&T) investment, and provides marketing and outreach. This Program's overarching role is to coordinate all elements that support and promote the USDOT Strategic Plan to ensure the FHWA R&T program invests in innovations that will result in fewer transportation-related deaths and serious injuries; infrastructure that supports mobility and economic competitiveness; innovation development and deployment; and reduced regulatory burden and greater efficiency. This FHWA R&T investment portfolio is stakeholder driven, with partners engaged throughout the entire innovation lifecycle process, from agenda setting and planning, through the research, technology development, and innovation deployment phases, to the implementation and assessment stages. The Research Infrastructure, Technology Transfer, and Partnerships Program supports these coordinated efforts across all other programs.

The Research Infrastructure, Technology Transfer, and Partnerships Program also coordinates activities and expenditures related to administration and facilities costs for the FHWA R&T Program (*Administration and Facilities funds are shown as a separate funding line in the tables in Chapter 3*). FHWA's Office of Research, Development, and Technology is located at the Turner Fairbank Highway Research Center (TFHRC), a federally owned and operated national research facility in McLean, Virginia. At the TFHRC, staff administers the majority of FHWA's research and development activities in the areas of infrastructure, operations, and safety. Research in areas of Intelligent Transportation Systems (ITS), policy, innovative finance, planning, operations, and the environment is conducted or administered by FHWA offices located at USDOT Headquarters.

In addition to supporting R&T development and deployment activities, the Research Infrastructure, Technology Transfer, and Partnerships Program promotes communication, coordination, and collaboration with FHWA's partners, which are crucial to conducting the right research, doing it well, and delivering solutions when and where they are needed. Communication strategies address the needs of internal and external audiences and cover the depth and breadth of the federal effort for highway research and technology, displaying prudent use of government resources, advancing the state of the practice, and building a case for continued and future funding.

Program Objectives

The primary role of the Research Infrastructure, Technology Transfer, and Partnerships Program is to provide leadership, coordination, and support in the administration of the FHWA R&T program. To accomplish this the Program will continue to foster and promote enhanced coordination of highway research among all stakeholders; communicate, publish, market, and disseminate research results to appropriate audiences; coordinate strategic resource allocation; and conduct R&T Program Evaluations.

Additionally, the Research Infrastructure, Technology Transfer, and Partnerships Program will maintain and support the operation of the TFHRC. The highway research and development relating to

emerging highway technology that occurs at TFHRC is focused on addressing research gaps not addressed by FHWA's partners. TFHRC specifically focuses on long-term, high-risk research to improve the materials used in highway infrastructure; the development of tools and techniques that provide solutions to complex technical problems; and the development of innovative highway products and practices.

The Research Infrastructure, Technology Transfer, and Partnerships Program provides the following services to the overall R&T program:

1. R&T Program Support and Administration:
 - Develop and execute the R&T program strategic direction, policies, and budget to further USDOT and FHWA initiatives.
 - Provide technical support to Congress and their staff members in the development and analysis of legislations and regulatory requirements impacting national research initiatives.
 - Identify and deliver communication and outreach strategies to engage transportation stakeholders in technology transfer and innovation delivery.
2. Communications, Publishing, and Marketing:
 - The FHWA Research Library located at TFHRC was created to preserve and maintain knowledge to support the research program.
 - Provides comprehensive topical searches to identify relevant literature, experts, and institutions, and to obtain bibliographic and electronic resources and materials to help inform the direction of research.
 - Helps employees to find facts, statistics, and other specific information.
 - Occasionally provides more detailed research and scanning activities to keep FHWA experts and managers current with the latest body of knowledge from various sources, including patent and prior art searches, and tracking new spin offs from a specific topic.
 - Promote marketing and communication activities for the TFHRC including participation in STEM Symposiums and FHWA's exhibition presence at the Transportation Research Board Annual Meeting.
3. Publications, periodicals, and technical reports: Plans, edits, and prepares technical reports and documents for publishing in print or on the web, and publishes the award-winning *Public Roads* magazine, R&T Now newsletter, and seven other newsletters.
 - Develops outreach and social media materials and campaigns to communicate research results to State DOTs and other stakeholders.
 - Develops, manages, and maintains the TFHRC website, which provides public access to program policy, ongoing and completed research, laboratory information, and connects users to experts as well as invites visitors to tour the facility and laboratories.
4. TFHRC Laboratory Capacity Building: Supports the technical and scientific needs of researchers, such as installing special hardware or software, maintaining scientific laboratory instruments, repair or replacement of research equipment resulting from failure or replacement of obsolete or end-of-service-life equipment, enhanced capabilities for existing laboratories.
5. R&T Evaluations Program: The R&T Evaluation Program has been designed to further FHWA's transparency, accessibility, and responsiveness of R&T for stakeholders. The program conducts retrospective and prospective program evaluations of selected FHWA research programs and projects. The impacts of deployed research and innovations are assessed, which then inform research planning and resource allocations

6. Support domestic and international partnerships: The FHWA R&T Program works with State DOTs to identify and conduct critical research; coordinates with National highway research organizations on priorities and objectives; collaborates with international organizations by sharing best practices and research results that are transferable or adaptable to the American highway system.
7. Knowledge Management: Supports more than 20 research and collaboration websites to address critical business topics by conducting day-to-day business and sharing knowledge within FHWA and with external partners including State DOTs and private organizations.

Key FY20 program activities are identified below.

Activity	Period of Performance	Partners/Notes
Support Technology Transfer of R&T Innovations	2018-2022	OST
Invest in laboratory and research infrastructure improvements and maintenance	On-going	N/A
Conduct R&T Program Performance Evaluation	On-going	TRB
Provide Administrative support services for the R&T program	On-going	
Manage the Transportation Pooled Fund Program	On-going	State DOTs
Newsletter and periodical development and distribution	On-going	State DOTs, transportation organizations, transportation industry
Technical communications, writing, and printing	On-going	State DOTs, transportation organizations, transportation industry
Website development and maintenance	On-going	State DOTs, transportation organizations, transportation industry
Technical symposium and meeting support	On-going	State DOTs, transportation organizations, transportation industry
Library staffing and maintenance	On-going	State DOTs, transportation organizations, transportation industry, Transportation Libraries, NARA
Research and Technology Coordinating Committee (RTCC)	2019-2022	Administered by NAS
TRB Core Program Services for a Highway Research, Development, and Technology Program	2020-2024	USDOT, State DOTs, NAS, and other Federal agencies and

		transportation organizations
Conduct Site Visits with State DOTs and FHWA Division Offices to Identify Emerging Issues and to Promote New Innovations	On-going	State DOTs
Conduct Instructional Webinars and Participate in Peer Exchanges	On-going	State DOTs
Update FHWA R&T Agenda	2020-2021	State DOTs
Provide IT services and improvements	On-Going	N/A

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes

This program is authorized in sections 502 and 503 of title 23, United States Code, which require the Secretary to carry out highway research, development, and technology deployment activities covering a broad range of topic areas to improve highway safety, improve infrastructure integrity, strengthen transportation planning and environmental decision-making, reducing congestion, and enhancing freight productivity, among others. Section 503 also requires that the Secretary “continue to operate in the Federal Highway Administration a Turner-Fairbank Highway Research Center.”

Administration of the FHWA Research and Technology Programs

23 USC 503 states:

503. Research and technology development and deployment

(a) IN GENERAL.—The Secretary shall—

- (1) carry out research, development, and deployment activities that encompass the entire innovation lifecycle; and
- (2) ensure that all research carried out under this section aligns with the transportation research and development strategic plan of the Secretary under section 508.1

Turner Fairbank Highway Research Center

23 USC 503(b)(7) states:

(7) TURNER-FAIRBANK HIGHWAY RESEARCH CENTER.—

(A) IN GENERAL.—The Secretary shall continue to operate in the Federal Highway Administration a Turner-Fairbank Highway Research Center.

(B) USES OF THE CENTER.—The Turner-Fairbank Highway Research Center shall support—

- (i) the conduct of highway research and development relating to emerging highway technology;
- (ii) the development of understandings, tools, and techniques that provide solutions to complex technical problems through the development of economical and environmentally sensitive designs, efficient and quality-controlled construction practices, and durable materials;
- (iii) the development of innovative highway products and practices; and
- (iv) the conduct of long-term, high-risk research to improve the materials used in highway infrastructure.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

The FHWA Research Infrastructure, Technology Transfer, and Partnerships Program supports all DOT Strategic goals. This Program leads the development and administration of the FHWA R&T program to close critical knowledge gaps, identify collaboration opportunities, and accelerate innovations and technology deployment. To accomplish this, the Research Infrastructure, Technology Transfer, and Partnerships Program coordinates with and supports all other R&T programs, thereby aligning with the respective strategies of those programs.

USDOT Research Priorities:

The FHWA Research Infrastructure, Technology Transfer, and Partnerships Program supports all USDOT Research Priorities that are included within the FHWA R&T programs outlined in the FY20 FHWA AMRP. These research priorities include:

- Economic Impact of Regulatory Reform
- Economic Impact of Permitting Reform
- Performance Based Regulations and Safety
- Potential Impact of Value Capture
- Improving the Mobility of Freight
- Improving Mobility for Underserved Communities
- Cybersecurity

Research Collaboration Partners:

The FHWA Research Infrastructure, Technology Transfer, and Partnerships Program supports and/or coordinates partnership activities at the State, national, and international level. Specific partnership activities are listed below:

- Transportation Pooled Fund (TPF) Program: When significant or widespread interest is shown in solving transportation-related problems, research, planning, and technology transfer activities may be jointly funded by several federal, State, regional, and local transportation agencies, academic institutions, foundations, or private firms as a pooled fund study. The FHWA-administered TPF Program allows federal, state, and local agencies and other organizations to combine resources to support transportation research studies.
- National partnerships: FHWA actively seeks cooperation with stakeholders. FHWA participates in TRB standing committees and in the AASHTO Research Advisory Committee. As a sponsor, FHWA is an active participant in stakeholder events such as the TRB annual meeting. FHWA also works closely with AASHTO and the State DOTs to coordinate RD&T initiatives and promote the implementation and use of new innovations.
- International partnerships: International cooperation to conduct research of interest to multiple countries is achieved through a partnership with the Forum of European Highway Research Laboratories (FEHRL) and through other agreements with foreign countries.

Input regarding the administration of the FHWA R&T program and the identification of R&T activities is coordinated through partnerships on many levels. An independent advisory board, the Research and Technology Coordinating Committee (RTCC), which is administered by TRB, provides insight and guidance on the overall administration of the R&T program and business practices used in identifying strategic investments. Additionally, FHWA researchers support and participate in AASHTO committees to receive input from the State DOTs on the appropriateness of our research goals and coordinate research efforts based on the relative priorities of the partner agencies. Technical staff also serve as members of various TRB committees related to their area of expertise and responsibility and receive feedback on the Federal role in furthering the research needs of that particular topic area relative to the role of State, local, and non-governmental organizations.

Benefits of Partnership Relations.

Partner Organization	User Perspective on Needs	Industry Perspective	Standard Setting	Field Trials	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Donation of Material or Services	Funding
USDOT			X			X			X
TRB	X	X	X		X	X	X		
AASHTO	X		X	X	X	X	X		
State DOTs	X			X	X	X	X		X
University Transportation Centers				X		X	X		
FEHRL				X	X	X	X		

Small Business and Innovation Research \$1,812,000

Program Description/Activities/Objectives:

Program Description

The SBIR program is a highly competitive, awards-based program that encourages domestic small businesses to engage in research and development addressing high priority research areas within USDOT. The SBIR program favors research that has the potential for commercialization through products and applications sold to the private sector transportation industry, State DOTs, USDOT, or other federal agencies.

The program is administered by the Volpe Transportation Center. The SBIR Program Office publishes one or two solicitations each fiscal year for proposals on specific research topics of interest to USDOT operating administrations, including the FHWA.

Program Objectives

To encourage small businesses to engage in research or research and development (R/R&D) that has the potential for commercialization and meets federal R/R&D objectives. The SBIR program is uniquely positioned to support both the interests of FHWA as well as the small business. In this respect, the SBIR programs aims to provide essential funding to small businesses with aim toward commercialization of products that align with FHWA and Departmental Strategic goals.

The SBIR program offers unique services to the small businesses to aid in their technical and commercial development. Specifically, the SBIR program offers a Commercialization Assistance Program to provide consulting services to the SBIR participants to help conduct market research, commercialization plans, and other services. In addition, in FY20 the FHWA SBIR program will continue with a Technology Readiness Level (TRL) assessment program, which was successfully piloted in FY19, to help the Small Businesses conduct an independent assessment of the technological status of the innovations developed through the SBIR program.

Key FY20 FHWA SBIR Program Activities

Activity	Period of Performance	Partners/Notes
Technology Readiness Level (TRL) Assessments	2020	N/A
Annual Solicitation of Topics	2020	N/A

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes

On December 31, 2011, the President signed into law the National Defense Reauthorization Act of 2012 (Defense Reauthorization Act), P. L. 112-81. Section 5001, Division E of the Defense Reauthorization Act contains the Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Reauthorization Act of 2011 (SBIR/STTR Reauthorization Act), which extended both the SBIR and Small Business Technology Transfer (STTR) programs through September 30, 2017. On November 30, 2016, a 5-year reauthorization was signed by the President, extending the expiration date to September 30, 2022.

Funding amounts are established in Law, as noted in the Defense Reauthorization Act (Sec.5102(a)(1)), each year Federal agencies with extramural research and development (R&D) budgets at the Department level that exceed \$100 million are required to allocate 3.2 percent of their R&D budget to these programs as listed below. Agencies may exceed these minimum percentages.

Program Alignment with Strategic Goals:

The SBIR program solicits research and technology topics from all FHWA R&T offices annually, including the ITS Joint Program Office. Topics are selected based on the merit, suitability for the SBIR program, as well as consideration of alignment with FHWA and Departmental Strategic goals. As a result, the SBIR program supports all of the FHWA R&T program offices and, by extension, all of the USDOT Strategic goals.

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

USDOT Research Priorities:

The SBIR program supports all FHWA R&T program offices and, by extension, all corresponding USDOT Research Priorities:

- Economic Impact of Regulatory Reform
- Economic Impact of Permitting Reform
- Performance Based Regulations and Safety
- Potential Impact of Value Capture
- Improving the Mobility of Freight
- Improving Mobility for Underserved Communities
- Cybersecurity

Research Collaboration Partners:

The FHWA SBIR program is coordinated internally within USDOT and methods and practices are shared with other modes through the Volpe center, which administers the SBIR programs for USDOT.

FHWA SBIR Partners

Partner Organization	User Perspective on Needs	Industry Perspective	Standard Setting	Field Trials	Deployment	Research Collaboration	Specialized Expertise or Capabilities	Donation of Material or	Funding
USDOT				X	X	X			

Exploratory Advanced Research Program

\$4,294,000

Program Description/Activities/Objectives:

Program Description

The EAR Program is the only funding specifically addressing the need for longer-term, higher-risk research in highway transportation. Funding of exploratory advanced research has a direct impact on the supply of potential technologies and processes necessary for continued industry innovation to meet the challenges of improving the safety, operation, and resilience of the U.S. highway system for years to come. The EAR Program applies proven deliberative and open processes to engage experts within and outside the Department to identify potential research topics among new discoveries in science and technology that may address current and emerging needs of the highway transportation industry. These new discoveries often are results from basic research sponsored, for example, by the National Science Foundation and National Energy Labs. The EAR Program conducts extensive investigations into 15 to 20 topics annually to identify three or four where a government investment has the potential for higher impact results. The Program continues to engage experts within and outside the Department during the conduct of Program-funded research, conducts regular screening of results, and supports active efforts to transition results that demonstrate high potential to applied research programs.

Program Objectives

The EAR Program is scouting topics for possible FY 2020 investment across multiple areas of focus

- With a large FY 2019 investment in the materials science focus area, the EAR Program does not anticipate new starts for research in this area in FY 2020.
- In the area of “connected systems,” the EAR Program is pivoting from research demonstrating the potential of vehicle platooning and hardware-in-the-loop technologies, which continue to transition and mature towards deployment, towards application of machine learning to support more complex system control scenarios at multiple scales and across modes.
- In the area of “human behavior,” the EAR Program expects to continue investments in computer vision as a tool for safety and operations researchers and practitioners to exploit the growing amount of image data while preserving privacy. The EAR Program also is scouting new methods for measuring and forecasting goods movement across modes that take into account economic behavior in support policy needs at multiple scales – national, state, and local.
- In the area “new technology for assessing performance,” the EAR Program is pivoting from demonstrating the potential of low-cost, low-energy wireless sensor systems for assessing structural conditions towards application of machine learning to increase the reliability of and reduce the cost of analyzing sensor data. The EAR Program also anticipates continued investment in approaches for creating “digital twins” of physical structures and pavements that extend applications beyond design and construction to the complete system lifecycle.

Key FY20 FHWA Exploratory Advanced Research R&T Program Activities.

Activity	Period of Performance	Partners/Notes
New research project starts acquired through a broad agency announcement	2020-2023	Working with FMCSA, ITS JPO
Supporting novel intramural research through placement of NRC Research Associates in FHWA	2020	
Leveraging broader federal investments through interagency agreements	2020	Potential partners include NSF, Energy

Statutory Requirements:

Is this program statutorily mandated (Y/N): Y

23 U.S.C. Section 503, Research and technology development and deployment, paragraph (b)(6) states "The Secretary shall carry out research and development activities relating to exploratory advanced research ..."

Program Alignment with Strategic Goals:

DOT Strategic Goal
Innovation

The EAR Program works with technical experts from across FHWA and other modal agencies to match advances in science and engineering with critical current and emerging needs. The EAR Program research portfolio provides a balance of investments to demonstrate innovative tools and processes across critical transportation topics. Examples of the potential impact of FY 2020 investments include proof of concept demonstrations of

- Machine learning applications to increase system owner and operator controls for providing reliable mobility.
- New computer vision tools that allow for study of large image data sets to improve system safety and mobility.
- New methods for understanding economic and other sociological influences on goods movement that can support freight mobility.
- The potential of machine learning to improve the accuracy and reliability of sensor system data for asset management for improving infrastructure and preserving the environment.

EAR Program research supports needs in urban and rural areas. New methods for analyzing unstructured data, for example, is critical in rural areas where traditional data may be limited making it more difficult for identifying potential safety issues or monitoring asset conditions for improving infrastructure.

USDOT Research Priorities:

Anticipated EAR Program FY 2020 investments have the potential to address

- Performance Based Regulations and Safety by proving new evidence for safety countermeasures based from large scale video image data.
- Potential Impact of Asset Recycling by improving the reliability of sensor system data that can allow asset owners to better manage asset lifecycles and timing of preventive maintenance.
- Improving the Mobility of Freight through new methods of gaging current and future goods movement across policy scenarios.

Research Collaboration Partners:

The EAR Program regularly works with technical experts in BTS, FMCSA, FAA, FTA, ITS JPO, and NHTSA across the range of EAR Program processes from participating in scoping activities, through serving on technical review panels for EAR Program investments, technical working groups reviewing ongoing EAR Program-funded research, and Technology Readiness Level assessment panels that provide input into the transition of results. Coordination across modes enhances the opportunity for EAR Program-funded results to benefit multiple modes.

The EAR Program also works with other government agencies. The EAR Program and the NSF Cyber Physical Systems program signed a new MOU in 2019 to coordinate on research such as artificial intelligence applications for surface transportation. The EAR Program also has an anticipate continued coordination with Defense, Energy, and NASA laboratories in individual research projects of joint benefit through Interagency Agreements. Work with NSF has more than doubled the research funding focused on critical agency research priorities such as mobility. Work with other laboratories has leveraged expertise, research facilities, and funding for FHWA research priorities.

There is a strong history of private sector involvement in EAR Program-funded research. Under 23 USC Section 502, cooperative agreements require a minimum 20 percent match. The match may be in kind, such as providing materials, salary costs, equipment, etc.

Benefits of Partnership and Partner Contributions to FHWA Exploratory Advanced Research.

Partner Organization	Initial Stage Investigations	Conduct of Research	Transition of Results	Funding
FMCSA, FTA, NHTSA	X	X		
Defense Department	X	X		
Energy Department	X	X	X	
National Science Foundation	X	X		X
National Institute of Standards and Technology, Commerce Department	X	X	X	
State Departments of Transportation	X		X	
Industry	X		X	X

Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Program \$35,334,000

Program Description/Activities/Objectives:

Program Description

The ATCMTD is statutorily required in the FAST Act Section 6004, 23 U.S.C. 503(c)(4). The ATCMTD grants are managed by FHWA and the ITS JPO contributes a mandated percentage of funding through FHWA to annually satisfy the requirement.

The language provided here duplicates the language provided in the ITS JPO AMRP for consistency.

The Advanced Transportation and Congestion Management Technologies Deployment Initiative (ATCMTD) Program is intended to provide funding for eligible entities to develop model deployment sites for large scale implementation and operation of a diverse set of technologies in various geographic regions. As the program is aimed at the rapid deployment of advanced technologies, limited expenditures for infrastructure construction is anticipated in grant application. The stated purpose is to reduce costs and increase return on investments; deliver environmental benefits through increased mobility; enhance transportation system operations; improve safety; improve collection and dissemination of real-time information; monitor transportation assets; deliver economic benefits; and accelerate deployment of connected and autonomous vehicle technologies. Successful proposals will contain quantifiable system performance objectives, use innovative technologies and strategies, and a plan for long term operation and maintenance of the deployed technologies. The U.S. Department of Transportation (DOT) encourages partnering among the private sector, public agencies, research institutions, technology leaders, and other transportation stakeholders.

Program Objectives

The DOT's vision for the ATCMTD initiative is the deployment of advanced technologies and related strategies to address issues and challenges in safety, mobility, sustainability, economic vitality, and air quality that are confronted by transportation systems owners and operators. The advanced technologies are integrated into the routine functions of the location or jurisdiction, and play a critical role in helping agencies and the public address their challenges. Management systems within transportation and across other sectors (e.g., human services, energy, and logistics) share information and data to communicate among agencies and with the public. These management systems provide benefits by maximizing efficiencies based on the intelligent management of assets and the sharing of information using integrated technology solutions. USDOT shares the advanced technology solutions and the lessons learned from their deployment with other locations, scaled in scope and size, to increase successful deployments and provide widespread benefits to the public and agencies.

Key FY20 FHWA ATCMTD R&T Program Activities.

Activity	Period of Performance	Partners/Notes
Selection of FY20 grant awards and timely implementation of projects.	FY20 to project closeout	Work with grantees to ensure timely implementation of grant awards.
Continue award of FY19 grants and manage FY16-18 projects.	To project closeout (varies)	Work with grantees to ensure timely implementation of grant awards.
Publish first ATCMTD annual report as mandated by the FAST Act.	FY20 to closeout of all projects.	Work with grantees to ensure timely submission of individual annual project reports.

Statutory Requirements:

Is this program statutorily mandated (Y/N): Yes
 FAST Act Section 6004, 23 U.S.C. 503(c)(4)).

Program Alignment with Strategic Goals:

DOT Strategic Goal
Infrastructure

ATCMTD Program goals are directly linked to DOT's Strategic Goals and include:

- Reduced costs and improved investment returns, including through the enhanced use of existing transportation capacity (Infrastructure)
- Delivery of environmental benefits that alleviate congestion and streamline traffic flow (Preserving the Environment)
- Measurement and improvement of the operational performance of the applicable transportation networks (Improving Mobility)
- Reduction in the number and severity of traffic crashes and an increase in driver, passenger, and pedestrian safety (Safety)
- Collection, dissemination, and use of real-time transportation-related information to improve mobility, reduce congestion, and provide for more efficient and accessible transportation, including access to safe, reliable, and affordable connections to employment, education, healthcare, freight facilities, and other services (Improving Mobility)
- Monitoring transportation assets to improve infrastructure management, reduce maintenance costs, prioritize investment decisions, and ensure a state of good repair (Improving Infrastructure)
- Delivery of economic benefits by reducing delays, improving system performance and throughput, and providing for the efficient and reliable movement of people, goods, and services (Improving Mobility)
- Accelerated deployment of vehicle-to-vehicle, vehicle-to-infrastructure, and automated vehicle applications, and autonomous vehicles and other advanced technologies (Innovation)
- Integration of advanced technologies into transportation system management and operations (Innovation)

- Demonstration, quantification, and evaluation of the impact of these advanced technologies, strategies, and applications towards improved safety, efficiency, and sustainable movement of people and goods (Safety, Improving Mobility)
- Reproducibility of successful systems and services for technology and knowledge transfer to other locations facing similar challenges (Innovation)

Fixing America's Surface Transportation (FAST) Act Section 6004 instructs the DOT to ensure that the selection of grant recipients represent diverse geographic areas of the United States, including urban and rural areas.

USDOT Research Priorities:

Although proposals are not limited to DOT priorities, the Department is particularly interested in deployment programs and projects in the following Focus Areas:

- Multimodal Integrated Corridor Management (ICM): ICM is the coordination of individual transportation network operations of adjacent facilities across all government or other operations agencies that creates a unified, interconnected, and multimodal system capable of sharing cross-network travel management to safely and efficiently improve the movement of people and goods. All corridor transportation assets and information services (i.e., local, county, regional, State) are brought to bear when prevailing or predicted transportation conditions trigger alerts. Through an ICM approach, transportation agencies manage the corridor as a multimodal system and make operational and safety decisions for the benefit of the entire corridor. The DOT is interested in increasing deployment of ICM.
- Installation of connected vehicle technologies at intersections and pedestrian crossing locations: Deployment of connected vehicle wireless communications technologies at intersections to enhance motorized and non-motorized traveler safety, or actively improve the management, operation, and maintenance of traffic signal systems through real-time data collection and signal control. Example technologies include vehicle-to-infrastructure (V2I) and vehicle-to-pedestrian (V2P) deployments, such as at intersections or midblock pedestrian crossings, to support activities and initiatives of the V2I Deployment Coalition and non-motorized traveler applications, or technologies to support automated traffic signal performance measures. Such technologies should provide information, notifications, and alerts in accessible formats to help all users navigate safely through intersections including providing contextual information for situational awareness and localization. The DOT has been working to accelerate the implementation of technologies that advance these strategies.
- Unified fare collection and payment systems across transportation modes and jurisdictions: Technological advancements in payment systems allow convergence across both publicly-delivered and privately-delivered mobility services. However, field implementations have been achieved only sparingly and in small projects. Convergence will enhance consumer payment options and mode choices and will forge partnerships among providers to achieve a seamless, accessible, and flexible transportation network across the Nation. DOT is engaged in efforts that will assist in identifying technical, institutional, and policy solutions to achieve unified transportation payment systems.
- Freight Community System: A Freight Community System (sometimes called Port Community System) is an electronic platform that connects the multiple systems operated by a variety of

organizations that make up a freight transportation community, including seaports, airports, rail yards, inland ports, and distribution centers. Set up, organized, and used by firms in the same sector – in this case, a freight community – the system provides a neutral and open electronic platform enabling an intelligent and secure exchange of information between public and private stakeholders to improve the efficiency and competitive position of the ports' community(ies). It also optimizes, manages, and automates smooth port and logistics processes through a single submission of data by connecting transport and logistics chains. This focus area is important to the departmental goal of integrating freight infrastructure within the surface transportation system, particularly maritime ports, while at the same time providing a platform to reduce the impacts of national freight movement on local communities.

- Technologies to support connected communities: Deployment of technologies for a multimodal transportation system provides Americans with safe, reliable, and affordable connections to employment, education, healthcare, and other essential services. Examples include dynamic ridesharing through the latest communications technologies and social network structures to bring drivers and riders together quickly and efficiently, technologies to mitigate the negative impacts of freight movement on communities, or technologies that support workforce development, particularly for disadvantaged groups, which include persons with visible and hidden disabilities and elderly individuals. These example technologies should consider the elements of universal design and inclusive information and communication technology solutions, and may include autonomous vehicles deployment through geographically contained ridesharing pilot programs, including the benefits of the technology with groups that might otherwise have limited transportation options, such as older Americans who no longer drive or those with disabilities or no driver's license. The DOT is interested in using advanced technologies to improve the public's connections to employment, education, healthcare, and other essential services.
- Infrastructure Maintenance, Monitoring, and Condition Assessment: Timely, accurate and efficient assessment of infrastructure condition is critical to effective infrastructure asset management. Current state-of-the-practice technologies for condition assessment represent a good start, but have a variety of limitations. Advancement opportunities include: implementation of friction management programs founded on highway-speed friction testing; highway speed deflection monitoring for pavement structural evaluation; sensor systems for infrastructure condition monitoring; use of unmanned aerial systems (UAS) for condition inspection; development of holistic and virtual data visualization technologies; and advancement of bridge load rating technologies. Emerging technologies implementation will enable improved highway safety and more timely intervention to address structural deficiencies and infrastructure deterioration with relatively low-cost solutions.
- Rural technology deployments: The deployment of advanced technologies to enhance safety, mobility, or economic vitality is also key in rural areas. Example technologies include improved access to transportation services, corridor freight platooning, mobile work zone alerts, improved roadway weather management, improved emergency response services and traffic incident management, curve warning systems, or animal intrusion detection and warning. The DOT is interested in geographically diverse application of technologies to include rural deployments.

Research Collaboration Partners:

ATCMTD is not a research program, rather it is a discretionary grant program established in the FAST Act, however, public and stakeholder input is considered in the development of the annual Notice of Funding Opportunity (NOFO).

To be selected for an ATCMTD award, an applicant must be an eligible applicant. Eligible applicants are State or local governments, transit agencies, metropolitan planning organizations (MPO) representing a population of over 200,000, or other political subdivisions of a State or local government (such as publicly owned toll or port authorities), or a multijurisdictional group or consortia of research institutions or academic institutions. Partnership with the private sector or public agencies, including multimodal and multijurisdictional entities, research institutions, organizations representing transportation and technology leaders, or other transportation stakeholders, is encouraged.

Typically, a consortium is a meaningful arrangement with all members involved in planning the overall direction of the group’s activities and participating in most aspects of the group; the consortium is a long-term relationship intended to last the full life of the grant. Any application submitted by a sole research or academic institution and that is not part of a consortium will not be considered for selection.

DOT encourages partnerships with the private sector or public agencies, including multimodal and multijurisdictional entities, research institutions, organizations representing transportation and technology leaders, or other transportation stakeholders. Numerous ATCMTD awardees from FY 2016 and 2017 include non-governmental partners that traditionally have provided non-Federal matching funds in the form of technical services, hardware, and software.

Program partners (both government and non-government), benefits derived from partnerships, and partner contributions are summarized in in the table below.

Benefits of Partnership and Partner Contributions to FHWA ATCMTD Program.

Partner Organization							
ATCMTD partners are the individual grant recipients (benefits of partnerships are identified in FAST Act Section 6004 and 23 U.S.C. 503(c)(4)). Benefits of partnership and partner contributions will be detailed in FAST Act-mandated Secretary’s report, which is due May 2020.							

Surface Transportation System Funding Alternatives

\$18,120,000

Program Description/Activities/Objectives:

Program Description

Fixing America's Surface Transportation (FAST) Act of 2015, Pub. L. No. 114-94, H.R. 22, § 6020, H.R. 22, 114th Cong. (2015) authorized the Secretary of Transportation to establish the Surface Transportation System Funding Alternatives (STSFA) program. The purpose of the STSFA program is to provide grants to States to demonstrate user-based alternative revenue mechanisms that utilize a user fee structure to maintain the long-term solvency of the Federal Highway Trust Fund. The FAST Act provides that \$15 million in Fiscal Year (FY) 2016 and \$20 million annually from FY 2017 through FY 2020 will be made available from the Highway Research and Development Program for grants for STSFA demonstration projects.⁸ These grants shall make up no more than 50 percent of total proposed project costs, with the remainder coming from non-Federal sources. Other Federal funds using their appropriate matching share may be leveraged for the deployment but cannot be considered as part of the STSFA matching funds, which must come from non-Federal sources unless otherwise supported by statute. On August 1 of each year, if there are insufficient grant applications that meet program requirements, any excess funds must be transferred back to the Federal Highway Administration (FHWA) Highway Research and Development program.

The grants are only available to States; however, groups of States can form partnerships for regional or national proposals.⁹ Section 6020 of the FAST Act authorizes the DOT to enter into agreements with State authorities to demonstrate user-based alternative revenue mechanisms. However, this solicitation requires that a State department of transportation (State DOT) serve as the lead agency for administering the program funding through the Federal-aid highway program. Another State agency or a State agency in a different State (if the project involves a group of States) may be responsible for providing day-to-day project oversight. It is expected that all relevant State agencies (e.g., Department of Motor Vehicles, Department of Revenue) needed to initiate a full-scale deployment of the proposed revenue mechanism will be actively involved in the planning and operation of the demonstration.

Program Objectives

The program seeks to fund activities that meet the following goals to:

- test the design, acceptance, and implementation of user-based alternative revenue mechanisms.
- improve the functionality of such user-based alternative revenue mechanisms.
- conduct outreach to increase public awareness regarding the need for alternative funding sources for surface transportation programs and to provide information on possible approaches.
- provide recommendations regarding adoption and implementation of user-based alternative revenue mechanisms.
- minimize the administrative cost of any potential user-based alternative revenue mechanisms.
- minimize the administrative costs associated with the collection of fees.

⁸ STSFA funds are subject to the overall Federal-aid obligation limitation. Therefore, the actual amount of STSFA funds available for grants in a fiscal year is reduced ("lopped off") based on the imposition of the limitation on obligations.

⁹ Except where specifically indicated, the term "States" as used in this Notice will apply to both individual States and groups of States submitting a common proposal.

The major focus of the program is in funding larger scale demonstrations projects, rather than smaller scale demonstration projects, and in awarding funds to both single State and multistate demonstrations.

Key FY20 FHWA STSFA R&T Program Activities.

Activity	Period of Performance	Partners/Notes
Administer and support the delivery of the STSFA grant program, evaluate program outcomes, and conduct outreach and technology transfer.	2018-2023	MPOs, State DOTs, Local Agencies
Conduct outreach to educate and inform State legislators about tools available to States interested in advancing STSFA strategies designed to provide alternate funding mechanisms to the gas tax for financing transportation infrastructure improvements.	2019-2021	State DOTs, Mileage-Based User Fee Alliance
NEW - Explore what would be needed to conduct a national pilot of STSFA strategies and develop a framework that could be used for a pilot.	2020-2021	MPOs, State DOTs, Local Agencies, Mileage-Based User Fee Alliance, and National Conference of State Legislatures

Statutory Requirements:

Is this program statutorily mandated (Y/N): _Y _____

Specific statutory authority for conducting this effort is found in the Fixing America's Surface Transportation (FAST) Act of 2015, Pub. L. No. 114-94, H.R. 22, § 6020, H.R. 22, 114th Cong. (2015), which authorizes the Secretary of Transportation to “establish a program to provide grants to States to demonstrate user-based alternative revenue mechanisms that utilize a user fee structure to maintain the long-term solvency of the Highway Trust Fund.” The purpose of the program is to identify strategies that could supplement or replace the gas tax. While gas tax revenues finance the Highway Trust Fund, the federal gas tax rate has not been raised since 1997. During that time, vehicles have become more fuel-efficient and automakers have introduced electric vehicles (EVs), which do not pay a federal gas tax.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Innovation

The STSFA program addresses the department’s goals for Innovation. Deploying road user charge strategies offers an innovative approach to maintaining the solvency of the Highway Trust Fund. The purpose of the program is to identify strategies that could supplement or replace the gas tax that

sustains the Highway Trust Fund. Funds generated from mileage-based user fees can be used to operate and maintain the National Highway System.

One of the objectives of the program is to identify potential negative impacts on rural drivers. Results from the Oregon vehicle miles traveled (VMT) pilot indicate that rural drivers take longer trips but fewer of them, as compared with urban drivers who take more frequent, shorter trips. The average daily VMT was 21.3 for urban drivers and 19.9 for rural. Delaware and Washington completed pilot studies in 2018 and results on the impacts on rural versus urban driver impacts should be available in the coming months.

USDOT Research Priorities:

STSFA is not a research program, rather it is a discretionary grant program established in the FAST Act that receives ITS funding through several FHWA research programs. This discretionary grant program is designed to provide grants to States to demonstrate user based alternative revenue mechanisms that utilize a user fee structure to maintain the long-term solvency of the Highway Trust Fund.

Research Collaboration Partners:

HOP staff works closely with FHWA Division Offices to provide technical support to States deploying STSFA demonstration projects. State transportation and revenue agencies are the program's primary stakeholders, so they are the target audience for most activities. FHWA staff from headquarters and the field offices work with partner organizations in a variety of ways, such as supporting the execution of demonstration projects, conducting webinars, workshops and roundtable discussions; developing written resources, providing technical assistance and support to assist with deployments. The Program office sponsored an in-person stakeholder meeting during the Transportation Research Board (TRB) Annual Meeting in January 2019. All of the projects participated in the meeting to share lessons learned from their pilot and seek input on challenges experienced by their pilots. The FHWA STSFA Program Manager was invited to speak at the Road User Charge (RUC) West technical meeting, which was held during TRB to discuss the status of the program and respond to partner questions. The Mileage Based User Fee Alliance (MBUFA) was formed in 2010. It is a national non-profit organization that brings together government, business, academic, and transportation policy leaders to conduct education and outreach on the potential for mileage-based user fees as an alternative for future funding and improved performance of the U.S. transportation system. MBUFA educates key federal policy-makers and the community at large on the importance of a sustainable funding mechanism for surface transportation through regular meetings and outreach by MBUFA members. Each pilot has a public outreach process. Some of the States that deployed pilots recruited State and local government officials as pilot participants. FHWA entered into a contract with MBUFA to have them conduct research on the public involvement approaches each State has launched. The final product will include a webinar to allow for information exchange between the State partners as well as lessons learned guide that includes cross cutting issues that will provide guidance regarding the best approach to supporting a national outreach effort. In November 2018, MBUFA sponsored a MBUF/Road User Charge (RUC) Symposium to seek input from thought leaders in the RUC community regarding what steps were necessary to support a National RUC Pilot. FHWA intends to collaborate with National Conference of State Legislatures staff to disseminate information about the pilots to increase awareness and understanding about road user charges.

Benefits of Partnership and Partner Contributions to FHWA STSFA.

Partner Organization	User Perspective on Needs	Field Trials	Deployment	Research Collaboration	Funding
State DOTs	X	X	X	X	X
MPOs	X			X	
Local Transportation Agencies	X	X		X	
Universities and other Research Organizations	X			X	X
Mileage-Based User Fee Alliance	X				X
National Conference of State Legislatures	X				X

Chapter 4 – FY 2021 Program Descriptions

Accelerated Implementation and Deployment of Pavement Technologies

Program Description/Activities/Objectives:

In 2021, FHWA will continue to conduct a AIDPT program that is closely coordinated with the Pavement & Materials R&D program. It will continue to drive implementation of innovative pavement technologies, with a focus on advancing performance-related specifications.

Demonstration of performance standards will be accomplished through demonstration and shadow projects, implementing new performance tests and procedures. Additionally, in 2021 FHWA will be developing a statistical evaluation tool to support quality assurance efforts and implementing protocols for evaluating pavement foundation condition to help optimize pavement performance.

Program Alignment with Strategic Goals:

FHWA's 2020 AIDPT Program supports the Department's Safety, Infrastructure and Innovation Strategic Goals. This program is authorized in section 503(c)(3) of title 23, United States Code, which require the Secretary to establish and implement a program under the technology and innovation deployment program to promote, implement, deploy, demonstrate, showcase, support, and document the application of innovative pavement technologies, practices, performance, and benefits. The AIDPT program directly supports the strategic goals relating to Infrastructure and Innovation contained in the FY18-22 DOT Strategic plan. Specific contributions to the strategic goals and the key program objective to optimize pavement performance are as follows.

Safety: The AIDPT Program will contribute directly to highway safety and the Department's Systematic Safety Approach by continuing to advance implementation of friction management programs to improve pavement safety. These efforts will provide State technical assistance and increased education and awareness to better consider safety in pavements related decision-making. Tangible outcomes are expected in 2021 and beyond. Indirect contributions will come about through durability improvements that will result in fewer work zones.

Infrastructure: The AIDPT Program supports the Life Cycle and Preventive Maintenance objective through continued efforts to accelerate implementation of improved pavement preservation practices and pavement management systems. Additionally, the program will continue to advance material and design innovations to improve pavement durability. These efforts will provide technical assistance to States and increased education and awareness. Tangible outcomes are expected in 2021 and beyond.

Innovation: The AIDPT Program supports the Department's Innovation Goal by accelerating the deployment of innovative pavement technologies. Furthermore, by advancing performance-related specifications, the program opens the door to further innovation on the part of the construction contracting community. Other entities such as NCHRP, the National Center for Asphalt Testing, and several universities are conducting supporting research in this area. These efforts will provide National standards published for procedures, tests, and equipment as well as technical assistance to States. Tangible outcomes are expected in 2021 and beyond.

Construction and Project Management

Program Description/Activities/Objectives:

In 2021, FHWA's Construction and Project Management Program will complete the development of quality assurance guidelines for bridge construction, continue implementation of identified improvement actions for the Major Projects Program, complete updates to National Highway Institute training on Utility Coordination, and initiate new projects to further advance Building Information Management implementation in the highway industry.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Infrastructure
Innovation
Accountability

FHWA's Construction and Project Management R & T Program supports the Department's Infrastructure, Innovation and Accountability Strategic Goals. Achievement of the Department's Life Cycle and Preventive Maintenance objective will be supported through development of quality assurance guidelines for bridge construction, while the Economic Competitiveness and Workforce objective will be advanced through development of training on utility coordination. They will contribute to Mission Efficiency and Support through improvement to major project cost estimating and program management improvement initiatives. The program will advance Deployment of Innovation through peer exchanges to promote and support effective application of unmanned aerial systems to support highway construction, and work to advance application of Building Information Modeling (BIM) in the highway industry. The use of BIM will increase the efficiency of highway construction and minimize the impact of construction on the public. In addition, BIM allows for better integration of highway agency data for more cost-effective decision making. Tangible outcomes in each of these areas are expected to be achieved in 2021.

Other organizations conducting or sponsoring work in these areas include individual State Highway agencies and the NCHRP. FHWA investment in construction and project management research and deployment is targeted at needs that cannot be effectively addressed by other organizations, including those requiring a national perspective.

Results and findings from past FHWA investments in construction and project management research and deployment include: the development of a method for highway agencies to quantify the return on investment of adopting e-construction technologies, case studies documenting construction automation, and the development of methods for agencies to gather utility location information. FHWA's FY21 investments in construction and project management research and deployment are expected to yield tangible outcomes no later than 2022.

Geotechnical and Hydraulics R&T

Program Description/Activities/Objectives:

In 2021, the FHWA Geotechnical and Hydraulics R&T Program anticipates continuing work in several areas, including development of design specifications and guidance addressing hydraulic issues such as highway drainage, hydroplaning risk assessment models using AI concepts, changes in rainfall and flood frequency, flow modeling for bridges and culverts, coastal highways impacted by extreme events, use of geosynthetics in pavements, assessment of corrosion for buried metallic foundations and elements, design and construction of mechanically stabilized earth walls, and slope management. Deployment efforts will focus on implementing research and development results in these areas. New areas of investigation planned for pursuit in 2021 include development of real-time 3-dimensional automated scour simulation and prediction tools to monitor bridge scour during storm events, evaluation of the use of NDE technologies to assess the condition of in-service pavement foundations, and findings on the durability and strength-deformation characteristics of recycled backfills for retaining walls.

Program Alignment with Strategic Goals:

The Program aligns with and supports the Department's Safety, Infrastructure and Innovation Strategic Goals. The Program contributes directly to highway safety through research of the interactions of water sheet flow, pavement systems, and vehicle stability (Hydroplaning) with a goal of improving driver and vehicle safety and stability. Prediction, prevention, and mitigation of scour and geohazards. Additionally, it will work to complete the development of protocols for the inventory and evaluation of embankments, slopes, walls, rock cuts, bridge foundations, bridge approaches, etc. necessary for life cycle assessments to equip transportation agencies to better manage these assets to ensure serviceability and safety. The Programs' expected FY21 contributions will come about through research related to scour resistant and more reliable bridge foundation design. The Program will continue to support the Department's Innovation Goal through research and development in technologies and tools that provide more reliable and cost-effective project designs, and follow-on technology deployment initiatives to see that the resulting innovations are put into practice.

It is necessary for the FHWA to engage in this work because no other research organization/sponsor is positioned to do the work that we undertake. While related research is pursued by individual State highway agencies, and the NCHRP, FHWA takes on work that by virtue of scope, technical requirements, and/or the need for an unbiased perspective, cannot be effectively pursued by others.

Past investments in this program area have produced innovations such as Geosynthetic Reinforced Soil-Integrated Bridge (GRS-IBS) and Collaborative Hydraulics: Advancing to the Next Generation of Engineering (CHANGE). The GRS-IBS was developed to serve as a cost and time effective solution to simple bridge construction, saving transportation agencies up to 60 percent compared to their conventional practice. CHANGE provides a better representation of flow data for planning and design teams leading to improved project quality.

FY21 investments in the Geotechnical and Hydraulic Program will begin to yield tangible results in 2022.

Long-Term Infrastructure Performance

Program Description/Activities/Objectives:

In 2021, FHWA's LTIP Programs will continue to pursue data collection, processing and analysis of pavement and bridge data required to advance understanding of how and why highway pavements and bridges perform as they do, in support of improved design and the Performance-Based Infrastructure Investments called for as part of the Department's Economic Competitiveness strategy. The LTPP InfoPave and LTBP InfoBridge web portals will be updated with data collected through the summer of 2020. New analysis projects will be undertaken to develop bridge performance models and address to-be-selected objectives identified in the [LTPP Data Analysis Plan](#). Both data collection and analysis activities for LTBP will ramp up, while LTPP data collection activities will wind down as the test sections under study reach conditions requiring major rehabilitation or reconstruction.

Program Alignment with Strategic Goals:

The Program primarily supports the Department's Infrastructure Strategic Goal. Activities under this program also support aspects of the Department's Safety and Innovation goals.

The LTIP Programs make direct contributions to the Infrastructure Goal objectives to maintain a state of good repair and promote economic competitiveness by enabling more effective management of infrastructure performance. Contributions to highway safety and the Department's Systematic Safety Approach are indirect, through design improvements and more effective infrastructure management, resulting in reduced risk of failure and work zone exposure. The programs support the Department's Innovation Goal through development of innovations needed to support data collection that have broader applicability, and by providing data to support development of improved design procedures and other solutions to pavement and bridge engineering challenges.

The fundamental problem addressed by the LTIP programs is the need to better understand and model highway pavement and bridge performance, in support of more effective infrastructure performance management. It is necessary for FHWA to invest in this research, because no other research organization is positioned to undertake a sustained, nationwide research effort of the required scale and duration.

Past investments in LTPP have supported a wide array of products and findings (see [the LTPP InfoPave web portal](#)), most notably the development of the current AASHTO pavement design guidance and software tool ([AASHTOWare Pavement ME Design](#)). Tangible products founded on the LTPP data are developed on a continuous basis, and will continue to be developed for many years.

LTBP investments to date have yielded data collection protocols and tools such as the RABIT™ Bridge Deck Assessment tool, detailed inspection data for 56 bridges, and the [LTBP InfoBridge web portal](#). Initial LTBP data analyses are in progress, and expected to yield results in 2019.

Pavement & Materials R&T

Program Description/Activities/Objectives:

In 2021, FHWA's Pavement and Materials R&D Program pursue work to improve durability, extend the life, and reduce the maintenance needs of infrastructure, as called for in the State of Good Repair/Advanced Materials, Designs, and Technologies strategy. Projects initiated in 2020 in support of effective use of pavement materials tests to relate paving mixtures to expected performance and improved construction quality assurance specifications that incorporate those tests will be completed. Anticipated new starts in 2021 include investigation of improved methods for designing and constructing open graded mixtures and demonstration of how those mixtures improved pavement safety. Research will also be directed at use of epoxy asphalt and other strategies for mitigating aging.

Program Alignment with Strategic Goals:

FHWA's 2021 Pavement and Materials R & D Program will continue to support the Department's Safety, Infrastructure and Accountability Strategic Goals. It will contribute directly to highway safety by providing tools, technologies, guidance and training to support infrastructure owners in considering the impacts of pavements on friction and macrotexture and providing highway agencies with tools to design, construct, and maintain pavements with safety in mind. It will support the Life Cycle and Preventative Maintenance Objective by providing test methods, and guidance to support infrastructure owners in effective design, construction and management of highway pavements. The Pavement and Materials R&D Program contributes to Development of Innovation by undertaking research and to develop innovative solutions to highway pavement analysis challenges. The Accountability goal is supported by the development of pavement performance related specifications that pay paving contractors based on the long term expected performance of the pavement they construct.

Other organizations conducting or sponsoring work in these areas include individual State Highway agencies and the NCHRP. FHWA investment in pavement and materials research is targeted at needs that cannot be effectively addressed by other organizations, including those requiring a national perspective.

Results and finding from past FHWA investments in pavement and materials research include: a potentially game-changing breakthrough in testing aggregate for susceptibility to ASR, a variety of improved test methods and specifications for paving materials, including rapid test methods to support construction quality assurance, and procedures to analyze the impacts of superheavy load movement on flexible pavements. FHWA's FY21 investments in pavement and materials research are expected to yield tangible outcomes no later than 2022.

Structures

Program Description/Activities/Objectives:

Consistent with the Department's State of Good Repair strategy, FHWA's FY 2021 Structures R&T Program will include work addressing Advanced Materials, Designs and Technologies, Risk-Based Asset Management, Infrastructure System Resilience, and Advanced Inspection Tools. In 2021, FHWA's structures R&D Program will complete several projects initiated in 2020 in support of effective use of innovative concrete and steel materials in bridge construction and preservation, and improved technologies and training for assessment, inspection, and load rating of highway structures. Refined guidance for the structural design of ultra-high performance concrete bridges will be developed. A primer on the use of lightweight concrete in highway structures will be published. Non-destructive evaluation tools and techniques for post-tensioned structural elements will be produced. Anticipated new starts in 2021 include investigation of new repair methods for steel bridges, development of technology transfer materials, non-destructive testing guidelines for AASHTO's consideration, and visualization tools for non-destructive evaluation technologies.

Program Alignment with Strategic Goals:

FHWA's 2021 Structures R & T Program will continue to support the Department's Safety, Infrastructure and Innovation Strategic Goals. It will contribute directly to highway safety by providing tools, technologies, guidance and training to support infrastructure owners in ensuring that highway bridges, tunnels and other structures are designed, constructed, inspected, evaluated, and maintained to safely carry traffic loads and withstand the forces of nature. It will support the Life Cycle and Preventative Maintenance Objective by providing test methods, and guidance to support infrastructure owners in effective design, construction and management of highway bridges, tunnels and other structures. The program addresses the Department's Economic Competitiveness and Workforce objective through training to ensure that personnel responsible for bridge and tunnel inspection have the knowledge and skills required to effectively and efficiently carry out this vitally important responsibility. The Structures R&T Program contributes to Development of Innovation by undertaking research and to develop innovative solutions to highway structural engineering challenges. Ultimately, the resulting innovations will improve the state of the practice and result in resilient and adaptable systems to mitigate the impact of hurricanes, floods, and other extreme events on bridges and other structures. Additionally, the Program contributes to Deployment of Innovation through training and technology transfer initiatives.

Other organizations engaged in and/or sponsoring highway structures research and technology include individual State highway agencies and the Transportation Research Board. FHWA's research investments are directed toward that challenges and needs of national importance that cannot or will not be addressed by others.

Past FHWA investments in Structures research and technology have resulted in the development and implementation of innovations such as the use of ultra-high performance concrete for connections in prefabricated bridge construction, development and delivery of guidance and training for bridge inspection, improved guidance for design and evaluation of connections in steel bridges, development and implementation of the National Tunnel Inspection Standards, and advancement of non-destructive testing technologies for infrastructure condition assessment. Some tangible outcomes from FY21 investments will begin to be realized no later than 2022.

Transportation Performance Management, Asset Management and Maintenance

Program Description/Activities/Objectives:

In 2021, FHWA's TPM and Asset Management R&T Program will continue as a coordinated and cohesive program of research, development and technology deployment activities focused on providing tools, innovations, technologies and on developing guidance and policies to advance the effective management of highway infrastructure and system performance. Research development and deployment activities will include: identification and advancement of specific strategies to enhance TPM; the improvement of AM, preservation and maintenance practices and the development and deployment of TPM and AM training, technology transfer and support initiatives.

Program Alignment with Strategic Goals:

FHWA's TPM, AM & M R & T Program supports: the efficient investment of Federal transportation funds across national transportation goals; the increase in accountability and transparency of the Federal-aid highway program; and the improvement of program and project decision-making through performance-based planning and programming. TPM, AM & M supports the Department's Safety, Infrastructure and Innovation Strategic Goals. Tangible outcomes in each of these areas are expected to be achieved in 2021.

FHWA's TPM, AM & M R & T Program supports: the efficient investment of Federal transportation funds across each of the four national transportation goals by:

- ensuring that highway infrastructure condition supports achievement of safety performance targets;
- ensuring that transportation agencies use sound asset management principles to optimize the condition of the highway system based on the resources invested;
- providing tools and resources to further advance and support innovative techniques to manage infrastructure conditions; and
- advancing new regulations that hold State's accountable to the achievement of performance targets while limiting federal oversight of program requirements.

This research plan aims to address gaps that exist today in the capability of highway agencies to use strategies that will increase their impact of their highway investments in providing for improved condition of their highway system over a life cycle. The development of additional technical resources, training, and sharing of best practices are intended to bridge this gap.

It is critical to invest in this research today as States are more and more challenged to acquire the funding needed to address their backlog of infrastructure condition investment needs. They need tools and resources today to more effectively invest the limited funding they have for the greatest return possible.

FHWA is working in partnership with AASHTO in meeting research needs which have been documented in a research road map. Through this partnership FHWA has identified where it is most effective to conduct research at the federal level vs. other efforts primarily funded through TRB or through State SPR funds.

FHWA has made previous investments in TPM, AM & M related activities. These investments have made an impact in the advancement of sound practices to improve infrastructure management. Although previous investments have been made, this is a new and evolving aspect of the federal-aid

highway program that is just becoming fully implemented. It will take several more years to understand and address gaps that need to be addressed at a federal level to improve infrastructure management.

The program is and will continue to produce tangible outcomes as implementation continues. For example, data quality has improving steadily over the past 3 years as a result of investments made to develop new tools, issue training, and advance best practices. It is expected that investment decision-making, performance modeling, and infrastructure conditions will improve as the products from these investments are fully realized.

Safety Program Delivery

Program Description/Activities/Objectives:

The FHWA Office of Safety, Office of Safety Research and Development and the Resource Center Safety and Design Technical Service Teams work alongside the safety specialists in the Division offices on a “Focused Approach to Safety.” This approach focuses our resources on activities that address the Nation’s most critical safety challenges by providing new tools and innovations, research, and training. This approach increases awareness on critical severe crash types, leads to key safety infrastructure improvements, assists in prioritizing limited resources, and creates positive organizational changes in safety culture, policies, and procedures. The three critical areas identified as providing the greatest potential to reduce highway fatalities using infrastructure-oriented improvements are namely:

- Roadway departure,
- Intersection crashes, and
- Pedestrian/bicycle crashes.

In 2021, FHWA will continue to conduct a coordinated Safety Program Delivery Program focused on providing guidance, policies, tools and technical assistance to improve safety. Through the HSIP and other efforts, FHWA will continue to encourage a data-driven, performance-based approach to save lives. Efforts in 2021 will build upon the 2020 activities and ensure alignment with the DOT and FHWA’s strategic plans. The main goal of the Safety Program Delivery Program to solve is to reduce the number of motor vehicle fatalities and serious injuries on our nation’s roads.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety

FHWA’s Safety Program Delivery primarily supports the Department’s Safety goal. FHWA’s Safety Program Delivery secondarily addresses the Department’s Infrastructure, Innovation, and Accountability Goals

The goals and purpose of the Safety Program Delivery Program provide vision and helps to focus attention and resources on preventing roadway fatalities and serious injuries. While the goals and purpose of the program don’t change, the activities remain fluid and are flexible to adjust to changing needs.

Safety: The Safety Program Delivery research focuses on strengthening States’ abilities to implement a performance driven safety program by sharing information, training, and

assistance. The program seeks to increase the technical capacity of transportation safety professionals at all levels of government to advance safety programs. The program fosters a safety culture not only through technical assistance but through marketing and communications programs.

Infrastructure – The Safety Program Delivery research promotes an integrated, multidisciplinary (4E's) approach to safety in all phases of program and project development including transportation planning. It includes evaluation and assessment of road owners' capabilities which enable target training and technical assistance to fill gaps. It includes providing technical assistance and training to State DOTs to ensure effective, data-driven infrastructure safety projects that lead to alternative infrastructure designs.

Innovation – The Safety Program Delivery research promotes the development and use of innovative tools to support decisions using a data-driven approach in managing highway safety.

Accountability – The Safety Program Delivery research program includes evaluation of various safety programs such as the SHSP and HSIP as well as the tracking and support of Safety Transportation Performance Management. The program provides support for states in developing safety performance targets and assistance to states that fail to meet their targets.

The Safety Program Delivery research program develops tools and technical assistance of great value to rural areas. Examples include high-risk rural roads technical assistance, marketing and communication materials specifically for local public agencies, working with local associations such as the National Association of County Engineers (NACE) to identify needs and provide technical assistance as well.

Safety Design and Operations

Program Description/Activities/Objectives:

The Safety Design and Operations program encompasses core safety engineering work that overlaps traffic engineering, geometric roadway design, transportation planning, and system management and operations, and aims to help stakeholders reduce fatalities and serious injuries on all public roadways. The program focuses on three critical areas identified as providing the greatest potential to reduce highway fatalities using infrastructure-oriented improvements, as follows:

- Roadway departure,
- Intersection crashes, and
- Pedestrian/bicycle crashes.

In 2021, FHWA will continue to research how to improve infrastructure to reduce fatalities and serious injuries and will continue to build our knowledge base of safety improvements and fill information gaps.

Program Alignment with Strategic Goals:

FHWA's Safety Design and Operations program supports the Department's Safety, Infrastructure, and Innovation Strategic Goals. Specific contributions are as follows:

Safety: The Safety Design and Operations program develops infrastructure-related research to improve the safety of the Nation's roadways by focusing on priority technical areas to address National safety data trends and Departmental/Agency policy initiatives. This includes research promoting safer roadway design by evaluating, documenting and promoting new approaches to road design that enhances road safety through proven safety countermeasures – many of which are developed to address the disproportionate risk of fatal and injury crashes in rural communities.

Infrastructure: The Safety Design and Operations program examines the interrelationships among the roadway, road users, and roadway context to determine effective ways to improve the safety performance of the physical infrastructure. The program identifies low-cost safety infrastructure improvements that reduce crashes by improving infrastructure performance and reduce project delivery time and project costs.

Innovation: The program supports demonstrations of advanced vehicle automation technologies to assess existing infrastructure design and operation practices and considering the value of current infrastructure safety strategies and treatments for the future. The Safety Design & Operations program also seeks to ensure that Automated Vehicles do not negatively affect other road users, namely pedestrians, bicyclists, and motorcyclists. The program develops innovative safety countermeasures to reduce fatalities on all public roads.

Accountability: The Safety Design and Operations program advances a data-driven systemic approach to reduce highway fatalities. The program provides tools for transportation agencies to analyze safety data, develop safety implementation plans, and to identify and implement cost-effective safety countermeasures.

The Safety Design and Operations program develops tools and technical assistance that are tailored to the needs of rural roadways and their owners. Such work is coordinated through a Local and Rural Road Safety working group.

Safety Data and Analysis

Program Description/Activities/Objectives:

The Safety Data and Analysis program area focus on the use of safety data to inform highway investment decision making through a systemic safety approach based on crash experience, crash potential, crash rate, or other data-supported means. The scope of the program includes research, development, and technology (RD&T) to improve State and local safety data systems commonly record crash, roadway inventory, and traffic volume data. The program enhances our State and local partners' capability to use safety data systems for analysis and evaluation supporting highway investment decision making to help ensure efficient and timely detection of critical safety hazards. The program also includes analyses supporting FHWA safety policy decision making, providing a foundation for systemic, performance-based approaches to improving safety.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety

FHWA's Safety Data and Analysis program primarily support the Department's Safety Strategic Goal. Additionally, the secondary impacts of the Safety Data and Analysis program also contribute to the other USDOT Strategic Goals and priorities. Specific contributions as follows:

Safety: Through the Safety Data and Analysis Program, FHWA has lead Federal responsibility to encourage and support State and local highway agencies in the improvement of roadway inventory and traffic volume components of safety data systems, and supporting crash data improvement. Accurate, complete, and timely data is critical to support effective systemic safety approaches and inform performance-based regulations. The program also establishes processes for integrating roadway inventory and traffic volume data with crash data through geolocation to a highway base map that provides a geospatial referencing system for all public roads. Improved data on all roads, whether urban or rural, leads to accurate problem identification, analysis, and effective safety countermeasure development. Much of the safety research stems from detailed analysis of the causal factors for crashes. The Highway Safety Information System (HSIS) provides a detailed crash data coupled with high-resolution roadway characteristics to enable such analyses.

Infrastructure: The program advances tools in safety data analyses that lead towards improving the infrastructure. The program is supporting Highway Safety Improvement Program (HSIP) planning, implementation, and evaluation efforts through the analysis of safety data available through various partners, establishing national level benchmarks. The program also performs data analysis that benefits the explicit, quantitative consideration of safety in planning, programming, project development, and operations decision making. The program established the Model Inventory of Roadway Elements (MIRE) as a guideline to help state agencies improve their roadway and traffic data inventories.

Innovation: The evaluation focus of the Safety Data and Analysis program advances the state-of-practice in safety evaluation. These analyses lead to countermeasure evaluation and crash modification factor (CMF) development, delivery, and use. This leads to making effective decisions, particularly on rural roads where safety deficiencies are more pronounced, about how to obtain more reliable data on the effectiveness of crash countermeasures. The program continually evaluates programs and processes for improving safety data and enhancing the analysis and evaluation capabilities at the State and local levels. Recently the Safety Training and Analysis Center (STAC) was created to study Naturalistic Driving Study data collected through the second Strategic Highway Research Program (SHRP2). This data captured the driver behavior and the movement of vehicles through everyday driving experiences, enabling new research into how crashes can be avoided.

Accountability: as road owners and operators gather and use more data and information for decision making; they will become more accountable to the public.

With a disproportionate rate of fatalities in rural areas, any activities to promulgate the scientific, data-driven approach to safety will save lives in those areas. Several emphasis areas in the Safety Data and Analysis program are highly relevant to rural safety, including a special set aside in the MIRE FDE for describing rural roads, and the use of the Systemic Approach to Safety.

Human Factors Analytics

Program Description/Activities/Objectives:

The purpose of the Human Factors (HF) program at FHWA's Turner-Fairbank Highway Research Center (TFHRC) is to better understand the relationship between roadway users, infrastructure, and vehicles. Human Factor Analytics encompasses human factors research and related activities. Human factors studies consider how drivers, pedestrians and special users' needs can be met through improved roadway designs and better roadway/vehicle integration. HF research looks at how people respond to highly visible, easy to read signs, improved pavement markings, CV/AV technology, innovative operational changes, and safer streets with improved walkability.

US crash report data identifies human error as a factor in approximately 94% of vehicle crashes (1). Human factors research is a cross-cutting field that routinely conducts both applied and more fundamental investigations for projects in areas such as traffic control device effectiveness, novel intersection designs, and pedestrian & bicyclist safety, to help reduce vehicle crashes resulting from human behavior and error. The HF Laboratory at TFHRC includes the Highway Driving Simulator (HDS), two Field Research Vehicles, the Highway Sign Design Lab, the MiniSim™ driving simulator, and the Virtual Reality Lab.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety

FHWA's Human Factors Analytics primarily supports the Department's Safety Strategic Goal. Additionally, the Human Factors Analytics program delivers secondary impacts to other USDOT Strategic Goals and Priorities. Specific contributions are as follows:

Safety/Promoting Safety: Many of our Human Factors research projects promote safer roadway design by evaluating and improving the design of roadway signing, and researching how emerging vehicle technologies can improve roadway safety and decrease crash frequency and severity. Human factors alternative intersection and interchange evaluation research is also focused on improving roadway safety, while simultaneously improving roadway efficiency.

Infrastructure/Improving Infrastructure: All our HF projects collect and analyze human performance and behavior data as a basis for decision making, technology evaluation and implementation, guidelines, recommendations, and policy creation. This includes projects in all our research areas, including Connected and Automated Vehicles (CAV), Traffic Control Devices and signing research, SHRP2 research, roadway user behavior (including traveler information research), and roadway design evaluation (including alternative intersection and interchange evaluation research). Our projects and research studies include a variety of

driving performance data including data from the driving simulators, field research vehicles, sign laboratory, and test track that are collected and analyzed to answer specific research questions.

Innovation: Automated Vehicles (as well as Connected Vehicles) are important areas for the Human Factors program and active areas of research. AVs has been an important area in the HF program in the last four years, and this will continue to be a very important and dynamic area for the program. The Human Factors Analytics program is coordinating within the Department on “Driver Acceptance of Vehicle Automation for Function-Specific Automation Applications.” This project builds on a previous multi-year program on “Cooperative Adaptive Cruise Control (CACC): Investigation of Key Human Factors Issues.”

Prior research activities considered the application of alternative intersection designs for rural locations. One design, the Restricted Centerline U-Turn (RCUT), was developed based on simulation work to understand how traffic flows for minor roadways would be affected as they intersect fast-moving arterial highways. Visualization work enables roadway designers to understand how design choices affect safety while providing valuable tools for building local community support.

Transportation Systems Management and Operations

Program Description/Activities/Objectives

Foundation for Successful Operations. In 2021, FHWA will continue to conduct a coordinated and cohesive Research and Technology Program focused on advancing the state-of-the-art institutional structures to ensure that advanced and emerging innovative operational strategies and technologies are successfully delivered and sustained for the benefit of the American public and the business sector. This program element will provide the tools and organizational support to enable agencies to evaluate, plan, fund, design, and capitalize on emerging cost-effective transportation technologies and operational strategies to improve reliability, mobility, safety, and economic competitiveness. This program element will build on 2020 efforts and further enhance planning and operations functions to improve and strengthen the key institutional underpinnings and linkages, enhance the performance-based planning and programming process, further ensure that the business processes, staff expertise, and investment prioritization methods are sufficiently robust, providing critical insights, research, and resources on public and private innovative operations funding opportunities, further supporting investment trade-off decisions through better, more comprehensive analysis benefits and cost, and further ensuring that agencies can objectively assess organizational capabilities and develop targeted action plans for improvement. Activities in 2020 will also take the next steps on research initiated in 2019 on the nexus between TSMO and safety, as well as how TSMO can be applied effectively in rural areas.

Activities will also continue support for effective delivery of TSMO programs through technical assistance, training, analysis, and support for implementation of FHWA research and development results.

Data-Driven Operations Decision-Making. In 2021, FHWA will continue to conduct a coordinated and cohesive Research and Technology Program focusing on the estimation and evaluation of transportation impacts of operations strategies using data management and analytics, analysis modeling and simulation tools, and transportation performance management techniques. FHWA will further develop resources for researchers and practitioners; provide resources on innovative strategies and technologies to improve data and performance measures and management practices that lead to improved transportation operations; collaborate with industry partners to adopt newly developed tools, capabilities, and resources in commercial software, agency processes and procedures, and industry-wide state of practice; develop management support systems to improve the efficiency and effectiveness of both operational and organizational performance; develop data business planning resources; develop congestion reporting and operations performance measures and management tools and resources; and improve both planning-level and real-time operational decision-making.

This program area will continue to develop and support data management and business planning, analysis tools, and performance management for decision-making, including implementation assistance for innovative concepts listed under this Priority Research and Technology Area

(PRTA), and support the storing and documenting of data acquired from operations projects, and making them accessible to the public.

Implementing Operations Strategies. In 2021, FHWA will continue to conduct a coordinated and cohesive Research and Technology (R&T) Program focusing on the use and deployment of operational strategies and practices to improve the performance of existing transportation infrastructure. This program will continue to target a range of traffic, demand, and parking management tools and strategies that agencies can employ to reduce congestion, improve safety and improve travel time reliability. The program will continue to effectively apply and integrate readily available (but perhaps underutilized) and innovative operational strategies, practices, and technologies for more efficient day-to-day management of the surface transportation system. The program will continue to advance operational strategies and tools including traffic control, traveler information, pricing, shared use mobility, integrated corridor management (ICM), active transportation and demand management (ATDM), traffic control device application, traffic management centers, and parking management systems. This program will continue to assist and support agencies to advance their current state of operations to a more proactive, integrated, performance-driven, and holistic approach to traffic management and operations.

Activities in 2021 will enable FHWA to address needs of agencies in using our transportation assets by developing strategies, policies, resources, and training; compiling best practices; organizing peer exchanges; and conducting applied research that help agencies more effectively manage their facilities using proactive, dynamic, and performance-driven approach to traffic management and operations.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation

Infrastructure: FHWA’s Transportation Systems Management and Operations R&T Program closely supports the Department’s Infrastructure Strategic Goal. The TSMO Research Program improves system reliability and enhances performance of the transportation system. Particularly, the research supports strategies that focus on operational improvements intended to maintain and, in some cases, restore the performance of existing transportation system before extra capacity is needed. This may enable transportation agencies to “stretch” their funding to benefit more areas and customers. The TSMO research also helps agencies to balance transportation system supply and demand and provides flexible solutions to match changing conditions, to reduce the need for excess infrastructure capacity during non-peak times. Finally, it helps agencies make informed decisions about the management of infrastructure related resources, such as snow and ice treatments, and how to plan for future system needs using performance metrics that account for travel conditions on specific route segments and from a systems perspective, including the potential for travel mode shift.

Innovation: TSMO applications rely heavily on technology and innovation, taking advantage of new data sources and advances in consumer applications, as well as innovations in traffic assets, such as traffic signal controllers, sensors, and communication devices.

Safety: TSMO applications often smooth the flow of traffic, which can reduce unexpected congestion that leads to crashes. Through detection and active system management, TSMO can enable system owner-operators to detect congestion, alert drivers of road conditions through traveler information so they are prepared before reaching congestion, and facilitate improved traffic flow in near real-time through strategies such as adjusting signal timing, opening an auxiliary travel lane, or providing alternate route information.

Connected and Automated Vehicles

Program Description/Activities The FHWA, in collaboration with the ITS Joint Program Office, other USDOT modes, State and local public agencies, Academia, industry, and other surface transportation stakeholders, will conduct a Connected and Automated Vehicle research program to address the challenges of integrating vehicles with Automated Driving Systems (ADS) with the road infrastructure system. Research in FY 2021 will build on research in FY 2020, with a focus in six major areas: (1) Support Development of Integration Paths for Road Infrastructure and Automated Driving Systems; (2) Roadway and ADS Data Assessment and Data Systems Framework; (3) Transfiguration of the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) for Connected and Automated Vehicles; (4) Enabling Technology for Connected and Automated Vehicles; (5) Cooperative Automated Vehicles; and (6) Next Generation Traffic Management Systems (TMS).

Support Development of Integration Paths for Road Infrastructure and Automated Driving Systems: The next step will be to formulate a Automated Vehicle Roadway Readiness Strategy. Developing a strategy builds off the FY20 research and per the developed paths and scenarios, facilitates stakeholders collaboratively formulate a collective strategy for the initial integration of Automated Vehicles into our roadway system. The research will include defining readiness elements, objectives, and an implementation time line. Readiness responsibilities will be assigned to appropriate stakeholders with critical coordination actions identified. The National Automation Vehicle Roadway Integration Forum will still support communication and coordination to facilitate the first stage of integration and subsequent future stages of integration of Automated Vehicles into our roadway system.

Research will also move forward with the fabrication, testing, and proof-of-concept development of artificial roadway feature prototypes for staging roadway test scenarios. This research will assist in determining if various techniques and methods can be used to depict realistic scenarios that can be easily custom configured or changed without permanently changing basic test facilities. The results will support joint ADS and roadway test and evaluation and enable the testing of multiple roadway configurations.

Data and Data Systems Prototype Testing and Evaluation: This research builds off the FY20 Data Assessment and Data Systems Framework research. This research provides a platform for stakeholders to develop and test prototype data systems for the access and exchange of data and test and evaluate these systems. The research will advance the conversation regarding data and data systems and assist stakeholders establish data systems for the integration of Automated Vehicles into our roadway system.

Transfiguration of the *Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)* for Connected and Automated Vehicles: The MUTCD is the national standard for traffic control devices on any street, highway, bikeway, or private road open to public travel, in accordance with 23 U.S.C. §§ 109(d) and 402(a). It is incorporated by reference in Title 23 of the

Code of Federal Regulations, Part 655, Subpart F. The MUTCD is administered by FHWA, which issues revisions and updated editions through the Federal rulemaking process. The last edition was published in 2009, with two revisions in 2012.

This research continues the research started in FY20 to adapt or enhance the MUTCD to address ADS recognition and perception of the roadway environment in relation to traffic control devices. The research will continue investigating how ADS interpret the roadway environment in collaboration with ADS developers and manufactures. The research will focus on developing a better understand regarding the level of consistency and uniformity that enhances ADS operations and what can be done through the MUTCD to address the consistency and uniformity challenge,

Enabling Technology for Connected and Automated Vehicles: Research in Analysis Modeling and Simulation (AMS) will advance the development of Hardware-in-the-Loop (HIL) capabilities, including the conduct of Proof-of-Concept (PoC) testing. Initial benefits and impact assessments of Connected and Automated Vehicles (CAV) in traffic will be conducted using improved models developed in FY 2020. FHWA also anticipates continuing to support State and local agencies in development of interoperable data exchange between vehicles, other road users, and infrastructure based components of the transportation system.

Cooperative Automated Vehicles: In 2021, FHWA, in collaboration with modal partners, IOOs, Academia, and industry, will continue the development of shared maneuver applications that address key transportation issues, and will develop and test Prototype applications from FY 2020 PoC applications. Joint testing of PoC and Prototype applications are planned at test sites used by CARMA Collaborative members, to advance the capabilities of the CARMA Collaborative members and to demonstrate interoperability.

Next Generation Traffic Management Systems (TMS): Building from FY 2020, FHWA will support and assist agencies in developing plans to manage the evolution of capabilities and performance of their TMSs. This work will be advanced in partnership with the TMC Transportation Pooled Fund Study.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Innovation

The Connected and Automated R&T Program supports the Department’s Safety, Infrastructure, and Innovation Strategic Goals through the conduct of collaborative research that will extend the emerging capabilities of automated vehicles. The development of systems and applications that enable new transportation systems management and operations (TSMO) strategies will improve the safety and efficiency of the Nation’s road system, while providing greater mobility, reducing

fuel consumption, and supporting infrastructure investments that will accelerate the development and deployment of automated driving systems by industry.

Federal leadership is critical to define needs, set standards, and incentivize investment in vehicle-to-everything connectivity and in the development of cooperative automation. Connectivity and cooperative automation will enable automated driving systems to safely operate under all conditions that are regularly faced by drivers. Connectivity also supports a reliable and equitable mobility ecosystem by enabling the data exchanges required to interconnect people and goods with mobility providers.

The Connected and Automated R&T Program is predicated on collaboration with the ITS Joint Program Office, other USDOT modes, State and local public agencies, Academia, industry, and other surface transportation stakeholders. The program will continue to expand and rely on the dialogue with stakeholders and partners, initiated with the FHWA National Dialogue on Highway Automation, to guide research that is appropriate, timely, and needed. To the greatest extent possible, the program will rely on open source development to leverage efforts by partners and support continuous validation of Federal efforts.

The FHWA initiated work on cooperative automation in FY 2015 to address a market failure and need for Federal leadership in this concept. While industry has remained properly focused on the development of safe and reliable automated driving systems, the FHWA has developed CARMA as an open source software functionality that will allow rapid development, testing, and evaluation of prototype shared maneuver applications and increased connectivity. Shared maneuvers and improved data exchange with infrastructure will enhance the potential capabilities of automated driving systems, providing improvements to safety, mobility, and productivity. FHWA will continue to collaborate with other public agencies, Academia, and industry to leverage the strengths of each partner and to encourage the automotive industry to incorporate the concepts of connectivity and shared maneuvers in production automated driving systems. Beginning in FY 2019, there was increased interest by Academia and industry to participate in the development of in the concept of cooperative automation and shared maneuvers. It is anticipated that this interest will result in joint, agile development of Proof-of-Concept (POC) shared maneuver applications in FY 2020, advancing to initial development and testing of Prototypes in FY 2021, and demonstrations in FY 2022.

Managing Disruptions to Operations

Program Description/Activities/Objectives:

In FY2021, several activities from FY2020 will continue and will need more funds to complete research, development, and deployment.

There will be continued engagement of stakeholders, training, and other outreach activities to better manage disruptions to operations and advance state-of-the-practice in the areas of work zone management (WZM), traffic and emergency management (TI&EM), and road weather management (RWM).

Road Weather Management:

In FY2021, FHWA will continue to conduct a coordinated and cohesive Research and Technology Program focused on advancing RWM strategies, technologies and practices to minimize any adverse weather-related impacts on highway infrastructure and performance. This program will build on FY2020 activities by continuing to develop tools, guidelines and strategies that enable weather-responsive decision-making, analyze and use of weather data and connected vehicle (CV) technologies, develop effective messaging based on better understanding of traveler behavior, and apply performance management strategies based on consideration of resilience and large range changes in weather patterns. Ongoing maintenance and further development of the Weather Data Exchange will advance that platform as a foundational proof of concept for related activities under the Data Supporting Operations for Non-Recurring Events activity.

Traffic Incident & Event Management:

In FY2021, FHWA will continue to conduct a coordinated and cohesive Research and Technology Program focused on advancing TI&EM strategies, safety, technologies and practices to minimize any adverse traffic incident and special events related impacts on highway infrastructure and performance. This program will build on FY2020 activities by continuing to enhance the capability and training of responders, develop tools and strategies based on better use of incident/crash data and other performance measures, benefit-cost analysis, and CV and integrated Computer Aided Dispatch, Unmanned Aircraft Systems and other technologies to enhance efficient incident mitigation and safety of responder and road users.

TI&EM program plans to start new activities to promote use of integrated sources in a big data approach to advance traffic incident management.

Work Zone Management:

In FY2021, FHWA will continue to conduct a coordinated and cohesive Research and Technology Program focused on advancing WZM strategies, technologies and practices to minimize any adverse work zone related impacts on highway infrastructure and performance. This program will build on FY2020 activities by continuing to develop tools and strategies based on work zone safety and activity data, performance measures, safety countermeasures including use of positive protection, and planning/implementation of ITS and other CAV technologies.

Data System Framework for Non-Recurring Events:

In FY2021, FHWA will continue to integrate program-focused research initiatives from across the Office of Transportation Operations into a comprehensive strategy to address data management for non-recurring events. This effort will serve ongoing development and deployment of a national digital infrastructure that extends capabilities for transportation management leveraging emerging technologies and the results from recent research initiatives to address current and emerging use cases, and will inform broader TSMO efforts in providing a necessary specialized focus on non-recurring events.

Program Alignment with Strategic Goals:

FHWA's Managing Disruptions to Operations R & T Program supports the Department's Safety, Infrastructure and Innovation Strategic Goals. Specific contributions are as follows.

Safety/Promoting Safety: The Managing Disruptions to Operations Program contributes to highway safety by providing tools, technologies/devices, resources, and training to minimize safety impacts (crashes, fatalities, injuries) of road construction, adverse weather, and traffic incidents on all road users including highway workers and emergency responders. The Manual on Uniform Traffic Control Devices improves safety by ensuring consistent use of traffic control devices in a way that accommodates road user expectancy.

Infrastructure/Improving Infrastructure: The Managing Disruptions to Operations Program supports this goal by ensuring impact of these disruptions are appropriately considered during life cycle cost analysis and other infrastructure investment analysis and decisions. Rebuilding our infrastructure, including traffic control devices, must be done in a manner that minimizes the impacts to those who rely on the system every day. This program area finds that balance between reconstruction, safety, and mobility.

Innovation: The Managing Disruptions on Operations Program supports this goal by undertaking research and development in the areas of automated and connected vehicles; data driven technologies and decision-making; experimentation of novel traffic control devices, and safety, durability, and resiliency of transportation systems. This effort is vital to improving the state-of-the-practice and mitigating impacts resulting from road construction, adverse weather, and traffic incidents.

Improving Mobility/Preserving the Environment: The Managing Disruptions on Operations Program contributes to improved mobility and ensuring the network is resilient by reducing duration and frequency of roadwork; effectively/consistently using traffic control devices; restoring roadway capacity and thus minimizing traffic delays, fuel usage, and emissions; and reducing the use of treatment materials for snow and ice control.

In accordance with 23 USC 502(a)(3), the nature of the work that FHWA will pursue under this program:

- Is of national significance;

- Delivers a clear public benefit and occurs where private sector investment is less than optimal;
- Supports a Federal stewardship role in assuring that State and local governments use national resources efficiently;
- Meets and addresses current or emerging needs;
- Addresses current gaps in research;
- Presents the best means to align resources with multiyear plans and priorities; or
- Offers the best means to support Federal policy goals compared to other policy alternatives.

As such, the research and technical assistance does not provide or is not intended to provide the immediate profit potential required to motivate private investment.

Freight Management and Operations RD&T Program

Program Description/Activities/Objectives:

In 2021, FHWA will continue to conduct a coordinated and cohesive Freight Management and Operations Research, Development, and Technology (RD&T) Program to improve the physical components of the highway system that support goods movement, including roads, bridges, pavement, parking facilities, and other components. These objectives seek to better understand how freight movement impacts—and is impacted by—this infrastructure.

Planned 2021 Freight Management and Operations RD&T Program activities seek assess the condition and performance of key freight infrastructure, and to provide guidance that permits States and other stakeholders to incorporate freight infrastructure improvement projects into transportation program delivery. Overall, this Program aims to ensure safe, durable, and high performing infrastructure, identify solutions to mitigate or address the negative impacts of freight transportation, and research the resiliency of the freight transportation system.

As in 2020, activities will include developing data-driven tools that States/other stakeholders can use to better assess the operating condition, capacity, performance, and use of the freight transportation system. These activities will also address the need to develop strategies that assess the impact of freight movement, while helping stakeholders more effectively incorporate freight infrastructure considerations into transportation planning/project development, such as truck parking needs.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation

Safety: The Freight Management and Operations RD&T Program seeks to improve the safety of the highway system that supports goods movement. These objectives seek to better understand safety issues of the highway system that support goods movement. These activities include:

- coordinating and investigating truck parking issues
- researching the resiliency of the freight transportation system through initiatives such as implementation of the recommendations of the USDOT Emergency Route Working Group.
- coordinating with FHWA partners on safety and resiliency areas impacting freight, including FHWA Office of Transportation Operations Road Weather and Workzone Management Team, the FHWA Office of Infrastructure, the FHWA Office of Planning, and the FHWA Office of Safety.

The Freight Management and Operations RD&T Program will work with other USDOT modal agencies, such as MARAD, FRA, NHTSA, and FMCSA, and other stakeholders, such as the National Coalition on Truck Parking, the Emergency Route Working Group, and Transportation Research Board (TRB) to identify opportunities to investigate freight transportation safety. This program is particularly applicable to rural areas where the freight transportation network is more susceptible to weather or other disruptive events and alternate routes are less available to trucks.

Infrastructure: The Freight Management and Operations RD&T Program seeks to improve the physical components of the highway system that support goods movement, including roads, bridges, pavement, parking facilities, and other components. These objectives seek to better understand how freight movement impacts—and is impacted by—this infrastructure. The Freight Management and Operations RD&T Program also seeks to assess the condition and performance of key freight infrastructure, and to provide resources that permits States and other stakeholders to incorporate freight infrastructure improvement projects into transportation program delivery. Objectives include ensuring safe, durable, and high performing infrastructure, as well as identify solutions to mitigate or address the impacts of freight transportation.

Innovation: The Freight Management and Operations RD&T Program seeks to improve the reliability of travel and freight movement on the Nation’s transportation systems by working with State DOTs and other stakeholders to identify data sources and models to assess overall system reliability.

The Freight Management and Operations RD&T Program seeks to improve the ability to measure current and future conditions and operation of the freight transportation network through the incorporation of more accurate, real-time, and localized freight data. These activities include improvements to:

- data collection methodologies (e.g., data sharing collaboration with industry and dynamic freight data collection and analysis)
- travel demand models (e.g., incorporating urban and rural freight movements and improvements to the accuracy and scale of the freight flows along the transportation network)
- strategies to facilitate public-private sector data coordination and sharing (e.g., facilitating peer exchanges and stakeholder outreach)
- freight-focused performance measures (e.g., incorporating reliability, economic impacts/costs, etc.)

The Freight Management and Operations RD&T Program will also enhance freight data resources, such as the Freight Analysis Framework (FAF), which provide national level freight flows and projections critical to understanding the impact of freight movement on the transportation network.

Truck Size and Weight RD&T Program

Program Description/Activities:

In 2021, FHWA will continue to conduct a coordinated and cohesive Truck Size and Weight Research, Development and Technology (RD&T) Program focused on providing other FHWA, other federal agencies, States and other stakeholders with information needed to create the safest and most efficient permitting and enforcement systems possible to ensure fluid freight movement across State borders. As in 2020, 2021 activities will include research on effective truck size and weight data use across States and supporting States in harmonizing oversize and overweight (OS/OW) permitting requirements. This Program will support FHWA's oversight efforts on State-enforced Federal size and weight truck/bus standards for travel on Interstate highways and the national network. TSW research will also examine the operations and safety of alternative truck configurations and oversize/overweight (OS/OW) vehicles.

FHWA 2021 activities will include implementing the highest priority elements of the CTSWL Research Plan. While these activities have not yet been determined, they would include research pertaining to the five topic areas identified in the 2016 Study. For example, activities could include: development of enhanced bridge deterioration models that can account for impacts of alternative truck configurations; creation of more accurate models that States and others can use to identify impacts of heavy trucks on pavements; commodity analysis of truck types, and safety impact assessments.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

Safety: Today, approximately 12 States require Pilot Car Certification. States use FHWA-developed guidelines, to support their certification requirements; however, these requirements vary from State to State. As a result, pilot car operators in the U.S. have to navigate a complex web of requirements when making a multi-state move. FHWA research in this program area will support harmonization among States on oversize/overweight State and local permits. The work outcome will improve safety on the national highways as well contribute to infrastructure preservation. Research activities will include research, review, and analysis of existing pilot/ escort vehicle operator (P/EVO) training materials and case studies and other information focused on the oversize loads movement.

Infrastructure: The Truck Size and Weight RD&T Program addresses alternative truck configurations on the highway system and highway operations. Activities will include alternative truck configurations or OS/OW freight vehicles cost-benefit assessments, and

general analysis of alternative truck configuration impacts on freight infrastructure, safety, and operations.

The draft National Freight Strategic Plan (NFSP) provides important context for truck size and weight research. The NFSP acknowledges that lack of uniformity across State truck size and weight regulations may be a potential efficient freight movements barrier and that there is a need for truck size and weight research specifically to assess tradeoffs involved in raising weight limits or allowing longer combination trucks on national highways. Outside DOT, National Cooperative Highway Research Program (NCHRP) analyses have provided a foundation for this topic area. The Truck Size and Weight RD&T Program supports addressing these research and data gaps.

Innovation: The Truck Size and Weight RD&T Program will provide States and other stakeholders with information needed to create the safest and most efficient permitting and enforcement systems possible to ensure fluid freight movement across State borders. Activities will include research on effective truck size and weight data use across States and supporting States in harmonizing OS/OW permitting requirements.

The Truck Size and Weight RD&T Program will support practitioners to plan for, prioritize, and implement projects that benefit goods movement. Truck Size and Weight RD&T Program activities include producing resource on what information is needed for analysis of freight vehicle size and weight, and examining methods for inventorying and applying these data.

Truck Size and Weight RD&T Program efforts aim to better understand the impacts of alternative truck configurations on freight infrastructure, safety, and operations, through data collection and development of data-driven tools and analytical techniques. Additionally, there is an effort to identify key TSW-related research needs relating to pavement, bridge, mode shift, safety, and enforcement. The combination of these activities will lead to improved technical and implementation resources for stakeholder decision-making and analysis.

Additional Information About Planned FY20 Freight Management and Operations RD&T Investments

Accelerating Project Delivery

Program Description/Activities/Objectives:

In FY21, the Accelerating Project Delivery research program will continue to expedite project delivery by improving environmental review and permitting processes to reduce regulatory timeframes and costs. These efforts will help FHWA deliver transportation projects more quickly and efficiently while safeguarding our communities and maintaining a healthy environment. This program will support improving the National Environmental Policy Act (NEPA) process and improves coordination and communication between Federal and State agencies, the public, and other stakeholders to create efficiencies in project review and development. This program supports work to accelerate project delivery through interagency collaboration, capacity building for environmental practitioners, integrating planning and environmental processes, and disseminating information about environmental program and process efficiencies.

The main objectives of the Accelerating Project Delivery program is to build tools and collaborate on studies to reduce regulatory burden and increase efficiencies in the environmental review process and real property acquisition process by innovating new ways to expedite project delivery. Examples of programs and tools that the Volpe Center will support in FY21 to accelerate project delivery include activities related to regulatory reform, rulemaking, guidance, “planning and environmental linkages” (PEL), programmatic approaches, NEPA assignment program support and audit support, “Eco-Logical: An Ecosystem Approach to Developing Infrastructure Projects,” resource agency liaison program support, and the Environment Discipline Support System. Examples of tools FHWA will create in FY21 through interagency agreements include programmatic approaches to expedite permitting and regulatory review times and policy and guidance development for stakeholder flexibilities. Examples in FY 20 for increasing the efficiency of the real property acquisition process include identifying opportunities to expedite real estate property acquisition by incorporating and leveraging big data.

The National Transportation Liaison Program has helped develop techniques that have expedited federally funded projects and permits, such as programmatic agreements, memorandum of agreement, and other tools that result in increased efficiencies throughout the project development and the environmental review processes. Additionally, the use of dedicated agency liaisons, such as the ones supported on this program, was identified as a best practice in the “Recommended Best Practices for Environmental Reviews and Authorizations for Infrastructure Projects for Fiscal Year 2018” by the Federal Permitting Improvement Council, to meet the objectives for federal permitting process improvement. This arrangement provides the support of liaisons in the federal permitting agencies who ensure the efficient application of those agency’s statutes and regulations. The research is conducted through continuous interaction between FHWA and the various liaisons.

In FY21, FHWA anticipates initiating several new activities to meet requirements under a re-authorization act for FHWA. The current Authorization for FHWA, Fixing America’s Surface Transportation (FAST Act), will end in FY20. FHWA anticipates that the re-authorization in FY21 will trigger a need for policy changes, rulemaking, guidance, and tools to meet requirements Congress will establish. As in past re-authorizations, FHWA will leverage the resources of its partner agencies to meet many of these needs, including but not limited to liaisons in other Federal departments, State agencies, and the Volpe Center in USDOT. Additionally, as

appropriate, FHWA will contract for services in the private sector to accomplish tasks that are not inherently governmental.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Infrastructure
Innovation
Accountability

Infrastructure, Innovation, and Accountability: Accelerating Project Delivery research will develop and analyze technology and innovation as they relate to accelerating environmental review and permitting processes and real property acquisition. This research will address the problem of environmental review timelines by leveraging other Federal agency resources to provide tools, technologies, guidance and training to accelerate project delivery. Within the context of accelerating project delivery, these activities will support efforts to reduce regulations and control regulatory costs with other Federal agencies and with Volpe support to draft policy, guidance, and rulemaking as well as develop tools such as programmatic approaches to expedite regulatory requirements. All activities will improve performance by accelerating and improving processes and maximizing employee performance, development, and engagement to make efficient and effective use of resources.

This investment is essential to avoiding project delays associated with environmental review. Ongoing work on this has yielded several tools and resources for State DOTs and FHWA to accelerate project delivery. From years of working with permitting agencies, FHWA has learned ways to create efficiencies such as programmatic approaches to expedite permits. FHWA has seen tangible outcomes of this program at varying intervals, from one year to five years to achieve the desired results.

This investment will also support identification of methods to reduce delays associated with the process of real property acquisition. Previous and ongoing work has yielded insights, tools, and regulatory revision's and proposals which have or will serve to accelerate project delivery. FHWA has developed and published revised rules allowing a number of early real property acquisition flexibilities and has developed another proposed rule which will allow additional real property acquisition flexibilities that have been requested by partners including AASHTO, SDOTs and Federal Agencies.

Performance Based Planning

Program Description/Activities/Objectives:

The USDOT assists States and MPOs in identifying performance measures and associated performance targets related to national highway and transit performance goals. This includes establishing and updating regulations on performance measures and providing technical assistance to States and MPOs to ensure consistent implementation of the performance measures requirements. Performance-based Planning supports the connection between performance measures and performance target levels that lead to data-driven, effective transportation solutions. These measures and targets are connected through transportation plans and programs developed at the statewide and metropolitan levels.

Performance based planning and programming (PBPP) provides a strategic, data-driven approach to decision-making that enables transportation agencies to efficiently allocate resources, maximize the return on investments, and achieve desired performance goals while increasing accountability and transparency to the public.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

Performance-based planning supports each of the Department’s goals. Specific contributions are as follows:

Safety: States are required to use a performance-based process through the development of data-driven, Strategic Highway Safety Plans (SHSPs), which involve tracking safety indicators, analyzing data, and identifying emphasis areas and strategies. Each State’s Highway Safety Improvement Program (HSIP) should be consistent with the SHSP, and includes collecting and maintaining data, conducting studies, establishing priorities, and implementing and evaluating the effectiveness of safety improvements. This research will provide tools, technologies, guidance, and training to support States, MPOs, and other transportation agencies (including rural communities) to achieve desired performance outcomes for the multimodal transportation system.

Infrastructure: Research will highlight the emphasis on performance management within the Federal-aid highway program, and requires use of performance-based approaches in statewide, metropolitan, and nonmetropolitan transportation planning. This research will provide examples of effective practices to help practitioners advance these approaches in their own planning and programming activities; promote and maintain the highway infrastructure asset system in a state of good repair; identify tools, technologies, and guidance

for States and MPOs; offer capacity building opportunities that plan and prioritize investments, accelerates project delivery; and effectively improve connectivity, accessibility, safety, and convenience for all users, including those in rural areas.

Innovation: Within the context of performance-based planning, the scenario planning approach visualizes and demonstrate, in both qualitative and quantitative terms, how the combination of various strategies would help meet performance targets. Research will allow for the consideration of how various factors, such as revenue constraints, demographic trends, economic shifts, or technological innovation can affect a state or region and its transportation system performance. Potential regional investment strategies for the planning horizon include packages of investments in transit, highway capacity, Intelligent Transportation Systems (ITS), and travel demand management strategies, or system preservation. Research will also assess new modes and technologies, notably automated vehicles and automated driving systems linked to data-driven decision-making.

Accountability: The expenditure of these resources ensures that the goals are achieved in accord with the performance based planning process, societal needs, e.g. safety, accountability, asset preservation, and the environment can be addressed in accordance with the priority placed on each by the public. Performance-based planning allows planners to evaluate and recommend strategies, projects, and programs to policy-makers based on anticipated system-wide impacts and support for goals. This research will provide tools, technologies, guidance, and training to support States, MPOs, and other transportation agencies (including rural communities) to improve mobility while preserving the natural and human environments.

Modeling and Analysis Tools

Program Description/Activities/Objectives:

For FY2021, the “Modeling and Analysis Tools” research program will continue its focus on the development of and deployment of new and refined analytical tools to reduce regulatory and analytical burdens and to support efficient delivery of highway projects. The research goal is to identify, develop, and deploy technologies, tools, analysis methods, and performance management approaches to accelerate the environment review process, and to effectively and efficiently analyze the impacts of projects on the environment and communities so that transportation projects, will be delivered more quickly and efficiently while maintaining a healthy environment, safeguarding our communities and stimulating economic growth. Research products such as analytical tools and models that are completed in FY2020 will be delivered to transportation stakeholders (State DOTs and MPOs) and the public in a variety of ways such as conferences, workshops, webinars, training courses, peer exchanges etc. Documents such as research reports, case studies, model sensitivity and validation analyses, and technical guidance will be posted on line and marketed at industry events.

Program Alignment with Strategic Goals:

The Modeling and Analysis Tools research program supports two of DOT’s Strategic Goals and three research topic areas described in the DOT RD&T Strategic Plan. These goals are shown in the following table:

DOT Strategic Goal
Infrastructure
Accountability

FHWA has invested in similar research topics in the past to develop modeling and analysis tools as innovative approaches to expedite the environmental review process and project delivery while maintaining a healthy environment. This past research paid off by producing tangible tools that aided our stakeholders in efficiently meeting environmental analysis requirements. For example, the new noise traffic noise model (TNM 3.0) adds substantial modifications, such as a graphical user interface and computer visualization tools, to make the model more user-friendly and faster to use. For air quality, the CMAQ Emissions Calculator Toolkit now has eight tools to calculate emissions reductions for a variety of different project types from traffic flow improvements to diesel idle reduction technologies. Many State DOTs and MPOs have already adopted the CMAQ tool for the calculation of emissions reductions of CMAQ-funded projects to meet the statutory requirement of reporting on the CMAQ performance measure. Almost all of the research for modeling and analysis tools to support air quality, noise and transportation planning analysis is done by the public sector since the tools are used to meet statutory requirements for environmental and planning analyses. FHWA is responsible for the development of state-of-the-art highway traffic noise and many transportation planning tools that reflects the latest technologies and science in these fields, while the U.S. EPA is the developer

of air quality and emission models and tools. State DOTs, MPOs and other transportation stakeholders rely on FHWA to make these models and tools applicable to highway applications and to develop tools such data processors to help simplify the application of these complicated air quality models. These agencies and highway users will benefit from these tools to support streamlined decision making and environmental reviews and analysis to meet air quality, conformity, and noise statutory requirements.

Resiliency

Program Description/Activities/Objectives:

The FY21 Resiliency research program will continue with the same main goals as the FY20 program, which is to focus on the development and deployment of tools, techniques, strategies and methodologies for assessing the resiliency, efficiency, and sustainability of transportation plans, projects and programs. However, it will build on it in important ways:

- Alternative fuels research and corridor designation activities will shift focus to new technology that is becoming available, particularly higher level (faster) chargers, and on filling in the remaining gaps in the nationwide system of alternative fuel corridors. Another new area of research will be examining the usage of alternative fuel stations. Finally, we will add research developing tools to examining the fuel and energy impacts of CAVs.
- Resiliency efforts will include a new focus on improving resiliency in post-disaster decision making. A new effort will also be initiated to institutionalize the best practices (developed and documented in *Hydraulic Engineering Circular (HEC) 17 Highways in the River Environment - Floodplains, Extreme Events, Risk, and Resilience* and *HEC-25 Highways in the Coastal Environment: Assessing Extreme Events*, and other work) by helping all state DOTs include relevant practices in their drainage manuals and other standard design manuals.

Program Alignment with Strategic Goals:

The FY21 Resiliency research program will address the need for tools, techniques, strategies and methodologies for assessing the resiliency, efficiency, and sustainability of transportation plans, projects and programs. We should invest in this research in order to:

- Extend the life of infrastructure and improve its performance by reducing damage from extreme events and other environmental causes of degradation.
- Accelerate project delivery by providing tools to help decision makers simultaneously analyze impacts on economic, social, and environmental considerations, smoothing interactions with stakeholders and resulting in more efficient project delivery.
- Decrease costs for DOTs and the public and increase energy security by creating opportunities for domestically sourced alternative fuels, thus also reducing trade deficits, increasing domestic economic activity and jobs, and diversifying fuel sources to protect against price and supply shocks.
- Decrease costs for state DOTs and create opportunities for the private sector by investigating cost-savings flexibilities in use of the ROW.

Others researching this issue include:

- DOE (alternative fuels)
- NOAA (resiliency)
- USGS (resiliency)
- AASHTO (resiliency, alternative fuels, accelerating project delivery)

Our previous research in this topic area has produced a framework for integrating resiliency, efficiency, and sustainability into transportation plans, projects, and programs, and has generated best practices in all these areas. The new FY21 research will match these best practices with new technologies that are coming into the market, increase adoption of the best practices, and develop new practices for parts of the transportation decision making process that have not yet been addressed, such as post-disaster planning. Although completion dates may vary by project, the new work described above for FY21 would be complete by FY25.

This program supports the Department’s Infrastructure and Innovation Goals as follows:

Infrastructure Goal

- **State of Good Repair:** Our research supports the State of Good Repair strategic priority within the Infrastructure Goal, particularly the components pertaining to Risk-Based Asset Management and Infrastructure System Resilience. Our program supports research, pilots, and other projects focused on incorporating resilience considerations into all aspects of the highway life cycle, particularly asset management, geohazards, planning, and engineering. The improved practices and tools developed and disseminated under this research program will extend the life of infrastructure and improve its performance.
- **Environmental Stewardship:** Our research also supports the Environmental Stewardship strategic priority within the Infrastructure Goal, in two primary ways:
 - *Alternative Fuels and Fuel Efficiency:* The development of Alternative Fuel Corridors and related research and demonstration projects on alternative fuels directly meet the goal stated in the DOT RD&T Plan to “advance the use of alternative fuels in transportation” (p.13). In addition, our research on reducing fuel and material use in construction, as well as research on efficiencies in operations, maintenance, and freight travel, all contribute to finding ways to reduce costs for transportation agencies and highway users.
 - *Accelerated Project Delivery:* Our research supports performance-based decision making in project delivery by providing tools to help decision makers analyze impacts on economic, social, and environmental considerations simultaneously, smoothing interactions with stakeholders and resulting in more efficient project delivery.

Innovation Goal

- **Mobility Innovation:** Our research supports the overall goal of mobility innovation to support economic growth by creating tools to balance decision making among economic and social outcomes simultaneously, allowing better consideration of underserved communities

that may otherwise not have their needs adequately addressed in transportation projects. It also specifically addresses the *Needs of Rural Americans* focus by providing new methodologies for geographically isolated communities with little network redundancy to assess their vulnerability to extreme weather events and develop solutions to strengthen their resilience to such events.

Planning for Bicycle and Pedestrian Safety, Connectivity, and Multimodal Mobility, including for Underserved Communities

Program Description/Activities/Objectives:

The goals of this program are to lower the number of pedestrian and bicyclist fatalities and serious injuries because of traffic crashes, and to improve the connectivity of the multimodal transportation system to allow travelers improved mobility options. The program will integrate improved pedestrian and bicycle systemic safety analysis techniques and design into transportation planning and project development. The program will also support economic growth and the competitiveness of the American economy by improving mobility options, including underserved communities such as people with disabilities and rural communities, and by efficient multimodal transportation planning for the National Highway System (NHS). This research seeks to promote transportation policy that supports multimodal transportation by assisting transportation agencies to build capacity to support an integrated, safe, and convenient transportation system for all users, in urban, suburban, and rural areas.

Program Alignment with Strategic Goals:

This program supports the Department's Safety and Infrastructure Goals, as follows:

Safety: This research will provide tools, technologies, guidance, and training to support State DOTs, MPOs, and other transportation agencies in ensuring that pedestrian and bicycle transportation facilities are systematically planned and designed to safely accommodate all users, including pedestrians and bicyclists. We need to reduce pedestrian and bicyclist fatalities and serious injuries while improving access to jobs and other important destinations. Through this investment, we will develop and implement products to support data-driven, systemic safety improvements.

Infrastructure: Multimodal connectivity research will provide tools, technologies, guidance, and training to support State DOTs, MPOs, and other transportation agencies to plan and prioritize multimodal investments on the NHS, accelerate the delivery of multimodal infrastructure more efficiently and effectively, and improve connectivity, accessibility, safety, and convenience for all users, including those in rural areas.

Innovation: Mobility research will study technologies, tools, analysis methods, and performance management approaches to promote mobility options for all users, while safeguarding communities, maintaining a healthy environment, and stimulating economic growth. This research will address mobility innovations that involve emerging technology, such as shared mobility, mobility as a service, and the interaction of automation with pedestrians and bicyclists.

Policy Analysis and Global Outreach

Program Description/Activities/Objectives:

The domestic component of the Policy Analysis and Global Outreach program seeks to enhance FHWA's understanding of how national transportation strategies and policies can improve the overall value of transportation investments to the American people. This research program supports the development and maintenance of a carefully-selected suite of tools and models to: assess and forecast the factors shaping modal choice and travel behavior, system performance, highway construction costs, and user contributions to highway costs; identify cost-effective future highway investment levels and associated job/GDP growth; and assess a range of revenue options. In 2020, this research program will continue to provide support to Agency and Departmental leadership on emerging policy questions. The domestic component of this research program encompasses two broad lines of research, which include eight main emphasis areas:

- *Transportation Investment*
 - Impacts of Investment on Conditions and Performance
 - Macroeconomic Impacts
 - Benefit-Cost Analysis
 - Highway Costs and Funding Options.
- *Emerging Trends, Policy, and Strategy Analysis*
 - Emerging Trends and Future Performance
 - Geo-Economics of Transportation
 - Strategic and Performance Management
 - Future Policy Symposia

The main focuses of the Impact of Investment on Conditions and Performance (C&P) emphasis area in FY 2021 will be wrapping up work on the model upgrades initiated in FY 2019 to support the 25th C&P report and initiating work on new model enhancements to support the 26th C&P report. This will include the implementation of recommendations from TRB's Future of the Interstate Study and FHWA's Reinventing the C&P Report in a Performance Management-Based World Study. For HERS, this will include the completion of a postprocessor to estimate distribution of truck cost savings by commodity category for potential integration with USAGE-Hwy and the development of a new inter-temporal optimization tool.

Research in the Macroeconomic Impacts emphasis area will include development work on USAGE-Hwy 1.2, building on USAGE-Hwy v 1.1 completed in 2020. This will include enhancements to the macroeconomic modeling structure, as well as updates to the engineering and economic model parameters. Work will continue on activities initiated in 2020, including a study on the distribution of land value appreciation from highway investment.

Within the Benefit Cost Analysis (BCA) emphasis area, work will continue to support FHWA's regulatory impact investment analysis needs.

FY 2021 work in the Highway Costs and Funding Options emphasis area will primarily build on prior years' work on pavement distress analysis and prediction modeling, highway construction unit cost analysis, modeling strategies for reflecting demand response to tolled and priced lanes,

and economic impacts of mileage-based user fees. Research will be pursued to validate and improve the construction cost per lane mile estimates for different types of improvements used in the HERS model and prepare forecasts of those costs.

FY 2021 work in the Emerging Trends and Future Performance emphasis area will build upon prior work to: 1) develop new methods for applying data to policy questions; 2) advance understanding of an AV future; 3) advance understanding of impacts of socioeconomic and demographic changes to transportation; 4) assess methods and variables to develop performance measures to evaluate the safety and mobility of roads; and 5) communicate actionable policy information and alternatives to support decision-making and strategic planning. This program area will be complemented and enhanced by Future Policy Symposia emphasis area work, which will provide an avenue for dialogue and communication between subject matter experts and U.S. DOT leadership on current policy issues.

The Geo-economics of Transportation emphasis area will build upon prior years' work to develop geo-typologies and a multimodal analysis tool that will allow the transportation research community to quantify and understand how investment and policy decisions impact performance measures, such as mobility and accessibility, and how economic factors influence the use and performance of the transportation network.

The Strategic and Performance Management emphasis area will continue supporting agency efforts to meet requirements for evidence-building performance and programs. Work may include program evaluation studies that lead to the identification of performance indicators for the new U.S. DOT or FHWA strategic plan.

For the Global Benchmarking Program, FY 2021 work will focus on coordinating two new studies as determined by FHWA leadership, as well as follow-up implementation activities related to the FY 2019 and 2020 studies.

For the Multilateral Relations Program, the FHWA will focus on the launching of technical committees and task forces for the 2020-2023 work cycle. As in the past, the expectation is that the U.S. will continue to influence the technical work produced by the World Road Association's technical committees and task forces, with the support of U.S. representatives. Special emphasis will be placed on products related to safety, infrastructure, and innovation. Products in the form of reports, guidelines, and other information tools, will capture the U.S. perspective. In addition, the quadrennial Winter World Roads Congress will be held in FY 2021, preparations for which take place in FY 2019 and FY 2020. It is also anticipated that Twinning projects with the European Union/European Commission scheduled to take place in FY 2020 will continue or be completed in 2021 or possibly evolve into follow-up projects.

For the Bilateral Relations Program, the next U.S.–Korea Roads Workshop will take place following the 2020 event, and additional professional exchanges are anticipated. The following U.S.–Japan Bridge Workshop will be scheduled for 2020, but other types of exchanges will take place in relation to bridge and other topics. This includes the first Twinning research efforts, which are currently being coordinated. Webinars on high-priority topics (e.g., freight) will continue with Australia and other countries.

Program Alignment with Strategic Goals:

The Policy Analysis and Global Outreach program supports all four Department Goals. Specific contributions are as follows.

Safety: This research program contributes to a systematic safety approach by developing data-driven baseline forecasts of crash and fatality rates reflecting changing economic and socio-demographic factors and travel behavior (including modal choices). This research provides a context for assessing the impacts of a range of broad policy options, as well as specific safety options, identified through participation in the U.S. DOT Safety Data Initiative, which is supported by this research program. Socio-economic factors affecting rural travel safety are being explored.

International safety-related activities include supporting the development and dissemination of the Road Safety Manual for the World Road Association, collaboration with Japan and Korea on bridge and tunnel safety, and bridge and road safety, respectively, and U.S.-Mexico border States regarding incident management and first-responder operations.

Infrastructure: This research program supports the development of tools and techniques for evaluating tradeoffs across competing types of transportation investments, including specialized and priced lanes and multimodal applications. This research includes tracking of highway construction costs, baseline forecasts of established system performance metrics, and estimates of cost-effective investment levels that can be used in setting performance targets intelligently. Transportation system investment, performance, and associated travel mobility are assessed for rural areas, as well as for the country as a whole.

International infrastructure-related activities include support for the development and dissemination of the Asset Management Manual for the World Road Association; exchanges with Korea on bridges, geotechnical topics, inspection techniques, infrastructure resiliency, and pavements; and collaboration with Japan on Intelligent Transportation Systems and bridge issues.

Innovation: This research program focuses heavily on the identification of emerging policy issues and support for the Agency's development of strategies for addressing them. This includes extensive coordination among stakeholders and exploration of emerging data analytic and methodological approaches for assessing the impacts of policies and strategies, including FHWA's first use of Artificial Intelligence data fusion techniques to understand emerging travel behavior. This program takes innovative approaches to assessing the various ways in which transportation investments and economic development affect each other, including GDP, employment, and land use. This research program is also exploring multi-modal geo-economic variations in transportation infrastructure costs, travel demand, and transportation services to better understand how technology and socio-economic changes may be reshaping future transportation system performance and policy opportunities. This geo-economic approach includes specific consideration of the differing travel needs of rural communities.

The Global Benchmarking Program (GBP) obtains and adapts foreign innovations that directly support U.S. DOT strategic goals and critical research, technology, and development areas. Instead of re-creating advances already developed by other countries, the GBP facilitates the acquisition and adoption of technologies and best practices already available and used abroad. The FHWA will continue to support domestic dissemination of the technical work produced by State and U.S. government representatives to the World Road Association technical committees and task forces. The products in the form of reports, guidelines, and other information tools, capture the U.S. perspectives and are invaluable tools for the professional roads community worldwide. State DOTs are leading the effort to promote and disseminate these products beyond the Federal sphere, including to counties, locals, and rural communities. In addition, several projects undertaken under the European Commission-USDOT Twinning Initiative will share findings on research performed in priority areas, such as automated and connected vehicle applications. Bilateral program activities directly address Agency priorities. The Office of International Programs works closely with FHWA and U.S. DOT offices to ensure that international topics and activities are geared to the Strategic Goals and topics. The specific areas addressed by each bilateral relationship depend on the expertise of the country involved and the interests of our partners, both internal and international. Two examples are Japan, with whom FHWA has a long-standing collaboration on bridge and seismic issues that has been very beneficial, and Korea, with whom FHWA has worked on long-span and other bridges, pavements, road safety, and infrastructure resilience. Topics currently being addressed with Korea include robotics, Nondestructive Evaluation techniques, the use of Unmanned Aerial Systems related to roads, and resilience to severe weather events, such as hurricanes/typhoons.

Accountability: This program supports economic regulatory impact analyses conducted on behalf of the Office of Chief Counsel for all regulatory and deregulatory actions under consideration within FHWA. It enables more consistent and methodologically-sound application of lifecycle-cost and related economic-impact strategic, programmatic, and project decision-making. This program's baseline forecasting also serves as an anchor for accountable strategic planning and development of measurable performance targets.

International activities in this area include collaboration with the Netherlands on emergency/crisis management.

Past investment in the Impact of Investment on Conditions and Performance emphasis area has yield projections of future highway system performance and identification of cost-effective levels of investment. These analyses are used in legislative development, as well as the development of performance targets for the President's budget. Other outside entities, such as the American Society of Civil Engineers (ASCE) and the American Association of State Transportation Officials (AASHTO), periodically produce investment needs assessments of their own, but they typically rely heavily on the HERS and NBIAS analytical models developed by FHWA or the findings based on these models presented by FHWA in the C&P report to Congress.

Past investment in the Macroeconomic Impacts emphasis area supported the development of USAGE-Hwy, a comprehensive model of the U.S. economy with a detailed highway transportation sector, building off of the USAGE model developed by the Centre of Policy Studies (now at Victoria University, Melbourne) in collaboration with the U.S. International Trade Commission. The USAGE model has been applied by, and on behalf of, many Federal agencies, including the U.S. International Trade Commission, the Departments of Commerce, Homeland Security, Agriculture, and Energy, and the Federal Aviation Administration. USAGE-Hwy has been applied in assessing the macroeconomic implications of alternative future investment patterns. Continued efforts in model enhancement to improve our understanding of alternative highway investment policies allow FHWA to provide consistent analysis as policy questions evolve. Additionally, the activity will enable cross-agency coordination for maximal synergies in providing evidence-based policy studies.

Previous model simulation found positive and lasting macroeconomic benefits from incremental increases of Federal funding consistent with the President's Infrastructure Initiative. While outside entities may pursue this type of research to support their own agendas, it is important to maintain an independent analytical capability at the Federal level. Activities in the Macroeconomic Impacts Program continue to provide techniques and tools for decision-makers on potential impacts from highway investment.

Past investment in the Benefit-Cost Analysis (BCA) emphasis area has produced new equations for the quantification of vehicle operating costs that are starting to be adopted in models in both FHWA and in the private sector, replacing a set of widely used equations based on decades-old research relying on out-of-date data. Other academic and government researchers are conducting work in various aspects of BCA, but there remains a role for FHWA involvement in research that fills knowledge gaps in this area.

Past investment in the Highway Costs and Funding Options emphasis area has yielded a more accurate measure of highway construction inflation via a revised National Highway Construction Cost Index, an improved highway revenue forecasting model, and tools supporting highway cost allocation analysis. Past investment in this area has produced cost estimates associated with market failures, such as the congestion or safety impacts of highway usage. Future expected tangible outcomes include the development of pavement distress analysis and prediction models (2022) and development of a tool for estimating the impacts of toll and priced lanes on travel demand (2023).

Past investment in the Emerging Trends and Future Performance emphasis area has identified key demographic, geographic, and technological trends influencing the system and improved the understanding of travel behavior and the impact of trends on supply, demand, and system performance. Past investment in this research area has also improved the overall understanding of outcomes, unintended consequences, risk areas for market failures, and policy alternatives to support decision-making and strategic planning. In addition, continued methods development, analysis, and estimation of user impacts of emerging technologies have improved our ability to develop quality estimates with existing data. White papers and policy briefs produced in this emphasis area synthesize cross-cutting issues and demonstrate the relevance of technical research findings to policy and decision-making.

Activities in Geo-Economics of Transportation emphasis area are intended to improve our understanding of relationships between different regions and their response to different transportation policies. This is an important topic, as it helps to evaluate policy impacts without a need to simulate or model each individual region in the future. It also helps identify possibilities for transportation performance improvements in different types of regions. Whereas the traditional urban versus rural approach to transportation research can overlook differences within rural or urban areas critical to understanding future transportation needs, this program area will explicitly model a set of 'geotypes,' representing a full range of rural and urban travel patterns. Previous studies have been defining typologies for their specific goals; however, none of them is capturing the relationship between transportation, economy, and build environment at the same time. The FHWA Office of Planning, DOE, and many other transportation research centers have been developing simulations to evaluate and understand changes in transportation systems. However, almost all of them are focused on metropolitan or large cities. Also, each of their solutions is specific for a particular city and cannot be easily transferred to other regions. This program intends to fill the gap and develop a solution to overcome the need for developing such expensive simulations for analyzing policy impacts within different geographical regions. This program began in FY 2018, and activities are in their initial stages. Intermediate outputs will be available, piece by piece, beginning in FY 2020, but major tangible outcomes are expected in FY 2022.

Previous studies in the Strategic Performance Management emphasis area has led to the identification of needs for additional data (i.e., safety data initiative), alternate measures for implementing transportation performance management (i.e., people throughput), enhancements in data visualization techniques for a variety of system mobility and performance trends (i.e., dashboards and scorecards), and application of evaluation methods, such as logic models, to test underlying program assumptions regarding effectiveness and efficiency (e.g. SHRP2 TIM training). In addition to complying with Departmental requirements based on the Evidence-based Policymaking Act, this research will establish a multi-dimensional agenda to set priorities and initiate efforts to collect new data, perform additional analyses, and report information to executives and managers that will inform policymaking in diverse areas, such as safety and mobility performance, operational improvements or tradeoffs, and program impacts on transportation system users and the surrounding human and natural environment.

Past topics explored in the Future Transportation Symposia research focus area have included connected communicates, smart cities, AV future scenarios, trends in industry and workers, and transportation data futures, and the relationship among transportation, land use, and economic growth. These symposia have facilitated leadership policy discussion, provided subject matter expertise on current policy issues, and supported engagement in an on-going dialogue with the transportation policy community. Similar events are held by policy/research organizations and academia, but this symposia series is focused on topics of particular Federal interest.

The Global Benchmarking Program benefits from the research investments of other countries. For example, findings from past studies have produced innovative technologies and practices related to infrastructure resiliency, tunnel safety, and shared use mobility. Building Information Modeling, and bridge tendon technology study reports and implementation actions are expected for 2020 and 2021.

The Multilateral Relations Program has similar counterparts in other DOT modes and OST with the same multilateral objectives. For 2020 and 2021, the Multilateral Relations Program continues to support domestic dissemination of the technical work produced by State and U.S. government representatives to the World Road Association technical committees and task forces. The products in the form of reports, guidelines, and other information tools, capture the U.S. perspectives and are invaluable tools for the professional roads community worldwide. State DOTs are leading the effort to promote and disseminate these products beyond the Federal sphere. Including to counties, locals, and rural communities. In addition, several projects undertaken under the European Commission-USDOT Twinning Initiative will share findings on research performed in priority areas, such as automated and connected vehicle applications.

The Bilateral Relations Program has counterparts in other DOT modes and OST with similar objectives. For 2020 and 2021, the following deliverables are expected to come to fruition: U.S.-Korea annual Roads Workshops, U.S.-Japan Bridge Workshops, U.S.-Japan Twinning research, innovative ideas related to robotics and non-destructive evaluations, and webinars related to priority topics, including freight.

Highway and Transportation Data

Program Description/Activities/Objectives:

In 2021, the Highway & Transportation Data (H&TD) work will continue to serve as a comprehensive program of research, development, maintenance, and technology activities focused on supporting and advancing the current and future state of data collection, processing, analysis, modeling, dissemination, and visualization.

The H&TD program directly supports policy and program activities and decision-making across the FHWA and the U.S. DOT. The H&TD program offers data and information that enable the U.S. DOT to carry out the RD&T strategic goals covering Safety, Infrastructure, Innovation, and Accountability. The H&TD program provides the foundation for the entire transportation community: public entities, private businesses, and researchers for data and information. The H&TD program also provides support to data providers at State DOTs and MPOs through policy and technical guidance.

The H&TD program encompasses 8 key data areas as listed below:

- **A - FHWA 500 Series Data** include (a) fuel consumption (gasoline and special fuel), (b) licensed drivers, (c) registered vehicles, and (d) highway financing including local, State, and Federal spending, revenue, tolls, and bonds. These data enable integrated analysis to support the Federal-aid highway program.
- **B - Policy Information Data Portal (PIDP)** offers a single stop for all State agencies to submit required data to the FHWA and provides office- and agency-wide programmatic and analytic support.
- **C - Highway Performance Management System (HPMS)** provides the foundation for all Federal-aid highway programs.
- **D - Integrated Transportation Information Platform (ITIP)** offers a mechanism for integrated data analysis throughout the FHWA.
- **E - Data Visualization Center (DVC)** activities benefit the entire FHWA through its data analysis and visualization expertise and products.
- **F - Traffic Monitoring** collects and disseminates consistent traffic volume, class, and weight data for both motorized and nonmotorized vehicles, and provides technical guidance for the transportation community.
- **G - National Household Travel Survey (NHTS)** provides the only national-level demographic, behavior, and origin/destination data for the entire transportation community; enabling future demand analysis and a wide range of project, program, and policy analysis and evaluation.
- **H - National Performance Dataset (NPD)** covers both the National Performance Management Research Dataset (NPMRDS) and the Performance Vehicle Occupancy data on an annual basis. It delivers travel time data for all NHS highways and vehicle (truck, bus, and POV) occupancy data for all States and urban areas, enabling transportation performance management for accountability and transparency. The annual NPD program

keeps track of trending, detects new issues, increases data quality, and lowers cost and the data reporting burden.

The above key data areas are supported by the H&TD research program with the following strategies:

- Develop and deploy effective policy and technical guidance and provide hands-on training and coaching to States and local MPOs on data acquisition and analysis.
- Develop and deploy effective IT technology to process data collected by States.
- Explore new alternative methods, approaches, and strategies to acquire needed data in a cost-effective, quality-driven, and timely manner.

The following subjects will be the key focus during FY21 for the H&TD program:

Driver License, Finance and Motor Fuel, and Vehicle Data

- Share with States and local agencies findings on identified gaps and best practices and provide training and education on the importance of quality and timely data submissions.
- Share with States and local agencies findings on the capability and maturity of their data programs regarding the collection and submission of driver license, finance and motor fuel, and vehicle data and provide training that will improve their processes.
- Improve and streamline FHWA's current processes in calculating and publishing yearly highway statistical results.
- Engage State, locals, and other data users to determine current and future data needs, develop a strategy to phase out unused Highway Statistics tables, and identify new data along with the most beneficial form of dissemination (e.g., reports, tables, machine readable data feeds).

Policy Information Data Portal (PIDP)

- Continue to expand the PIDP coverage on data areas
- Improve on-line processing time and reliability from the 2020 baseline
- Provide training to States and local agencies on the usage of the platform

Highway Performance Monitoring System (HPMS)

- Improve data submittal processing
- Reduce the amount of data being submitted by implementing an incremental data approach
- Explore alternative data sets to reduce data submittal and improve data quality
- Provide training to States and locals

Integrated Transportation Information Platform (ITIP)

- Improve data integration capabilities
- Increase data system connectivity
- Increase data sets inclusion
- Enable greater access to warehouse data for analysis by standard analysis packages

- Provide training to FHWA and other users

DVC

- Increase data analytical capability
- Improve data quality through visualization development
- Enhance data related communications, both internal and external
- Provide training on the latest approaches to data visualization

National Performance Data (NPD)

- Improve data compatibility between the 2020 and 2021 data and other infrastructure based data
- Integrate the 2021 NPMRDS data with the 2020 HPMS data, enabling integrated analysis
- Continue to collect, process, analyze, and release the 2021 NPMRDS data with improvement to data quality
- Continue to derive 2021 vehicle occupancy factors based on lessons gained in the 2020 cycle

Traffic Monitoring and Traffic Data

- Deploy big data analytics based on the new passive data AADT method developed in 2020
- Deliver the monthly Traffic Volume Trend report with improvement on data coverage due to the 2020 coding efficiency improvement
- Continue the R&D work on empty truck weight database for the new generation of freight analysis stated in 2020
- Deliver technical assistance and workshops to State and local agencies in adopting new methods and approaches developed in 2020

National Household Travel Survey (NHTS)

- Continue to improve the 2020 data methods and improve the timeliness of 2021 passenger origin destination (OD) data
- Build on 2020 data and 2021 core data to increase the geospatial resolution
- Continue to provide technical assistance to State DOTs and MPOs for data gathering and data application
- Develop the latest travel behavior information based on 2020 data

Program Alignment with Strategic Goals:

Safety: The H&TD program contributes directly to highway safety and the Department's Systematic Safety Approach by providing mission critical human factor and exposure data on personal and commercial travel, highway system performance and use, traveler demographics and use, weigh-in-motion and vehicle classification, vehicle registrations, and licensed drivers. The H&TD program continues to enhance and offer innovative tools and techniques for analyzing, visualizing, and disseminating transportation data to support Department-wide safety programs.

Infrastructure: The H&TD program provides mission critical data on the nation's infrastructure to support the infrastructure strategy covering areas of accelerated project delivery, risk based

asset management, and system resilience, in addition to supporting the Federal-aid program performance management initiative and several Agency-wide programmatic needs. These data include: highway system condition, performance, and use; personal and commercial travel; traveler demographics and use; weigh-in-motion and vehicle classification; and highway finances. The program continues to enhance training and support for data providers, while also expanding the tools and techniques used to quality check, analyze, visualize, and disseminate past, present, and future data. Several of the data programs are undergoing reassessments to ensure their ability to meet current and future Department-wide needs.

Innovation: The H&TD program continues to be a hotbed for testing and deploying new technologies and techniques for data collection, processing, analysis, and visualization. The program developed a generic data portal using commercial off the shelf software (COTS) for any program or office to use for collecting form based data, thus eliminating the need to build new systems every time an office or program wants to collect new data. The program developed statistical big data methods to derive vehicle occupancy factors versus the time-intensive and expensive traditional survey method. The program manages the Data Visualization Center (DVC), which is an Agency-wide service providing customized data visuals, assistance with existing data visualizations, and consulting services. Since its inception, the DVC has received over 150 requests for services from 40 offices throughout FHWA and the U.S. DOT. In addition, on the data application front, significant effort has been devoted to cooperating and partnering with private businesses on adopting and using private data.

Accountability: The H&TD program serves a critical role in implementing the Transportation Performance Management (TPM) requirements of MAP-21 and the FAST Act that were codified in 23 USC § 103. The HPMS serves as the system of record for travel, pavement, National Highway System (NHS), adjusted urbanized boundaries, and speed data. The Integrated Transportation Information Platform (ITIP), which is the name of the data warehouse, will serve as the central repository for all TPM data. The NPMRDS offers State and local agencies the data needed for the TPM. The program also provides information on how much States and locals spend annually on transportation by various categories of improvements, including, but not limited to: capital improvements, restoration and rehabilitation, maintenance, and safety.

Every Day Counts Program

Program Description/Activities/Objectives:

The Every Day Counts (EDC) Program is a State-and Local-based program that identifies and rapidly deploys proven, yet underutilized innovations to enhance roadway safety, shorten the project delivery process, reduce roadway congestion, and integrate automation. Proven innovations promoted through EDC facilitate greater efficiency at the State and local levels, saving time, money and resources that can be used to deliver more projects. In FY 2021, FHWA will be advancing the sixth 2-year, round of the EDC program (EDC-6 calendar year 2021 to 2022).

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

The EDC Program accelerates the deployment of innovations support all four goals of the DOT Strategic Plan. In addition, many of the innovations advanced under this program are having a significant positive impact on rural communities. FHWA anticipates that the innovations identified for inclusion in EDC-6 will continue to align with DOT Strategic Goals.

State Transportation Innovation Council (STIC) Incentive Program

Program Description

The FHWA STIC Incentive program provides resources to help foster a culture for innovation and make innovations standard practice in their States. Through the program, funding up to \$100,000 per State per Federal fiscal year is made available to support or offset the costs of standardizing innovative practices in a State transportation agency or other public sector STIC stakeholder. FHWA intends to continue the STIC Incentive program in FY 2021 and continue to support a nationwide culture of innovation through the National STIC Network.

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

The STIC Incentive Program supports all four goals of the DOT Strategic Plan. In addition, many of the innovations advanced under this program are having a significant positive impact on rural communities.

A summary of all STIC Incentive Projects to date is provided at:
https://www.fhwa.dot.gov/innovation/stic/incentive_project/

Accelerated Innovation Deployment (AID) Demonstration Program

Program Description:

The Accelerated Innovation Deployment (AID) Demonstration Program provides funding to State DOTs, federal land management agencies, tribal governments, metropolitan planning organizations, and local governments to offset the risks associated with the initial deployment of an innovation by that agency. Innovations funded by AID can come from EDC or other sources. The AID Demonstration Program provides funding to support the pilot/demonstration of innovations on projects by State DOT, federal land management agencies, tribal governments, metropolitan planning organizations, and local governments. Funding recipient reports on experiences and lessons learned from each innovation deployment are shared via the program web site to provide technology transfer.

FHWA intends to continue the AID Demonstration program in FY 2021 with a new NOFO that will cover the same time period as the next surface transportation legislation.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

The FHWA AID Demonstration Program supports the Department's Safety, Infrastructure, Innovation and Accountability Strategic Goals.

This program impacts and is of benefit to transportation agencies throughout the nation, including those in rural communities. It is anticipated that Local governments will continue to be eligible to apply for the AID Demonstration Program, through the State DOT as a sub-recipient. Consistent with other FHWA funding provided to tribes, any federally recognized tribe will also be eligible to apply to AID Demonstration Program.

Accelerating Market Readiness (AMR) Program

Program Description:

The Accelerating Market Readiness (AMR) program supports promising innovations that have the potential to be considered for accelerated deployment. The AMR program provides resources for the rapid, national assessment of emerging innovations and for the development of objective, written documentation of these assessments. The AMR Program is intended to help advance the innovations to a more complete market-ready status, which in turn should accelerate the adoption of the innovations by transportation agencies under the EDC Program or by other initiatives.

In FY 2021 FHWA intends to continue to solicit ideas for the AMR program through the issuance of a BAA. FHWA expects to update or refine the topic focus areas specified in the BAA based on agency and departmental goals along with an assessment of types of proposals received through previously issued BAAs.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

The AMR Program will continue to support the Department's Safety, Infrastructure and Innovation Strategic Goals.

Innovative Program Delivery

Program Description/Activities:

Innovative Program Delivery (IPD) provides tools, training and technical assistance that support the transportation community's use of cutting-edge financial and procurement strategies to deliver critical infrastructure projects. FHWA's efforts in this area are primarily led by the Center for Innovative Finance Support (CIFS), whose products are often marketed and deployed under the brand of the Secretary's Build America Bureau. These research and technology deployment efforts focus on revenue generation (tolling and value capture), procurement (public-private partnerships and other alternative contracting methods), and innovative finance (Federal project finance tools such as GARVEE Bonds and State Infrastructure Banks). Support for our partners include (1) technical resources, guidebooks and analytical tools, (2) capacity building and outreach, and (3) technical assistance for project implementation.

Technical resources:

- Public policy research into how transaction costs of P3s can be controlled for projects smaller than typically thought suitable for this delivery model. This would build on the growing recognition among public agencies that P3s – as a delivery mechanism instead of a funding solution – have potential for broad and creative application beyond the mega-project, but their high transaction costs (relative to other ACMs) may inhibit use.
- Refinements to FHWA's suite of ACM evaluation tools (including P3-VALUE), based on feedback from the community of users that have adopted the tool since its launch in 2019.

Capacity building activities:

- Training for state and local partners on the appropriate use of Federal project finance tools, with an emphasis on opportunities for rural communities.
- Financial and organizational support for the Center for Excellence in Project Finance (CEPF) via a cooperative agreement to be awarded per a new competitive solicitation. The current CEPF, the [BATIC Institute: An AASHTO Center for Excellence](#), offers a program of training, sharing of best practices, and technical assistance to all State Departments of Transportation and their local partner agencies.
- Intensive training for public project sponsors on critical aspects of public-private partnerships (P3s), including life-cycle cost comparisons between alternative delivery methods (Value for Money analysis), model contract provisions for long-term concession agreements, and best practices for competitive procurements. Each training course is based on material developed by the CIFS in recent years with research funding.
- Training for state and local partners on best practices for achieving efficiencies of scale on multiple small projects, such as bridges, via their "bundling" into consolidated design and construction packages. This training is based on research funded via FHWA's Accelerated Market Readiness program.

- Training for state and local partners on best practices for the successful implementation of “value capture” techniques to help finance transportation projects via the incremental property value generated by the project itself. This training would be based on research funded in FY 2020.

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Technical assistance activities:

- Project-specific assistance to public sponsors assembling financial plans for Federal-aid projects. Building on research conducted in FY 2018 and FY 2019, the CIFS will focus on opportunities for using SIBs to enable local and rural communities to finance the non-Federal share of project costs, which can present an inordinate challenge for small public budgets.
- Project-specific assistance to public sponsors implementing a P3 delivery method for a project seeking credit assistance via the TIFIA loan program and/or Private Activity Bonds (PABs). All such assistance would be coordinated through the Build America Bureau (see below) as established via the FAST Act.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Infrastructure
Innovation

Infrastructure: Construction and maintenance of critical national infrastructure lies at the core of the IPD mission. The condition and performance of our nation’s roads, bridges and tunnels demand that State and local agencies spend more on infrastructure than their budgets allow. Scarce Federal funds, therefore, must be used efficiently to attract both public and private investors. In looking at rural communities, FHWA seeks to emulate Federal financing programs in sectors such as agriculture and housing, which play significant roles in rural development. Research into FHWA financing opportunities to leverage local participation in Federal-aid projects may open doors for this type of assistance.

Innovation: Regardless of how it is funded or financed, infrastructure will always require proficiency in project delivery. The IPD research on public agency best practices in evaluating innovative (alternative) contracting methods seeks to expand the range of appropriate delivery methods among all States. Alternative contracting methods typically are used less frequently in States with a higher proportion of rural communities, which

could benefit from access to contracting approaches that enhance quality as well as cost and schedule reliability.

Research Infrastructure, Technology Transfer and Partnerships

Program Description/Activities/Objectives:

The FHWA Research Infrastructure Program supports the goals of the USDOT Strategic Plan to invest strategically in transportation infrastructure, promote safe and secure transportation, support the development and deployment of infrastructure innovations, and promote greater accountability. The program monitors legislative developments, helps to coordinate the R&T budget allocation, administers the R&T program, maintains the Turner Fairbank Highway Research Center, organizes strategic Research and Technology (R&T) investment, and provides marketing and outreach. The overarching role is to coordinate all elements that support and promote the highway R&T portfolio to ensure the FHWA R&T program addresses national needs, meets future demands, and maximizes the strengths of all research entities. This R&T program is stakeholder driven, with partners engaged throughout the entire innovation lifecycle process, from agenda setting and planning, through the research, technology development, and innovation deployment phases, to the implementation and assessment stages. The Research Infrastructure, Technology Transfer, and Partnerships Program supports these coordinated efforts across all other Programs.

In addition to supporting R&T development and deployment activities, the Research Infrastructure, Technology Transfer, and Partnerships Program promotes communication, coordination, and collaboration with FHWA's partners, which are crucial to conducting the right research, doing it well, and delivering solutions when and where they are needed. Communication strategies address the needs of internal and external audiences and cover the depth and breadth of the federal effort for highway research and technology, displaying prudent use of government resources, advancing the state of the practice, and building a case for continued and future funding.

The Research Infrastructure, Technology Transfer, and Partnerships Program will build upon the activities in FY20 on multiple fronts. There will be continued work to identify opportunities to enhance communication, outreach, and sharing of information with our State, local, national, and international partners. The program will focus on strengthening the feedback loops in the Innovation Lifecycle and offering new services that move early-stage innovations from the laboratory to the field.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

The FHWA Research Infrastructure, Technology Transfer, and Partnerships Program supports all DOT Strategic goals. This Program leads the development and coordination of a national highway research portfolio to close critical knowledge gaps, identify collaboration opportunities, and accelerate innovations and technology deployment. To accomplish this, the Research Infrastructure, Technology Transfer, and Partnerships Program coordinates with and supports all other R&T programs, thereby aligning with the respective strategies of those Programs.

Small Business and Innovation Research

Program Description/Activities/Objectives:

The SBIR program is a highly competitive, awards-based program that encourages domestic small businesses to engage in research and development addressing high priority research areas within USDOT. The SBIR program favors research that has the potential for commercialization through products and applications sold to the private sector transportation industry, State DOTs, USDOT, or other federal agencies.

The program is administered by the Volpe Transportation Center. The SBIR Program Office publishes one or two solicitations each fiscal year for proposals on specific research topics of interest to USDOT operating administrations, including the FHWA.

Program Alignment with Strategic Goals:

The SBIR program solicits research and technology topics from all FHWA R&T offices annually, including the ITS Joint Program Office. Topics are selected based on the merit, suitability for the SBIR program, as well as consideration of alignment with Agency and Departmental goals. As a result, the SBIR program supports all FHWA R&T program offices and, by extension, all of the USDOT Strategic goals.

DOT Strategic Goal
Safety
Infrastructure
Innovation
Accountability

Exploratory Advanced Research

Program Description/Activities/Objectives:

The EAR Program scouts new topics – around a dozen annually – as part of a continuous process engaging partners broadly from within and outside the highway transportation industry to seek, screen, and scope for emerging, unexplored advances in science and technology

Based on knowledge gained from current research investments, external technology scouting, and engagement with experts within and beyond the transportation community, the EAR Program screens new topics for where EAR Program funds could create important breakthroughs for highway transportation. The EAR Program then solicits proposals for research on promising topics – generally between two and four – using a broad agency announcement, which describes a desired outcome and related technology but allows each proposer to suggest a unique approach for conducting the research.

The EAR Program generally does not invest in the same topic area from one year to the next but may return to a topic that continues to warrant additional exploratory research after a full cycle of investment. The EAR Program actively manages and integrates research in new topics into the existing portfolio to provide a continued source of innovation into the highway research pipeline. Research projects generally span three years often with mid-point milestones to assess progress and revised objectives to pivot towards more impactful results based on finding from the initial phase of research and continued market research of external efforts.

Program Alignment with Strategic Goals:

The EAR Program works with technical experts from across FHWA and other modal agencies to ensure new topics and future investments address critical current and emerging needs.

The EAR Program annually screens the Program portfolio of current projects to identify potential high impact results and focus transition of those results into applied research programs and demonstrations. These results help assure a continued supply of innovations for Agency programs and future industry needs.

Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Program

Program Description/Activities/Objectives:

The ATCMTD is statutorily required in the FAST Act Section 6004, 23 U.S.C. 503(c)(4). The ATCMTD grants are managed by FHWA and the ITS JPO contributes a mandated percentage of funding through FHWA to annually satisfy the requirement.

The language provided here duplicates the language provided in the ITS JPO AMRP for consistency.

The Advanced Transportation and Congestion Management Technologies Deployment Initiative (ATCMTD) Program is intended to provide funding for eligible entities to develop model deployment sites for large scale implementation and operation of a diverse set of technologies in various geographic regions. As the program is aimed at the rapid deployment of advanced technologies, limited expenditures for infrastructure construction is anticipated in grant application. The stated purpose is to reduce costs and improve return on investments; deliver environmental benefits through increased mobility; enhance transportation system operations; increase safety; improve collection and dissemination of real-time information; monitor transportation assets; deliver economic benefits; and accelerate deployment of connected and autonomous vehicle technologies. Successful proposals will contain quantifiable system performance objectives, use innovative technologies and strategies, and a plan for long term operation and maintenance of the deployed technologies. DOT encourages partnering among the private sector, public agencies, research institutions, technology leaders, and other transportation stakeholders is encouraged.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Infrastructure

ATCMTD Program goals are directly linked to DOT's Strategic Goals:

- Reduced costs and improved return on investments, including through the enhanced use of existing transportation capacity (Infrastructure)
- Measurement and improvement of the operational performance of the applicable transportation networks (Improving Mobility)
- Reduction in the number and severity of traffic crashes and an increase in driver, passenger, and pedestrian safety (Safety)

- Collection, dissemination, and use of real-time transportation-related information to improve mobility, reduce congestion, and provide for more efficient and accessible transportation, including access to safe, reliable, and affordable connections to employment, education, healthcare, freight facilities, and other services (Improving Mobility)
- Monitoring transportation assets to improve infrastructure management, reduce maintenance costs, prioritize investment decisions, and ensure a state of good repair (Improving Infrastructure)
- Delivery of economic benefits by reducing delays, improving system performance and throughput, and providing for the efficient and reliable movement of people, goods, and services (Improving Mobility)
- Accelerated deployment of vehicle-to-vehicle, vehicle-to-infrastructure, and automated vehicle applications, and autonomous vehicles and other advanced technologies (Innovation)
- Integration of advanced technologies into transportation system management and operations (Innovation)
- Demonstration, quantification, and evaluation of the impact of these advanced technologies, strategies, and applications towards improved safety, efficiency, and sustainable movement of people and goods (Safety, Improving Mobility)
- Reproducibility of successful systems and services for technology and knowledge transfer to other locations facing similar challenges (Innovation)

Fixing America's Surface Transportation (FAST) Act Section 6004 instructs the DOT to ensure that the selection of grant recipients represent diverse geographic areas of the United States, including urban and rural areas.

Surface Transportation System Funding Alternatives

Program Description/Activities/Objectives:

The STSFA Program purpose is to provide grants to States to demonstrate user based alternative revenue mechanisms that utilize a user fee structure to maintain the long-term solvency of the Highway Trust Fund.

Program Objectives

The STSFA Program objectives include testing design, implementation and acceptance of functional future user-based alternative revenue mechanisms that minimize administrative costs, increase public awareness of the need for and possible approaches for alternative funding sources for surface transportation programs, and to provide recommendations on various approaches. The grants are only available to States or groups of States.

Program Alignment with Strategic Goals:

DOT Strategic Goal
Innovation

- Reduced costs and improved return on investments, through the identification of an alternative revenue source capable of funding future infrastructure.
- Charging by the mile reveals to users how much they drive, which could influence driver behavior. Research suggests that it leads to some people driving less which is an environmental benefit that alleviates congestion and streamlines traffic flow and improves travel which reduces accident risks (Safety)
- Deployment of mileage-based user fee technologies and other road user charge related technologies addresses Innovation