Federal Highway Administration (FHWA) Update for the Research and Technology Coordinating Committee (RTCC)—December 2020

Surface Transportation Reauthorization Update

The Fixing America's Surface Transportation Act (FAST Act) was extended through the end of Federal fiscal year 2021 (FY21)—September 30, 2021. Although both Houses of the U.S. Congress have been working on proposals for the next reauthorization bill, all unpassed bills expire when Congress adjourns. The new Congress will take up reauthorization and other legislative matters after it convenes in January 2021. For more information, contact Craig Thor at craig.thor@dot.gov or 202-493-3338.

Exploratory Advanced Research (EAR) Program New Extramural Awards

FHWA made the following four awards for proposals submitted in response to the EAR Program FY20 Broad Agency Announcement (BAA): 1) New Jersey Institute of Technology for a project titled "Decentralized Vehicle Credential Management System Based on Consortium Blockchain," 2) Michigan Technological University for a project titled "Autonomous Winter Road Maintenance Decision Making Enabled by Boosting Existing Transportation Data Infrastructure with Deep and Reinforcement Learning," 3) Tufts University for a project titled "Traffic Incident Detection And Analysis System (TIDAS)," and 4) Louisiana Technical University for a project titled "Improving the Compatibility of Waste Plastic and Asphalt Binder Via Theoretically Justified Identification of Compatible Blends." FHWA anticipates making additional awards in machine learning. For more information, contact David Kuehn at david.kuehn@dot.gov or 202-493-3414.

FHWA Participation in the National Science Foundation (NSF) National Artificial Intelligence (AI) Research Institutes' Program

The NSF National AI Research Institutes' program provides research awards of up to $20 million over 5 years to enhance fundamental research and use-inspired research in AI. The EAR Program, working with the FHWA Office of Safety and Operations Research and Development and the Intelligent Transportation Systems (ITS) Joint Program Office (JPO), is encouraging NSF National AI Research Institutes to consider AI research for highway transportation uses. In FY20, NSF made an award titled "Institute for Foundations of Machine Learning," which considers transportation-related uses. The University of Texas at Austin is the lead institution. More information is located at https://ml.utexas.edu/ifml. FY21 proposals were due December 4, 2020. For more information, contact David Kuehn at david.kuehn@dot.gov or 202-493-3414.

FHWA Is Seeking State Departments of Transportation (DOTs) Interested in a Pooled Fund Project for Building Information Modeling (BIM)

BIM for infrastructure is moving transportation into the 21st century. BIM leverages digital practices to bring profound improvements for project delivery and life-cycle data management. The data capabilities are envisioned to better connect the silos within our agencies and build greater collaboration and real-time, fact-based decisionmaking to manage our highway assets. FHWA worked with stakeholders to develop a 10-year national strategic work plan to advance the use of BIM for infrastructure. Iowa DOT is leading a new pooled fund project and FHWA is seeking other States interested in participating. The solicitation can be found at https://www.pooledfund.org/Details/Solicitation/1547. For more information, contact Katherine Petros at katherine.petros@dot.gov or 202-493-3154.

Pooled Fund on Ultra-High Performance Concrete (UHPC) for Bridge Components

The expertise within the FHWA Office of Infrastructure Research and Development and the excitement within the bridge engineering profession surrounding the topic of UHPC are being captured in a new pooled fund study on Structural Behavior of UHPC, which can be found at https://www.pooledfund.org/Details/Study/695.

FHWA will lead the effort to advance the use of UHPC in primary bridge components, thus capturing opportunities for greater efficiency, durability, and cost-effectiveness in the delivery of the Nation's Highway Bridge Program.

This large-scale, experimental testing program will be conducted at the Turner-Fairbank Highway Research Center (TFHRC), investigates the structural performance of bridge girders and similar components, helping to refine design specifications while concurrently assisting partners in defining optimal solutions for their markets. Given that fabricators across the United States are gearing up to produce UHPC components, organizations may consider both financial contributions and in-kind contributions of locally produced structural components. To date, seven States have committed funds. Additional contributions, allowing for expanded scope and more thorough investigations, are encouraged. For more information, contact Ben Graybeal at benjamin.graybeal@dot.gov or 202-493-3122.

Developing Speed Crash Modification Factors (CMFs) Using Second Strategic Highway Research Program (SHRP) 2 Roadway Information Database (RID) Data

Charles Fay, of the FHWA Office of Safety and Operations Research and Development, hosted the sixth webinar in the series resulting from the Naturalistic Driving Study Pooled Fund project. The project's objective is to develop speed-related CMFs for the Highway Safety Manual (HSM) Part C crash prediction models. The study links:

- The SHRP 2 RID, which contains roadway data spanning six States.
- The National Performance Management Research Data Set (NPMRDS) Version 2 database, which contains travel time of National Highway System data in 5-minute increments.
- The Highway Safety Information System (HSIS) crash data, which include data for the same years as the NPMRDS Version 2 database.

Linking the three databases provides a rich data source including roadway, crash, and operating speed characteristics. The collective databases enable FHWA to conduct research on the effect of operating speed and speed differentials on crash frequency and/or crash severity. Webinars will be posted on the FHWA Safety Training and Analysis Center (STAC) website at https://highways.dot.gov/research/data-sets/safety-training-analysis-center/about-stac. If you would like a recording before the posting, please contact Charles Fay at charles.fay@dot.gov or 202-493-3336.

The Long-Term Pavement Performance (LTPP) Program Is Updating its Data Analysis Plan

LTPP program staff started the planning process for holding a workshop in April 2020 to update the program's Data Analysis Plan, with assistance from the Transportation Research Board (TRB) LTPP Expert Task Group (ETG). The initial plan was developed in 1999 and has been updated over the years to keep current with the pavement community's most pressing issues. It was last updated in 2010. FHWA held a productive virtual workshop beginning on November 2, 2020, and spanning over six days with the ETG members and other invited experts from the State DOTs, industry organizations, and academic institutions to align LTPP's research roadmap with current stakeholders' needs. For more information, contact Larry Wiser at larry.wiser@dot.gov or 202-493-3079.

Optimization of the Procedure for the Quantification of Calcium Oxychloride in Cementitious Systems

Joint deterioration is an issue affecting concrete pavements exposed to chloride-based deicing salts in cold climates. The deterioration, in part, is attributed to a chemical reaction occurring between the portlandite, a product of the cement and water reaction, and the calcium chloride present in the deicers. The chemical reaction generates highly expansive crystals, calcium oxychlorides, which induce damage to the joints.

A relatively new procedure, American Association of State Highway and Transportation Officials' (AASHTO) T 365, published in 2020 (https://store.transportation.org/item/publicationdetail/4382), quantifies the amount of calcium oxychlorides potentially formed in a cementitious system. One of the procedure's drawbacks is the duration of the test, which takes 10.7 hours to complete and, in the process consumes a significant amount of liquid nitrogen, resulting in a large cost per sample. The Concrete Laboratory at TFHRC evaluated the T 365 procedure and reduced its duration to facilitate adoption of the procedure among practitioners. So far, promising results show a reduction in the testing time from 10.7 hours to 1.6 hours. The reduction of the test duration has the potential to drastically cut the costs of the test and make it more competitive with other available techniques for the estimation of calcium oxychloride formation. The Concrete Laboratory is in the process of extending the verification study of the modified procedure to a larger number of cementitious systems. Once completed, the Concrete Laboratory team will submit recommendations to AASHTO for modifying the existing standard. For further information, contact Robert Spragg at robert.spragg@dot.gov or 202-493-3233.

Highlighting Human Factors Project in the *Safety Compass* Newsletter

The FHWA Office of Safety and Operations Research and Development *Stakeholder Workshop Results on Automated Vehicles, Safety, and Human Factors* article was published in 2020 in the FHWA Office of Safety's *Safety Compass* newsletter, summarizing the stakeholder workshop held as part of the Investigate Key Automated Vehicle Human Factors Safety Issues Related to Infrastructure project. For more information, contact Laura Mero at laura.mero@dot.gov or 202-493-3377.

FHWA Continues Launch of Every Day Counts (EDC)-6

On December 8-10, 2020, FHWA hosted a virtual summit to convene transportation leaders and frontline professionals to learn about the benefits of the seven innovations included in the sixth round of the EDC-6 innovation deployment program.

The EDC program promotes the accelerated use of tools, technologies, and methods nationwide to improve road and bridge projects, reduce cost, and shorten their time to completion. Since the establishment of EDC in 2010, FHWA has worked with State, local, and Tribal governments, and Federal agencies to widen the use of dozens of innovations leading to better and safer roads and bridges, reduced project delivery times, and more cost-effective transportation improvements.

All virtual summit presentations are available on demand at www.labroots.com/ms/virtual-event/fhwa-everyday-counts-6-virtual-summit. In January, EDC-6 deployment teams will begin providing technical assistance and training to help transportation agencies implement the innovations at their chosen levels of adoption. For more information, contact Julie Zirlin at julie.zirlin@dot.gov or 202-941-9468, or visit https://www.fhwa.dot.gov/innovation/everydaycounts/.

Revolutionary Test Method for Alkali-Silica Reactivity (ASR) Gels in Concrete

After a 10-year research effort, the FHWA Chemistry Laboratory has developed a new test method for determining the ASR reactivity of aggregates used in concrete. First discovered in France in the 1930s and the USA in 1940, ASR damages concrete. The alkali in the cement reacts with silica in the aggregate to form a gel. The gel can absorb water. The gel swells as it absorbs water and exerts sufficient pressure to crack the concrete, often resulting in the costly replacement of concrete structures. A reliable test method to determine an aggregate's potential to form ASR gels in concrete has eluded the transportation industry since the first ASR test methods were proposed in 1947. There have been many variations of test methods over the years. Almost all rely on measuring the physical expansion of concrete or mortar specimens. None work particularly well.

The Chemistry Laboratory has developed a new test method which relies exclusively on chemical measurements. No concrete or mortar samples are needed. The method is still a work in progress; however, it shows 100 percent agreement with block farm weathering data, something not previously achieved with existing test methods. A provisional test method for coarse aggregates has been presented to AASHTO for their perusal. Research is continuing to include fine aggregates and mitigation strategies to help in locations where only reactive aggregates are locally available. The final step in the planned research is to develop a test method looking not at the aggregates themselves, but at the job mix formula planned for use in the concrete. For more information, contact Terry Arnold at terry.arnold@dot.gov or 202-493-3305.

Presentation on Cooperative Driving Automation (CDA) and Naturalistic Driving Study (NDS) Use

James Pol, with the FHWA Office of Safety and Operations Research and Development, delivered a presentation to the Naturalistic Driving Data Analytics workshop on October 30, 2020, as part of the Institute of Electrical and Electronics Engineers (IEEE) Intelligent Vehicles Symposium. The presentation considered the current applications developed for CDA under the FHWA CARMA℠ program, and what information on *normal* behavior can be extracted from NDS. One of the concepts included automated feature extraction from the NDS, which could be used to train CDA models in challenging environments like work zones. For more information, contact James Pol at James.Pol@dot.gov or 202-493-3371.

FHWA Safety Strategic Plan Development

The next FHWA Safety Strategic Plan was drafted by teams of FHWA staff around the country to provide a comprehensive look towards the future. The new Plan, which is now with technical editors for finalization, will be made available to the public as a high-level document in Spring 2021. The new Plan will underscore FHWA's commitment of advancing Toward Zero Deaths through the applied use of the Safe System Approach. For more information, contact James Pol at James.Pol@dot.gov or 202-493-3371.

Mid-Point for Small Business Innovation Research (SBIR) Phase 2 Projects on 'Machine Vision-Based System to Support Connected and Automated Vehicle (CAV) Safety Applications

The two SBIR awardees, Connected Wise and Intelligent Automation, Inc., are now at the halfway mark for the development of prototype devices which use commercial camera and logic to interpret machine readable, complex messages from special signage. These prototype devices would enable data to be conveyed to CAVs in locations in the country where access to communications is poor or unavailable. The prototype devices also provide for visual signs to convey complex environments like work zones or route detours. Both companies demonstrated the ability of the devices to read and capture the message of signs at roadway speeds. For more information, contact Mohamad Banihashemi at mohamad.banihash@dot.gov or 202-493-3334.

CARMA Testing

The CARMA team has initiated testing of the self-driving features to prepare for testing and validation of the cooperative driving use cases of basic travel, work zones, and incident management in 2021. Testing includes weekly testing of the CARMA passenger vehicles at the Summit Point Motorsport Park, in Summit Point, WV, and testing of CARMA trucks at the Aberdeen Test Center (ATC), in Aberdeen, MD. The team is preparing to support a demonstration of commercial vehicle safety features under the Federal Motor Carrier Safety Administration Activity Center for Enforcement (FMCSA ACE) Program at ATC in January 2021. For more information, contact Pavle Bujanovic at pavle.bujanovic@dot.gov or 202-493-3271.

AI for TIDAS

The FHWA Office of Safety and Operations Research and Development and the staff from the EAR program kicked off the first of three Artificial Intelligence and Machine Learning (AI/ML) in Transportation Management Systems projects. Tufts University was selected to conduct the TIDAS to utilize AI/ML advancements in computer vision techniques, known as ClearVision. The techniques enhance images with object detection and provide tracking of objects using neural networks, scenario detection algorithms, and a user interface to assist operators. The technology will work with existing cameras and equipment, resulting in lower implementation costs. Through innovative AI-based use of existing roadside equipment, the project could improve image processing, improve vehicle classification, and automatically identify anomalies to regular roadway performance. For more information, contact Peter Huang at Peter.Huang@dot.gov or 202-493-3484.

Automated Vehicles and Analysis, Modeling, and Simulation (AMS)

FHWA is planning to collect data using an advanced driver assistance system (ADAS) level 2 enabled vehicle and a human-driven vehicle on roadways in Northern Virginia in 2021. The data collection will take place on an approximately 12-mile loop near the TFHRC campus. Both vehicles will be equipped with a suite of sensors to enable data collection about the adjacent vehicles in the traffic stream. The dataset will help inform the development of microsimulation models that accurately emulate the impact of level 2 ADAS technology on traffic flow and capture how human drivers alter their behavior in the presence of the technology.

In a related effort, FHWA issued a BAA, Acquiring Connected and Automated Vehicle (CAV) Performance Datasets, to obtain datasets that document how Advanced Driver Assistance Systems (ADAS) and Automated Driving Systems (ADS) operate in traffic while using and not using connectivity. The datasets will also document how adjacent human-driven vehicles in the traffic stream, detectable by vehicle sensors equipped on the ADAS/ADS, interact with the ADAS/ADS. The datasets procured through the BAA will be useful toward developing more robust traffic microsimulation models. Ultimately, improved models of ADAS/ADS and human driver behavior will allow State and local agencies to make better decisions toward how to operate their facilities over time. The award of contract(s) to procure the collection of the data should be made soon. For more information, contact Rachel James at rachel.james@dot.gov or 202-493-3205.

FHWA Crashes into the Future

Sharing crash tests at FHWA's Federal Outdoor Impact Laboratory (FOIL) is not as easy as taking a video on a cell phone and streaming it live. Cameras used in crash tests are not like personal video cameras. Crash test cameras are designed to withstand g-forces experienced during crash events and capture much more information. All digital details translate into extremely large files.

Figure 1. Full-Scale Crash Test. (Source: FHWA.)

During a crash test, several video views (7 to 9) are recorded at very high frame rates—500 to 1,000 frames per second. According to FOIL Manager Eduardo Arispe of the FHWA, "Although we are not currently able to use our cameras to webcast the tests in a live stream, laptops with wireless connections and internal cameras do allow us to show several different live views of the tests. The videos from the 'official' seven to nine cameras are later emailed to the audience after those files have been downloaded and converted."

Arispe continued, "And most important, the videos would not show the whole picture." A crash test is not composed of just videos. Crash tests also rely on sensor equipment and heavy data analysis to help researchers find the reasons for the problem. In combination with the video, pre- and post-vehicle measurements, the sensor data will be compiled and studied to build a three-dimensional (3D) model. The 3D model will be put through a variety of scenarios.

Finally, the scenarios will be analyzed to find a solution. Even though FHWA is testing various equipment to bring a live video stream to the Internet, the video is only part of the crash test. In the words of famous radio personality Paul Harvey, and then there is "the rest of the story."

For more information, contact Eduardo Arispe at eduardo.arispe@dot.gov or 202-493-3291.

Evaluation of Aesthetically Treated Crosswalks

FHWA has received many requests to install colored aesthetic treatments within crosswalks. However, when changing recognizable transportation devices such as crosswalks, many questions would need to be answered to ensure the safety of the traveling public. Would different colors be distracting for drivers? Would the colors be recognized as a crosswalk by pedestrians and drivers? Would the colors be as effective as white pedestrian crosswalk markings when seen from a distance? These types of questions and many others would need answers before implementing changes that might affect safety.

The FHWA Office of Operations, Manual on Uniform Traffic Control Devices (MUTCD) Team and the FHWA Office of Safety and Operations Research and Development are collaborating on the research study Evaluation of Aesthetically Treated Crosswalks. The study focuses on a rainbow color pattern since there is significant interest in its use with crosswalks.

Through closed-course studies, this project will evaluate the impact that aesthetic treatments have on motorists' and pedestrians' recognition and behavior at crosswalks, including pedestrians with low vision. The study will also attempt to determine what conditions or aspects of the aesthetically treated crosswalks impact road user recognition and behavior.

Road users include drivers and pedestrians (with normal and low vision). The project began on June 1, 2020 and is scheduled for completion by May 31, 2022.

The results of the study will identify not only the impact of aesthetically treated crosswalks on road user's recognition and behavior, but also what conditions or aspects of the aesthetically treated crosswalks have the most impact. This will allow the FHWA to identify the crosswalk designs that do not impact recognition and behavior, if any

exist. These results will also inform FHWA's future decisions on aesthetically treated crosswalks.

For more information, contact Ann Do at ann.do@dot.gov.

FHWA's Office of Research, Development, and Technology Releases Interactive Highway Safety Design Model (IHSDM) 2020 Public Release (version 16.0.0)

IHSDM is now available for free download at www.ihsdm.org. FHWA also held a webinar on October 28, 2020, to introduce the new release: "IHSDM 2020 – New Enhancements Support Data-Driven Safety Analysis." IHSDM supports FHWA's Data-Driven Safety Analysis (DDSA) initiative, and is a suite of safety analysis tools to evaluate the safety and operational effects of project-level geometric design decisions on highways.

For more information, contact Clayton Chen at Clayton.Chen@dot.gov or 202-493-3054.