Description

The U.S. Department of Transportation (U.S. DOT) Small Business Innovation Research (SBIR) Program invites small business concerns to review this pre-solicitation notice for opportunities within its Fiscal Year 2021 (FY21) SBIR Phase I solicitation.

THIS IS A PRE-SOLICITATION NOTICE; NO SUBMISSIONS ARE ACCEPTED AT THIS TIME.

The pre-solicitation period for U.S. DOT's FY21 solicitation is from January 5, 2021 through February 2, 2021 at 5:00 pm Eastern Time (ET). Full descriptions of U.S. DOT's proposed FY21 Phase I solicitation research topics can be found in **Appendix A: U.S. DOT SBIR Proposed FY21 Phase I Research Topics**.

During the pre-solicitation period, small businesses must post any technical questions concerning the proposed research topics to the SBIR Pre-solicitation Q&A Forum at https://usdot.uservoice.com/forums/932932 (see instructions below). Questions shall be limited to specific information related to improving the understanding of a particular topic's requirements. Please note that all posted questions will be publicly available. Do not share solution ideas or proprietary information. Only clarifying questions should be submitted. Telephone inquiries or meeting requests will not be accepted nor responded to.

Potential offerors should not seek advice or guidance on their solution to any given topic nor submit any materials other than questions(s) regarding the topic. The U.S. DOT shall not respond to requests for advice or guidance on any offeror's solution to any SBIR topic, and shall not consider any submitted materials other than questions. Potential offerors shall not include in the question(s) any information that they do not wish to be made public. All questions and corresponding answers will be available to the public.

Technical questions regarding the research topics will be accepted only during the pre-solicitation period (January 5, 2021 through February 2, 2021). Technical questions will not be accepted after 5:00 pm ET on February 2, 2021. Only questions received by posting to the forum as cited above prior to the deadline will be answered by the U.S. DOT research topic authors. Answers to all questions from the pre-solicitation period will remain available on the forum when the U.S. DOT FY21 SBIR Phase I solicitation is released on or about February 4, 2021.

How to Use the SBIR Pre-solicitation Q&A Forum (https://usdot.uservoice.com/forums/932932):

1. **Register (optional):** Anyone can view questions and answers without an account, but registration is recommended if you wish to post a question and receive a notification when it is responded to.
2. **Search**: Browse the existing questions to see if your question has already been addressed. If you see a question you are also interested in, you can add a vote to the question, or leave a comment.
3. **Post**: If your question has not already been posted, use the "Enter your idea" box at the top of the page to enter your question.
    a. Select the research topic your question is related to from the drop-down menu that appears when you begin typing.
    b. You may add more detail in the Description box (optional). Do NOT attach any files. The U.S. DOT shall not consider any submitted materials other than questions.
    c. Enter your email address (optional).

d. When finished, select "Post idea." If you registered, you will be able to track responses to your post.

The U.S. DOT anticipates release of its FY21 Phase I solicitation on or about February 4, 2021. An informational webinar about the solicitation and new program changes is tentatively scheduled for February 11, 2020 at 1:00 pm ET. More information on how to register for this webinar will be available on the U.S. DOT SBIR website and in the solicitation when it is issued.

Upon solicitation release, only small businesses as defined in the Small Business Administration (SBA) SBIR Policy Directive, are eligible to submit offers to the U.S. DOT SBIR FY21 Phase I solicitation. Additionally, all small business offerors must be registered in the following databases: SBA's Company Registry Database (https://www.sbir.gov/registration) and the System for Award Management (SAM) (https://sam.gov/SAM/).

The proposed FY21 research topics are listed below.

Full descriptions of each research topic are included in Appendix A, which is attached to this notice.

Federal Highway Administration (FHWA)

- 21-FH1: Device for Assessing Environmental Impact of Post-Consumer Waste Plastic in Highway and Airfield Materials and Pavements
- 21-FH2: In-situ Determination of Pore Solution Resistivity
- 21-FH3: Accelerating Performance Testing Using the Asphalt Mixture Performance Tester (AMPT) Equipment
- 21-FH4: Reference Hardware for Infrastructure GPS Abnormality Detector for Connected and Automated Vehicle Applications

Federal Motor Carrier Safety Administration (FMCSA)

- 21-FM1: Automated Vehicles: Deployment of Traffic Warning Devices (Triangles)
- 21-FM2: Readiness Assessment Technology

Federal Railroad Administration (FRA)

- 21-FR1: Passenger Train Exterior Side Door Safety
- 21-FR2: Wheel Measuring Device

Federal Transit Administration (FTA)

- 21-FT1: Robots for Unmanned Disinfection and Decontamination of Transit Assets
- 21-FT2: Using Artificial Intelligence (AI) to Inspect, Repair and Sanitize Transit Vehicles

National Highway Traffic Safety Administration (NHTSA)

- 21-NH1: Securing Safe Passage when Crossing a Roadway to Board Buses
- 21-NH2: Ignition Interlock Device Data-Integrated Mobile Device App

Pipeline and Hazardous Materials Safety Administration (PHMSA)

- 21-PH1: Lithium Ion Battery Packaging

Appendix A: U.S. DOT SBIR Proposed FY21 Phase I Research Topics

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About this Document

Below is a list of the U.S. DOT's proposed research topics for the Fiscal Year 2021 Phase I Solicitation. Information on each operating administration participating in this year's solicitation is provided as an introduction to the topics proposed during the pre-solicitation period.

Federal Highway Administration (FHWA)

About Us: FHWA's Research, Technology, and Evaluation Program strives to generate new solutions, build more effective partnerships, and provide better information and tools for decision making, which will enable the Nation to enhance and make the best investments in the U.S. transportation system.

21-FH1: Device for Assessing Environmental Impact of Post-Consumer Waste Plastic in Highway and Airfield Materials and Pavements

The National Asphalt Pavement Association estimates about 82.2 million tons of reclaimed asphalt pavement (RAP) was used in 2018 paving operations (National Asphalt Pavement Association, 2019). A 2014 estimate of recycled concrete aggregate from the Construction and Demolition Recycling Association suggests around 140 million tons per year (Snyder et al., 2018). As interest in using post-consumer waste plastic in pavement materials grows, a critical question to answer remains: can we recycle a plastic-modified mixture and reincorporate into a future pavement section?

A recycled/reclaimed pavement material mixture is generally (but not always) considered to be resource-conscious, whether it be through retained natural resources, lower CO_2 emissions, or reduced landfilling. For plastic-modified mixtures, a critical issue surrounding recyclability, and use in general, circles around environmental safety. Microplastics represent one element in the environmental safety evaluation. According to the National Oceanic and Atmospheric Administration, microplastics are any type of small plastic less than five millimeters in length. There are concerns over the ability of microplastics to be inhaled by construction workers or to absorb other hazardous chemicals and make their way into the water sources. Methods have been developed to characterize or detect the presence of microplastics in oceans and are described in the literature (Prata et al., 2019).

The research challenge to be addressed through this project is to develop a device to assess environmental impacts of pavements with post-consumer waste plastics or other polymer-based additives that present an environmental concern for inclusion in highway and airfield paving materials. The specific solution being sought would provide a sensor or product that could be used to assess leaching of plastics during operation or potential airborne microplastics that could be released during construction or rehabilitation of pavements incorporating post-consumer waste plastics. The specific solution shall be able to accurately measure microplastic contents of a range of particle sizes that could leach from the pavement surface, with consideration of potential contaminants presence on the pavement (e.g., deicing salts, dirt). A successful outcome will contribute to achievement of the DOT and FHWA Innovation and Infrastructure goals by providing an innovative and sustainable alternative to conventional asphalt and concrete paving materials used in highway and airfield construction and rehabilitation. Additionally within the pavement community, the desire to include recycled pavement materials into future sections is very high.

The use of post-consumer waste content through incorporation in paving materials represents an innovative approach to cut down on the incineration and landfilling of plastics. This solution will provide a tool or device to ensure that the construction, operation, rehabilitation, and end-of-life

of pavements incorporating post-consumer waste plastics do not place undue burden on the environment. This project will support the key activity outlined by FHWA's Annual Modal Research Plan (AMRP)[1] of assessing the durability of recycled materials and industrial byproducts for use in pavements. The project will support FAA's evaluation of "green technologies" for use in airfield pavements by providing a tool to ensure minimal environmental impact of waste stream plastics.

The opportunity for commercialization in the U.S. is very high. A large portion of post-consumer waste plastic ends up in waste disposal streams, and many groups have been investigating ways to use this waste stream as an ingredient in pavement materials. This has the potential to create a whole new market. The owners in this new market would be infrastructure owners that often have a desire to minimize the environmental impact of construction, operation, and rehabilitation of their systems. This proposed solution would give them a tool to address microplastics, an item of growing concern as this market expands, and explain environmental impacts of the project to the local community.

Expected Phase I Outcomes

Through the Phase I proof of concept reports, this phase will seek to demonstrate with high confidence that the technique and framework for an assessment tool will result in satisfaction of the performance requirements described above. The Phase I final report shall summarize a novel use for a device to measure and detect leaching or airborne microplastic generation in pavement materials, investigate the market availability of raw materials and any necessary processing equipment, discuss any economic or environmental concerns, present critical opportunities and obstacles to implementation, and provide a tentative plan for verification and demonstration to be conducted in Phase II.

Expected Phase II Outcomes and Deliverables

Phase II shall scale the concept detailed in Phase I to small-scale production for evaluation on test specimens. Phase II shall demonstrate the sensor or tool to assess the microplastics content over time so that the aging implications of microplastic development are better understood. This demonstration shall be documented in a format that can be peer-reviewed by the pavement materials research community to establish accuracy targets or thresholds. The Phase II plan should detail how the device cost can be reduced for manufacturing purposes and how the testing time can become more efficient by using the device.

[1] https://www.transportation.gov/administrations/assistant-secretary-research-and-technology/federal-highway-administration-2020

21-FH2: In-situ Determination of Pore Solution Resistivity

Rapid evaluation of the durability of concrete materials used in transportation infrastructure has recently focused on electrical-based measurements, specifically resistivity and formation factor. While measurements (resistivity) can be conducted very quickly (on the order of minutes) to properly assess the microstructure of the material and link to a quantifiable parameter (formation factor), information about the electrical properties of the pore solution is a key link between the measurements and ability to understand the quality of a concrete's microstructure.

The Performance Engineered Mixtures (PEM) initiative has implemented transport properties and formation factor concepts, and the key document in this initiative (a guide specification termed AASHTO PP84-20, more information available at https://www.fhwa.dot.gov/pavement/materials/hif20005.pdf and https://cptechcenter.org/performance-engineered-mixtures-pem/) has identified three methodologies to determine the electrical properties of the pore solution. The most accurate methodology is measurement of the pore solution properties. Currently, this is accomplished through invasive and destructive techniques that require specialized equipment and skills that many state highway agency (SHA) laboratories may not be able or willing to perform. Furthermore, this existing procedure is time intensive, can only yield results from early ages, and is susceptible to changes due to environmental conditions (e.g., carbonation of the pore solution). These challenges have hampered the adoption of this assessment technique, and forced users to the technique that approximates the pore solution properties.

An alternative option would make use of sensors or a sensor system physically embedded in the concrete (laboratory cylinder specimens or field pours) that would determine the electrical properties of the pore solution (an approach shown in literature suggests this to be possible and practical[2, 3]). The solution being sought would provide a simple tool that would enable SHAs using formation factor-based durability performance evaluation of their concrete mixtures to reduce the subjectivity, the number of assumptions, and the complexity of physical tests that are made in the evaluation of mixture durability.

The proposed solution supports FHWA's AMRP[4] by developing and enhancing tests and processes related to the PEM initiative for concrete pavements. Specifically, this topic seeks to evaluate the durability of concrete materials. It will also contribute to the Department's strategic objective of improving the performance of the Nation's infrastructure. This can be achieved through research and accelerating development and deployment of innovative technologies and practices by the continued refinement of techniques of accurately assessing the durability of concrete pavements and structures.

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[2] Rajabipour, Farshad, Gaurav Sant, and W. Jason Weiss. 2007. "Development of Electrical Conductivity-Based Sensors for Health Monitoring of Concrete Materials Development of Electrical Conductivity-Based Sensors for Health Monitoring of Concrete Materials." In *Proceedings of the Transportation Research Board*, 1–16. Washington, DC. http://docs.trb.org/prp/07-1765.pdf.

[3] Rajabipour, Farshad. 2006. "In situ Electrical Sensing and Material Health Monitoring in Concrete Structures." PhD: Purdue University: West Lafayette, Indiana.

[4] https://www.transportation.gov/administrations/assistant-secretary-research-and-technology/federal-highway-administration-2020

The opportunity for commercialization in the U.S. is high. There are many agencies that are transitioning to electrical property evaluation of their concrete mixtures, and this solution would be a simple way to implement the evaluation and correlate measurements with durability performance. In the future, an effective solution could make its way into other markets such as bridge construction or commercial construction where the concrete would be in an exposure category that would require assessment of its durability properties.

Overall, this SBIR topic seeks to create a sensor, an array of sensors, or a sensor system that could be embedded into a concrete element and be able to able to determine the concrete's pore solution electrical properties. The solution should include either 1) a consumer level mobile measuring device, or 2) the ability to be measured using low-cost (less than approximately $10k) commercially available mobile equipment. If needed, the post-processing of the data to convert measurements to the electrical properties should be limited to that which could be implemented in a spreadsheet or be conducted by a workforce with skills similar to that of an American Concrete Institute (ACI) certified field technician. The solution should be able to determine the electrical properties of a known reference solution within 5% or less, and shall be able to determine the electrical properties of the pore solution in a partially saturated concrete within 15% compared to the pore solution when expressed from companion test specimens. Specific stakeholders that could be involved in the evaluation and testing phase include the FHWA Office of Infrastructure R&D, one or more progressive SHA, and academic institutions that are interested in implementing this technology.

Expected Phase I Outcomes

The Phase I project is expected to result in a proof-of-concept report that describes the evaluation of materials proposed for the sensor, the market availability and costs of those materials, the proposed prototype(s), including information on measurement techniques and procedures. The report should include an estimated timeline for the prototype(s) production, evaluation, and accuracy verification. The Phase I report should discuss critical opportunities and obstacles to implementation, and a tentative plan for verification and demonstration to be conducted in Phase II.

Expected Phase II Outcomes and Deliverables

Phase II will include the development and demonstration of a market-ready prototype for user testing and possible commercialization. Phase II shall perform further refinement of the concept, design, and fabrication of the prototype(s); and conduct analytical and experimental verification. The experimental verification will include verification with a wide range of equipment (e.g., scientific equipment and low-cost alternatives that an owner agency might purchase for field use) to increase the likelihood of effective implementation. Another final outcome is the delivery of some number of final prototype sensors to FHWA for evaluation on shadow projects with owner agencies. Actual number may be determined or negotiated as part of Phase II process.

21-FH3: Accelerating Performance Testing Using the Asphalt Mixture Performance Tester (AMPT) Equipment

The asphalt pavements community is moving rapidly towards mixture design and construction acceptance specifications which use laboratory performance tests to measure various properties that relate to field performance. The Asphalt Mixture Performance Tester (AMPT) equipment previously developed for pavement structural analysis is performance test equipment now capable of analyzing materials during mix design. The current laboratory performance tests are well-suited for mixture design verification applications, where testing time is manageable because asphalt construction has not started. However, further implementation can be experienced if the tests can expedite the performance testing and Balanced Mixture Design (BMD) concepts.

FHWA is soliciting proposals to develop methods of rapidly securing test specimens without epoxy (or other glue) and with contactless deformation measuring sensors for use in performance tests, such as the AMPT Cyclic Fatigue Test (standardized as AASHTO TP 107 & TP 133) for both full-size (100 mm diameter x 130 mm height) and small-size (38 mm diameter x 110 mm height) test specimens and the Texas Overlay Test (standardized as Texas DOT Tex-248-F). This could be accomplished by developing; 1) a standalone rugged and repeatedly used field test equipment based on AMPT requirements or; 2) developing reasonably priced fixtures and measurement technologies, or other innovative methods, for the existing AMPT equipment to help accelerate methods which require epoxy (or other glue) and mounted deformation measurement systems. These advancements are needed to minimize specimen preparation and instrumentation time, such as attaching end plates and re-equilibrating temperature due to attachment of deformation sensors. Proposers may also include other innovations to accelerate testing time. An expedited test specimen preparation and instrumentation procedure will be useful to measure performance-related properties to assess impacts of volumetric variability, assess mixture quality, and long-term performance. Successful development of these technologies could apply to a wide range of performance tests used for research and mix design applications.

The proposal would support FHWA's AMRP[5] by developing and enhancing tests and processes related to performance and innovation initiatives for asphalt pavements. This project will also contribute to the Department's strategic objective of improving the performance of the Nation's infrastructure through research and accelerating development and deployment of innovative technologies and practices by the continued refinement of techniques to accurately assess the performance of asphalt pavements.

The opportunity for commercialization in the U.S. is high. There are many agencies that started the transition to performance-driven testing and evaluation of their asphalt mixtures, and this solution would be a simple way to implement AASHTO standardized tests, cracking performance evaluations, and help improve long term pavement performance. In the future, an effective solution could make its way into other markets such as airfield/airport markets, ports or

[5] https://www.transportation.gov/administrations/assistant-secretary-research-and-technology/federal-highway-administration-2020

trucking distribution markets, other commercial construction markets, or international markets where asphalt pavement performance is deemed critical to project success, facility operations, and economic viability.

Specific stakeholders that could be involved in the evaluation and testing phase include the FHWA, one or more State Highway Agencies (SHA), and academic institutions that are interested in implementing this technology, testing, and evaluation.

For further information on past research related to this topic, please see the following technical resources:

- https://www.fhwa.dot.gov/pavement/asphalt/tester.cfm
- Cyclic Fatigue Index Parameter (Sapp) for Asphalt Performance Engineered Mixture Design, FHWA-HIF-091, 2019
- Equipment Specification for the Simple Performance Test System, Version 3.0, Prepared for National Cooperative Highway Research Program (NCHRP), October 16, 2007. Appendix E of NCHRP Report 629 (PDF, 6.20 MB) from Project 9-29 contains detailed equipment specifications for the AMPT. And improvements for tension testing capabilities.
- AASHTO R 83 Standard Practice for Preparation of Cylindrical Performance Test Specimens Using the Superpave Gyratory Compactor (SGC),
- AASHTO PP 99 Standard Practice for Preparation of Small Cylindrical Performance Test Specimens Using the Superpave Gyratory Compactor (SGC) or Field Cores; and improvements resulting from FHWA contract DTFH6117C00037
- AASHTO TP 107 Standard Method of Test for Determining the Damage Characteristic Curve and Failure Criterion Using the Asphalt Mixture Performance Tester (AMPT) Cyclic Fatigue Test; and improvements resulting from FHWA contract DTFH6117C00037
- AASHTO TP 133 Standard Method of Test for Determining the Damage Characteristic Curve and Failure Criterion Using Small Specimens in the Asphalt Mixture Performance Tester (AMPT) Cyclic Fatigue Test

Additionally, FHWA has published four videos on our YouTube channel (which include the fabrication and AASHTO test standards performance testing; Stress Sweep Rutting and Cyclic Fatigue).

The videos are based on AASHTO standards:

- PP 99 - Preparation of Small Cylindrical Performance Test Specimens Using the Superpave Gyratory Compactor (SGC) or Field Cores
- TP 132 - Determining the Dynamic Modulus for Asphalt Mixtures Using Small Specimens in the Asphalt Mixture Performance Tester (AMPT)
- TP 133 - Determining the Damage Characteristic Curve and Failure Criterion Using Small Specimens in the Asphalt Mixture Performance Tester (AMPT) Cyclic Fatigue Test

- TP 134 - Stress Sweep Rutting (SSR) Test Using Asphalt Mixture Performance Tester (AMPT)

Video 1: Fabrication of Small and Large Specimens
https://youtu.be/raDoPi1jcag

Video 2: Dynamic Modulus Small Specimen Test
https://youtu.be/ZlCHD3Mf1z4

Video 3: Cyclic Fatigue Small Scale Specimen Test
https://youtu.be/MKN1ihZkWr0

Video 4: Stress Sweep Rutting Test
https://youtu.be/bUChELQ28c0

Expected Phase I Outcomes

The Phase I project is expected to result in a proof-of-concept report that describes the development of the proposed solution; provides preliminary technical drawings, component parts, and proposed prototype(s); and discusses how to achieve the most effective implementation into standards and agency specifications. The report should include:

- An estimated timeline for the prototype(s) production, evaluation, and accuracy verification;
- A description of how test results using the proposed approach compare to current practice; and
- A tentative plan for verification and demonstration to be conducted in Phase II.

Phase I would include fixtures or other innovative methods to accelerate specimen preparation and instrumentation and/or a standalone device capable of executing test methods which currently use epoxy (or other glue) and mounted deformation measurement systems, conducting the tests, and recording deformations and responses. Part of demonstrating a successful proof-of-concept includes documenting how test results using the Phase I approach compare to current practice.

Expected Phase II Outcomes and Deliverables

Phase II will include the development and demonstration of a market-ready prototype for user testing and possible commercialization. Phase II shall perform further refinement of the concept, design, and fabrication of the prototype(s); and conduct analytical and experimental verification. Phase II efforts include fully developing and demonstrating a finalized fixture(s) and/or standalone device capable of executing test methods which currently use epoxy (or other glue) and mounted deformation measurement systems. This includes manufacturing, ruggedness and round-robin testing of the fixture(s) and standalone cyclic fatigue performance tester. Phase II will also seek at least 3 final prototypes, or as negotiated, to FHWA for evaluation on shadow projects with owner agencies.

21-FH4: Reference Hardware for Infrastructure GPS Abnormality Detector for Connected and Automated Vehicle Applications

As Connected and Automated Vehicle (CV/AV) technology continues to advance, there is a growing need to ensure accuracy in location, particularly when approaching intersections and other safety critical junctions. This is highly dependent on GPS accuracy. Any temporary issues or inaccuracies in the GPS can pose a huge safety risk. This project would develop the reference hardware for a low cost, receive only, GPS abnormality detector. This can be used to provide advanced warning of localized GPS issues to warn AVs in advance, or to provide a "no service" warning to CV drivers.

The hardware is intended for static installation and must be able to monitor and detect errors of high precision GPS signal using L5 or GNSS location data generated from a combination of multiple terrestrial and space based signals[6,7]. This hardware would also use other signals to validate GPS availability and could include other ground-based signals to validate GPS status. The intended buyer would likely be State and local DOTs, while the users will be those that implement CV and AV applications that need GPS information to function.

Expected Phase I Outcomes

The Phase I proof of concept report should:

- Provide hardware proof of concept for GPS abnormality detector.
- Establish operational and design targets that consider cost of deployment, lifecycle cost, and ease of use and integration.
- Develop a hardware development plan for continuous testing and design refinement to meet project targets established at beginning of Phase 1.

Expected Phase II Outcomes and Deliverables

Phase II outcomes typically include further demonstration or validation of design/concept and/or prototype development. Deliverables may include prototype iterations, software capabilities, or test results. Deliverables are typically documented in reports and not physically delivered to the Government.

[6] https://www.gps.gov/technical/icwg/ (Interface Control Documents). ICD for L5 includes IS-GPS-705 and others as appropriate.
[7] https://www.gps.gov/technical/ps/ (Performance Standards and Specifications). Most recent version is 5th edition published on April 2020

Federal Motor Carrier Safety Administration (FMCSA)

About us: The mission of FMCSA's Office of Analysis, Research, and Technology is to reduce the number and severity of commercial motor vehicle (CMV) crashes and enhance the efficiency of CMV operation by: 1) providing data, producing statistics, and conducting systematic studies directed toward fuller scientific discovery, knowledge, or understanding, and 2) identifying, testing, and supporting technology transfer activities and deployment of CMV safety technologies.

21-FM1: Automated Vehicles: Deployment of Traffic Warning Devices (Triangles)

A key strategic objective of the Federal Motor Carrier Safety Administration (FMCSA) is to prevent commercial motor vehicle (CMV) related fatalities and injuries. CMV safety is reflected in the current Federal regulation for drivers of commercial motor vehicles to place warning devices (reflective triangles, flares, other) around their vehicle in the event that the CMV is stopped upon the travel portion of the shoulder of a highway. The driver must place the warning devices as soon as possible, but in any event within 10 minutes. Title 49 USC 392.22(b)[8] calls for the driver of the CMV to place the warning devices in the following manner:

(i) One on the traffic side of and 4 paces (approximately 3 meters or 10 feet) from the stopped commercial motor vehicle in the direction of approaching traffic;
(ii) One at 40 paces (approximately 30 meters or 100 feet) from the stopped commercial motor vehicle in the center of the traffic lane or shoulder occupied by the commercial motor vehicle and in the direction of approaching traffic; and
(iii) One at 40 paces (approximately 30 meters or 100 feet) from the stopped commercial motor vehicle in the center of the traffic lane or shoulder occupied by the commercial motor vehicle and in the direction away from approaching traffic.

There are special rules regarding placement of warning devices if the vehicle is stopped within 500 feet of a curve, crest of a hill, or other obstruction, as well as special rules regarding placement on divided or one-way roads. Section 393.95(f)[9] defines warning devices for stopped vehicles as one of the following options: "(1) Three bidirectional emergency reflective triangles that conform to the requirements of Federal Motor Vehicle Safety Standard No. 125, §571.125 of this title; or (2) At least 6 fusees or 3 liquid-burning flares. The vehicle must have as many additional fusees or liquid-burning flares as are necessary to satisfy the requirements of §392.22. (3) Other warning devices may be used in addition to, but not in lieu of, the required warning devices, provided those warning devices do not decrease the effectiveness of the required warning devices."

FMCSA's Annual Modal Research Plan (AMRP)[10] highlights the need to evaluate the safety implications of automated and semi-automated vehicles prior to deployment of these technologies. During initial research into automated vehicle technologies, it has become apparent

[8] https://www.ecfr.gov/cgi-bin/text-idx?SID=6be86f66c4096ac034b4e1c9028c7585&mc=true&node=pt49.5.392&rgn=div5#se49.5.392_122
[9] https://www.ecfr.gov/cgi-bin/text-idx?SID=6511386912deb05af1f8ac8f6b8c119a&mc=true&node=pt49.5.393&rgn=div5#se49.5.393_195
[10] https://www.transportation.gov/sites/dot.gov/files/2020-11/FMCSA%20AMRP%20FY2020%20Enacted.pdf

that there is a need for innovative solutions as to how automated vehicles without a driver present would be able to comply with Title 49 USC 392.22(b).

This topic seeks to inform the feasibility of various methods for automatically deploying the required warning devices in the event that an automated CMV must stop upon the traveled portion or the shoulder of a highway for reasons other than necessary traffic stops. The solution should have the capability to reliably and accurately deploy traffic warning devices without requiring the presence of a human driver with the vehicle and must deploy the traffic warning devices in such a way as to comply with Title 49 USC 392. The system should be cost-effective and technology neutral towards the automated CMV it would be deployed on. Additionally, the solution should follow best practices in mitigating potential IT securities and vulnerabilities. The potential buyers of this system include drivers, owner-operators, and motor carriers. Potential buyers also include original equipment manufacturers (OEMs) of automated vehicles who may choose to include this technology with the vehicle. The end user would ultimately be a carrier or owner-operator of automated commercial vehicles where Title 49 USC 392.22(b) requirements will be encountered.

Expected Phase I Outcomes

The Phase I SBIR project outcome is a proof-of-concept report that describes the intended development of an automated deployment mechanism for traffic warning devices on commercial automated vehicles. The awardee should consider working with automated commercial vehicle developers to determine constraints and feasibility of the proposed approach. Additionally, the awardee shall also work closely with FMCSA staff to determine the feasibility of complying with current federal regulations regarding proper placement of traffic warning devices. The awardee shall produce a sample of the system to demonstrate the recommended approach, along with functional requirements regarding the sample's reliability, accuracy, expected cost, and considerations regarding cybersecurity or other potential IT vulnerabilities. . The report should also include potential benefits of the system and potential limitations to deployment of the system.

Expected Phase II Outcomes and Deliverables

The Phase II SBIR project will produce a prototype and test it in a limited operational setting. The system must be capable of reliably and accurately deploying and retracting traffic warning devices on an automated vehicle without the interaction of a human driver in various operational design domains (ODDs), including adverse weather or other unexpected situations when an automated vehicle may be required to cease operating. The system must be capable of determining the correct placement of the warning devices in order to comply with Section 392.22 of Title 49. The system must be secure from cybersecurity or other potential software attacks or IT vulnerabilities which could impact the effectiveness or safety of the system. The awardee is expected to have a commercialization plan developed for the technology solution, as well as a final report documenting the results of the test event(s) and any system limitations or known vulnerabilities.

21-FM2: Readiness Assessment Technology

NHTSA estimates that in 2017, 91,000 police-reported crashes involved drowsy drivers. These crashes led to an estimated 50,000 people injured and nearly 800 deaths. However, there is broad agreement across the traffic safety, sleep science, and public health communities that this is an underestimate of the impact of drowsy driving. (NHTSA Traffic Safety Facts, Drowsy Driving, October 2017[11]). Drowsy driving's impact is even more pronounced among commercial vehicle drivers. Commercial vehicle drivers face many challenges that can increase fatigue including increased driving hours per day, nighttime driving, and health-related issues such as untreated obstructive sleep apnea.

An objective quantifiable measure, which can serve as a Readiness Assessment Technology, is needed to assess a driver's alertness *before* driving a commercial motor vehicle (CMV). Such a measure could be used to identify and mitigate driver fatigue. This project directly supports the Federal Motor Carrier Safety Administration's (FMCSA) strategic objective to produce safer commercial drivers, carriers, and vehicles described in FMCSA's Annual Modal Research Plan (AMRP)[12]. Additionally, the Readiness Assessment Technology developed through this process could potentially be useful to other Department of Transportation agencies. The technology could be applied to other modes as well as non-commercial drivers to address operator alertness.

The success of the Readiness Assessment Technology will rely on the product's ability to produce reliable, accurate and timely results when measuring driver readiness. Production of the end product must also be technically feasible and cost effective to produce. Additionally, the technology must comply with important security requirements such as confidentiality, integrity, privacy and security. Once successfully developed, the Readiness Assessment Technology will be marketable to prospective buyers such as CMV drivers and carriers who are challenged by drowsy driving and are interested in increasing driver safety. Overall, the results of this project will have strong potential to contribute to the overall reduction of crashes due to commercial drivers' alertness, thus furthering the strategic objectives set out in the FMCSA's 2020 AMRP.

Expected Phase I Outcomes

At the end of Phase I, the awardee will have successfully completed a thorough investigation of the product requirements with input from potential end users of the system. The proof of concept report should describe how the product will be designed and how it will be used in an operational environment. The awardee will also describe the results of any market research for the potential commercialization of the product and identify potential customers. The proof of concept report should seek to describe how the product can be developed in an accurate, timely, and secure manner.

Expected Phase II Outcomes and Deliverables

Phase II efforts will develop and test the prototype to ensure reliability, accuracy, and timeliness of the product while use in operations. At the end of Phase II, the awardee will have developed a

[11] https://www.nhtsa.gov/risky-driving/drowsy-driving#:~:text=NHTSA%20estimates%20that%20in%202017,injured%20and%20nearly%20800%20deaths
[12] https://www.transportation.gov/sites/dot.gov/files/2020-11/FMCSA%20AMRP%20FY2020%20Enacted.pdf

system that can be tested in an operational environment with drivers and carriers. The awardee will recruit drivers and carriers for this testing phase. The intended goal is to begin commercialization of the product.

Federal Railroad Administration (FRA)

About Us: FRA's research, development, and technology (RD&T) mission is to ensure the safe, efficient, and reliable movement of people and goods by rail through basic and applied research, and development of innovations and solutions. Safety is U.S. DOT's primary strategic goal and thus, the principal driver of FRA's RD&T program. FRA's RD&T program also contributes to other U.S. DOT strategic goals because safety-focused projects typically yield solutions toward state of good repair, economic competitiveness, and environmental sustainability goals. The RD&T program also has an important role to play in workforce development.

FRA's RD&T program is founded on an understanding of safety risks in the industry. Hazard identification and risk analysis allows us to identify opportunities to reduce the likelihood of accidents and incidents, and to limit the consequences of hazardous events should they occur. Key strategies include stakeholder engagement and partnerships with other researchers such as the Association of American Railroads, prioritization of projects, and conducting research through cost-effective procurement.

21-FR1: Passenger Train Exterior Side Door Safety

The Federal Railroad Administration (FRA) is seeking a technological solution to improve passenger train exterior side door safety. The proposed research will improve passenger safety by developing technology that can determine whether the exterior doors of a passenger train are closed and communicate this information to the train operator. The system should be capable of performing the following:

- Detecting a door that is opened by 3/8"
- Classifying "gaps" of 3/8" as an open door
- Identifying open doors on both sliding and swinging exterior side doors.

One example of an approach to this problem (although not the only solution this topic is seeking) could include an appropriate camera mounted to the locomotive side view mirror which could monitor the status of manual or power doors to determine whether doors closed or were prevented from closing. The technological solution envisioned should be most applicable to passenger equipment not already equipped with advanced door safety systems (that is, railroads that operate older (legacy) equipment that does not employ a door safety system). Additionally, the research should include an assessment to determine the extent to which this technology can be applied to other transportation modes.

Interested proposers are invited to familiarize themselves with following reference documents on passenger train exterior side door safety for more information:

- FRA Final Rule on Passenger Train Exterior Side Door Safety: https://www.federalregister.gov/documents/2015/12/07/2015-30488/passenger-train-exterior-side-door-safety
- Federal regulation §238.131 - Exterior side door safety systems—new passenger cars and locomotives used in passenger service: https://www.ecfr.gov/cgi-bin/text-idx?SID=38f57bf84ee49d55bd6d556cea7dc8a0&mc=true&node=pt49.4.238&rgn=div5#se49.4.238_1131

- APTA standard PR–M–S–18–10, Standard for Powered Exterior Side Door System Design for New Passenger Cars: https://www.apta.com/wp-content/uploads/Standards_Documents/APTA-PR-M-S-018-10.pdf

Expected Phase I Outcomes

Through the Phase I proof-of-concept report, Phase I will seek to demonstrate how the features of the proposed advanced door safety system will be addressed in the prototype. The proposed technology and means of application will be determined, developed and demonstrated using a mock-up passenger car doorway consisting of both sliding and swing-type exterior side doors. The prototype system will be assessed in terms of door-open detection accuracy. For the purposes of this demonstration, FRA will assist successful proposers by identifying a passenger railroad operator(s) with legacy rolling stock with door systems described above to permit familiarization with the car arrangement.

Expected Phase II Outcomes and Deliverables

Phase II outcomes will include the development of a market-ready prototype (developed during Phase I) suitable for successful demonstration of its capabilities on a representative passenger train (or trains) and possible commercialization.

The prototype technology and means of application will be demonstrated using a mock-up train consisting of four passenger cars whose doors will be randomly prevented from closing when so commanded. The prototype system will be assessed in terms of door-open detection accuracy. The mock-up train consists will be comprised of both sliding and swing-type exterior side doors. For the purposes of this demonstration, FRA will provide assistance by identifying a passenger railroad operator(s) with legacy rolling stock with door systems described above to permit familiarization with the car arrangement and to identify any existing physical constraints which might impede operation of the prototype.

The relationships developed during Phase I will be leveraged to facilitate these demonstrations. The research team will also develop a final report which will document all Phase II activities including the results of the demonstration test(s).

21-FR2: Wheel Measuring Device

Federal regulations and industry standards impose requirements on railroad wheel geometry to improve safety and avoid derailments. In order to ensure compliance with these requirements, railroads periodically take certain measurements to determine whether wheels and wheelsets remain fit for service. These measurements include:

- Wheel Diameter
- Wheel back-to-back spacing (the distance between the back-face of wheels on an axle)
- Wheel profile (the shape of the portion of the wheel that contacts the rail from back face to field side rim)
- Out of roundness (deviations from uniform wheel diameter)
- Length and width of wheel defects (e.g., flat spots)

Other attributes are derived from these measurements, such as wheel flange angle (see APTA PR-M-S-015-06, Rev. 1, Wheel Flange Angle for Passenger Equipment[13]).

Current manually operated devices used to measure wheel profiles have limited functionality with respect to the above list of measurements and can be subject to operator error. Improved techniques for measuring railroad wheel geometry will contribute to the overall improvement of railway safety.

FRA seeks development of a portable wheel geometry measuring device that can be used in the shop and the field by a single operator. The device should be able to capture the relevant measurements listed above, and should meet the following technical requirements:

- The device must be lightweight, handheld, fit in tight spaces, and easy to use by a single operator.
- Measurements are produced quickly (including taking and displaying measurements and set up and dismantling of the device), accurate to within 0.0005 inches, and repeatable to within 0.0001 inches.
- The device is able to operate in a wide range of temperatures and lighting conditions, while also being capable of functioning without external power for a minimum of two hours.
- Measurement data must be able to be identified and stored, and included software must allow for the export of data into American Standard Code for Information Interchange (ASCII) format.
- The device must be capable of performing calculations with the measurement data to derive non-measured features such as wheel flange angle, calculated in accordance with the APTA Standard referenced above.
- Production cost must be low and use off the shelf technology to the extent possible.

Expected Phase I Outcomes

This Phase I project will seek to produce a detailed proof-of-concept that demonstrates how the attributes listed above will be addressed in a prototype wheel-measuring device. The final Phase

[13] https://www.apta.com/wp-content/uploads/Standards_Documents/APTA-PR-M-S-015-06.pdf

I report will contain a description of the proof-of-concept, identify any impediments to actual prototype development and describe the potential commercialization path forward.

Expected Phase II Outcomes and Deliverables

Phase II outcomes will include the development of a near-market-ready prototype for user testing and possible commercialization. Partnerships with a railroad operator(s) during Phase II prototype development is strongly encouraged to help the research team better understand the needs of the end-users. In addition to delivering a near-market ready prototype, the research team will draft a comprehensive Phase II report that will capture the details of the design, development and testing of the prototype.

Federal Transit Administration (FTA)

About us: The Federal Transit Administration's (FTA) mission is to improve public transportation in America's communities. In support of this mission, FTA's research vision is to advance public transportation by accelerating innovation that improves mobility, enhances transit operations, and ensures safety for all. The goal of FTA's SBIR program is to help small businesses grow by funding product development research in strategic areas such as safety, infrastructure, mobility, and other topics important to transit. The program helps invest in promising early-stage innovations that may otherwise be too high of a risk for private investors.

21-FT1: Robots for Unmanned Disinfection and Decontamination of Transit Assets

The current COVID-19 pandemic has presented many challenges to the safety of transit riders and operators. Along with social distancing and wearing mask, a need for safe and efficient methods and processes for disinfection and decontaminant of transit assets including buses, trains and transit facilities has emerged. Autonomous robots and unmanned systems have been used for a variety of emergency response operations in other industries in recent times. These robots have the potential to find use in the transit industry to reduce risk of exposure to transit riders and operators and is especially relevant in the context of the COVID-19 pandemic.

The proposed research explores the use of robots for disinfection and decontamination of transit assets including buses, trains, transit facilities, etc.

The main objectives of this research in Phase I is to conduct a feasibility-study of the potential solutions to develop, prototype and test robot(s) to disinfect and decontaminate transit assets including assessing the use of spray or light technologies in such applications and methods.

Phase II outcomes will include the development of a market-ready prototype that can be deployed in a variety of disinfection and decontamination operations and are capable of working autonomously and collaboratively.

This proposed project aligns with the DOT Innovation strategic goal: "Lead in the Development and Deployment of Innovative Practices and Technologies that Improve the Safety and Performance of the Nation's Transportation System".

Expected Phase I Outcomes

Outcomes expected from Phase I include development of a concept of operations and a set of detailed requirements for a fully autonomous robot(s) that performs disinfection and decontamination operations in automatic mode while monitoring the level of the sprayed/light solutions, coverage area, and battery charge including return to station for refills or battery recharge. The awardee is expected to work with a transit agency to refine a concept of operations and a set of detailed requirements, develop use case and scenarios, and create performance criteria.

Expected Phase II Outcomes and Deliverables

Phase II funding will be directed towards the build of the application, user testing, and submittal for approval in the stores available for iPhone, Android, and Blackberry platforms. Phase II

outcomes will include the development of a proof of concept leading to market-ready prototype for testing that:

- Is convenient and efficient for scheduling disinfection tasks, monitoring the progress of disinfection, and planning/mapping a set of application/maintenance over a period of time);
- Can operate independently or in a team based on an assigned map and tasks for small or large operations;
- Can be demonstrated at a transit agency; and
- Can collect the necessary data to validate the technology based on the performance criteria set under Phase I.

21-FT2: Using Artificial Intelligence (AI) to Inspect, Repair and Sanitize Transit Vehicles

The preferred method of keeping transit vehicles in working order has been schedule-based. In many cases, transit vehicle maintenance (bus and rail) are performed at regular schedule intervals based on unit mileage. Meanwhile, there has been an incredible amount of new sensor technologies, artificial intelligence (AI), and machine learning innovations in the last 10 years. With these combined, many industries have been moving toward condition-based maintenance by leveraging new sensors, machine learning algorithms, and AI to analyze the data stream.

The inspection, repair and sanitation of a transit agency's vehicle fleet could use these innovations to improve the efficiency and effectiveness of their operations, especially as proper fleet cleaning and sanitation becomes even more critical due to the COVID-19 pandemic.

The successful offeror should provide a detailed description of the following:

- Technology proposed;
- How the technology will be applied;
- What type of issue(s) the technology is trying to solve (inspection, repair or sanitation);
- What data can be supplied to provide a level of confidence that this approach will work;
- Feasibility of the technology; and
- An approach in solving the problem or improving the maintenance of transit vehicles.

Expected Phase I Outcomes

The proof-of-concept report should describe how the prototype would be designed and evaluated to determine its effectiveness in improving in improving transit vehicle inspection, maintenance or cleaning and sanitation of transit vehicles. It is expected that the awardee will work with a transit agency to refine the proof-of-concept.

Expected Phase II Outcomes and Deliverables

Phase II is focused on the development of a market-ready prototype for testing at a transit agency, with the collection of all necessary data to validate the technology based on the performance criteria set under Phase I.

National Highway Traffic Safety Administration (NHTSA)

About Us: NHTSA research efforts are primarily comprised of programs within the Office of Vehicle Safety Research and Office of Behavioral Research and support U.S. DOT's and NHTSA's safety goals by conducting research and safety testing of motor vehicles and motor vehicle equipment as well as research supporting behavioral countermeasures to reduce the occurrence of traffic crashes.

The Office of Vehicle Safety Research (VSR) performs testing and research related to vehicle electronics and emerging technologies, advanced driver assistance systems for crash avoidance, human factors, and crashworthiness/human injury research. Research efforts include technologies that aim to address common crash problems on U.S. roadways as well as research addressing unsafe driver behavior including distracted and impaired driving. In addition, VSR conducts testing and research on the reliability of complex safety-critical electronic control systems, vehicle cybersecurity, and develops new test tools and countermeasures to improve vehicle crashworthiness. The Office of Behavioral Safety Research directly supports the Department and Agency goals of reducing traffic crashes, fatalities, and injuries by providing the scientific basis for the development of effective behavioral countermeasures to reduce the occurrence of traffic crashes. The Office focuses on unsafe driving behaviors that contribute significantly to death and injury from crashes on the Nation's highways, evaluates the relative effectiveness of programs to reduce highway fatalities and injuries, and assesses existing and emerging highway safety problems.

21-NH1: Securing Safe Passage when Crossing a Roadway to Board Buses

One of the greatest threats to school children arriving safely to school or home is not riding a bus, but boarding or disembarking a bus safely. There is an alarming amount of stop-arm violations where a vehicle illegally passes a school bus with their stop arm engaged. On a single day in 2019, 130,963 school bus drivers reported that 95,319 vehicles passed their busses illegally (National Association of State Directors of Pupil Transportation Services, 2019). The number of violations is likely far greater, since not all school bus drivers participated in this voluntary survey. These numbers indicate that more than 17 million stop-arm violations occur a year, putting children in significant danger every day. With the number of stop-arm violations increasing, and several recent fatalities, preventing deaths and injuries resulting from these violations has become a priority for NHTSA. After investigation of a recent fatal crash by the National Transportation Safety Board, they recommended a greater use of technologies to prevent these tragic events, including vehicle-to-everything (V2X) and school bus safety enhancements, since there will continue to be some routes where students must cross a roadway (NTSB, 2020). In addition, most of these fatalities have occurred while it was dark, in unlit areas suggesting that visibility is an issue.

We are seeking either vehicle-to-everything (V2X) technologies to alert oncoming vehicles of children in the roadway or school bus safety-enhancing technologies to illuminate children in the roadway, particularly when visibility is limited due to low light conditions. V2X is communication between a vehicle and any entity it may interact with, typically using cellular networks. In the case of V2X, the technology for this proposal must automatically alert oncoming drivers when children are in the roadway without input from the bus driver. Technologies based upon school bus safety enhancements to illuminate children need to be capable of being operated by school bus drivers and must meet the Federal Motor Vehicle Safety

Standards for school buses. Commercialization potential includes buyers like school districts, individual schools, and private transportation school contractors. Possible applications to other markets include other bus types such as city buses, tour buses, and others. As such, the technology may be of interest to the Federal Transit Administration and the Federal Motor Carrier Safety Administration.

Expected Phase I Outcomes

Phase I should result in a proof-of-concept report that describes the specific technological approach selected and include a testing plan to determine how well the device works in alerting oncoming drivers to a child in the roadway. At a minimum, the testing plan should evaluate the device's sensitivity, validity, and reliability. For V2X technologies, the testing plan must include determining how quickly a vehicle detects and alerts a driver to a child's presence and whether it does so in a consistent manner. For school bus safety-enhancing technologies, the testing plan must include determining the distance at which an oncoming driver can consistently see an ongoing crossing. The paper should also discuss the feasibility of use by school bus drivers and describe mounting to school buses if applicable.

Expected Phase II Outcomes and Deliverables

Conditional on the outcomes of Phase I, Phase II will produce a working prototype. This device will be tested using the testing plan developed in Phase I for determining how well the device works in alerting oncoming drivers to a child in the roadway. The working prototype will also be tested with school buses, including any required mounting or hardware. The device must be affordable for most school districts and, if applicable, feasible for a school bus driver to use with a reasonable amount of training. The expected outcome is a demonstration of the working prototype as well as a report that documents the testing results and contains a marketing plan.

References

National Association of State Directors of Pupil Transportation Services. 2019. *2019 Survey on Illegal Passing of School Buses –Summary Results.* https://nasdpts.org/resources/Documents/2019%20NASDPTS%20Illegal%20Passing%20Results%20Summary-7-24-19-v2-Updated%201-3-20%20to%20Include%20DC.pdf

National Transportation Safety Board (NTSB). 2020. *Vehicle Collision with Student Pedestrians Crossing High-Speed Roadway to Board School Bus, Rochester, Indiana, October 30, 2018.* Highway Accident Report NTSB/HAR-20/02. NTSB. https://www.doe.in.gov/sites/default/files/transportation/ntsb-full-final-report-rochester-fatalities-2018-april-2020.pdf

21-NH2: Ignition Interlock Device Data-Integrated Mobile Device App

Driving under the influence of alcohol is a serious problem, with alcohol-impaired drivers involved in 29% of all motor vehicle crash fatalities in 2017 (NHTSA, 2018)[14]. Recidivism is of particular concern, given that individuals with a history of alcohol-impaired driving violations are more likely than those without such a history to drive while intoxicated (DWI) in the future (Rauch et al., 2010) [15]. One effective sanction for reducing recidivism among DWI offenders is ignition interlock devices (IIDs)—devices installed in vehicles to prevent alcohol-impaired individuals from starting their vehicles. The effect of IIDs is further enhanced when offenders' IID performance is closely monitored and they are provided with frequent feedback. Unfortunately, this is often absent despite being a key factor in offenders' success on IIDs because of time-, cost-, or other logistical-constraints of the sanctioning agent/agency (Zador, Ahlin, Rauch, Howard & Duncan, 2011[16]).

To address this limitation, this SBIR project aims to provide a time- and cost-effective approach to close monitoring and frequent feedback by developing an IID data-integrated mobile device application (app) to be used in conjunction with IIDs. Mobile device apps have become a common, easily-accessible, and widely-used approach to help individuals monitor and change a range of health and safety behaviors (Burke et al., 2011[17]; Bricker et al., 2014[18]; Juarascio et al., 2015[19]; Hoeppner et al., 2017[20]). However, to date, no app has been designed specifically for IID-sanctioned DWI offenders, despite their high risk for recidivism and the availability of IID data offering critical insight into their drinking and driving patterns.

The goal of this IID data-integrated mobile device app is (1) to enhance the effectiveness of IIDs at reducing recidivism while the IID is on the vehicle and (2) to retain that benefit once the IID is removed from the vehicle. To achieve this, the app would need to be able to "communicate" seamlessly with IIDs to capture and monitor offenders' IID performance in real-time and analyze overall patterns. The app would then utilize a variety of evidence-based approaches to behavior modification, including: providing frequent, immediate, detailed and tailored feedback; highlighting desirable/undesirable behavior; identifying and increasing users' awareness of their patterns of behavior, particularly their high-risk days/times and; preemptively offering reminders and alternatives prior to high-risk days/times. In addition, this approach will also address logistical and financial barriers to close monitoring and frequent feedback (e.g., time- and cost-constraints) by shifting the burden of this enhanced level of monitoring and feedback away from the sanctioning agents/agencies.

This innovative approach to providing evidenced-based close monitoring and frequent feedback of DWI offenders' IID performance fits in with NHTSA modal priorities on impaired driving. Further, it would benefit all DOT modes involved with, or concerned about, surface

[14] https://crashstats.nhtsa.dot.gov/#!/
[15] https://ajph.aphapublications.org/doi/pdfplus/10.2105/AJPH.2008.154575
[16] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3153731/
[17] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3268700/?referringRepId=225798
[18] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4201179/
[19] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4847127/
[20] https://www.sciencedirect.com/science/article/abs/pii/S0740547217301691

transportation safety, including the National Highway Traffic Safety Administration (NHTSA), Federal Motor Carrier Safety Administration (FMSCA), and Federal Highway Administration (FHWA). In addition, other interested agencies/entities may include the Association of Ignition Interlock Program Administrators (AIIPA), State Highway Safety Offices (SHSOs), State and local law enforcement agencies, and technology companies whose mobile operating systems would potentially be compatible with this new app.

Expected Phase I Outcomes

A Phase I outcome would be a proof-of-concept report that describes the proposed prototype, including:

1. How it will enhance IIDs by providing closer monitoring and feedback to IID users about their IID performance in real-time;
2. How it will incorporate evidence-based interactive and personalized/tailored features to support short- and long-term behavior change;
3. Document approaches and provide recommendations regarding IID/app interoperability; and
4. Document any potential challenges and mitigation strategies regarding users/stakeholders, including: IID users (e.g., acceptance, use of app, data privacy concerns), legal issues, IID sanctioning agents/agencies (e.g., parole officers, State Dept. of Motor Vehicles), and technology companies/operating system companies.

The report shall also outline a plan for the development and demonstration of the app, particularly the app's "communication" with the IID, and its interactive and personalized features. Further, a Phase I outcome would include a mock-up of the app.

Expected Phase II Outcomes and Deliverables

The Phase II outcome will include the development of a market-ready prototype for user testing and possible commercialization. The final product should be able to "communicate" with an IID by receiving and storing IID data in real-time; be personalized; be interactive and; incorporate evidence-based features that support short- and long-term behavior change (e.g., identify users' patterns, provide feedback about performance and patterns; provide tailored messages based on performance (congratulatory/praise, reminders, alternative options), utilize a motivational-interviewing tone and goal-setting approach).

Pipeline and Hazardous Materials Safety Administration (PHMSA)

About Us: The Pipeline and Hazardous Materials Safety Administration (PHMSA) operates in a dynamic and challenging environment where advances in technology, manufacturing, and energy production impact transportation safety. PHMSA's mission is to protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives.

PHMSA's Office of Hazardous Material Safety regulates the transportation of hazardous materials by air, rail, highway, and water. Over 1.3 million hazardous material products are transported daily over the various transportation modes. Because of the ubiquity of hazardous material movements, supporting the safe transport of these products will have a positive impact on safety and performance. The Office of Hazardous Material Safety seeks to improve the safety and reliability of hazardous material transportation through topic PH1.

21-PH1: Lithium Ion Battery Packaging

Lithium ion battery (LiB) failures pose potentially serious hazards for the transportation industry. As the volume of LiB powered devices increases, so too have the number of incidents. Thermal runaway events can produce significant smoke, fires and explosions. In 2010, a LiB fire in the cargo hold of a Boeing 747 operated by UPS crashed in Dubai 22 minutes after take-off. It is suspected that thermal runaway of LiBs in the cargo hold led to a fire that generated substantial smoke in the cockpit, causing the pilots to crash (UAE General Civil Aviation Authority Case Reference: 13/2010). The surface of LiB cells can approach 1000°C during thermal runaway, which is more than sufficient to ignite flammable packaging materials on contact and propagate thermal runaway amongst the other batteries in close proximity. Consequently, there is a need for improved LiB packaging that can prevent and mitigate LiB fires during transport.

For this topic, PHMSA is looking for the offeror to design a novel packaging design that can minimally contain but preferably extinguish thermal runaway in LiBs. PHMSA is seeking efficient and cost-effective extinguishing agent(s) and packaging design(s) for battery fires. PHMSA is interested in a packaging technique that is optimally designed for the physical size and electrical energy capacity of the battery to prevent its propagation among an array after a single battery proceeds into thermal runaway. The packaging solution shall prevent and mitigate thermal runaway. The hazard solution shall be for a specific LiB form-factor that must be delineated in the proposal.

The commercialization potential of this proposal is high. Hundreds of millions of LiBs are manufactured and shipped every year. Potential customers for this new packaging/mitigation technology include the shipping and battery industry, amongst others. This topic will benefit all modes of transportation, particularly the air and highway modes.

Expected Phase I Outcomes

The Phase I project is expected to result in a proof-of concept report that describes the proposed prototype that will be developed in Phase II. Desired deliverables for this technology would include research to demonstrate technical feasibility during Phase I and show a path toward Phase II full prototype development.

Expected Phase II Outcomes and Deliverables

During Phase II, the offeror should proceed to full-scale development of a packaging design. The new packaging must be tested in-house or by a contract lab using industry accepted testing techniques. Deliverables should include a report on the final packaging design and the results of package testing.