U.S. DOT SBIR Pre-Solicitation Notice

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 2022 (FY22) 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 FY22 solicitation is from January 5, 2022, through February 2, 2022, at 5:00 p.m. Eastern Time (ET). Full descriptions of U.S. DOT's proposed FY22 Phase I solicitation research topics can be found in **Appendix A: U.S. DOT SBIR Proposed FY22 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/938697 (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 or responded to.

Potential offerors should not seek advice or guidance on its solution to any given topic nor submit any materials other than question(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, 2022, through February 2, 2022). Technical questions will not be accepted after 5:00 p.m. (ET) on February 2, 2022. 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 FY22 SBIR Phase I solicitation is released on or about February 7, 2022.

How to Use the SBIR Pre-solicitation Q&A Forum (https://usdot.uservoice.com/forums/938697):

Register: Anyone can view questions but registration is required if you wish to post a question and receive a notification when it is responded to.

1. To create a new account or to sign in with an existing account, please click on "sign in" located at the top-right of the page.
2. A new pop-up window will open to make a selection. You can use an existing Google or Facebook account to access the site or you may select to create a new account.
3. If you choose to access UserVoice with an existing Google or Facebook account, you will be required to enter your login credentials for Google or Facebook and agree to terms of service.
4. If you create a new account, click "Create an Account" underneath the password box.
5. In the next screen, type in the email and click "Verify Email."

6. Navigate to your inbox and click the link within the email to verify. The link will be generated by noreply@trymagic.com. That link will be live for 20 minutes. Once that time elapses, you will have to request another one.
7. Navigate back to UserVoice, and you will need to provide your name, a password, and agree to terms of service and storage permissions. Click "Create Account."

Search: Browse the existing questions by category to find the topic you are interested in and 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.

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.

1. Select the research topic your question is related to from the drop-down menu that appears when you begin typing.
2. 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.
3. When finished, select "Post idea." If you registered, you will be able to track responses to your post. Please include only one question or comment per post to help us keep the forum organized.

The U.S. DOT anticipates release of its FY22 Phase I solicitation on or about February 7, 2022. An informational webinar about the solicitation and any program changes is tentatively scheduled for February 10, 2022, at 1:00 p.m. (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 FY22 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 FY22 research topics are listed on the following page.

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

Federal Highway Administration (FHWA)

22-FH1: Enforcement of Bridge Load Posting Using Nondestructive Evaluation Techniques
22-FH2: AI Video Analysis of Dilemma Zone Conflicts at Signal-Controlled Intersections
22-FH3: Concrete Curing Quantification

Federal Railroad Administration (FRA)

22-FR1: Traction Motor Seizing Device
22-FR2: Locomotive-Mounted Track Safety Assurance System (LOSAS)

Federal Transit Administration (FTA)

22-FT1: Reduction of Transit Bus Collisions with Other Vehicles
22-FT2: Connecting Individuals in "Food Deserts" to Healthy Foods
22-FT3: Blockchain-Enabled Transit Incentivization
22-FT4: Tools and Applications Towards Moving to Zero-Emissions

Pipeline and Hazardous Materials Safety Administration (PHMSA)

22-PH1: Nondestructive, Streamlined Testing and Monitoring of Metal Cylinders and Tanks to Prevent Packaging Failure
22-PH2: Autonomous Vehicle Leak Detectors
22-PH3: Vibration Sensing System to Monitor for Potential Excavation Damage
22-PH4: Underground Natural Gas Storage (UNGS) Advanced Leak Identification and Well Control Solutions

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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.

22-FH1: Enforcement of Bridge Load Postings Using Nondestructive Evaluation Techniques

All bridges in the National Bridge Inventory[1] are required to have structural load ratings[2]. Those load ratings determine the safe load capacity of the bridge. Load ratings may indicate the need to load-restrict bridges if load ratings values are below the state-defined legal loads. In the worst cases, when overweight vehicles exceed posted load restrictions, they can cause damage to or failure of the bridge.

The lack of enforcement of these load restrictions is an issue nationwide. Most, if any, verification of actual truck weight is accomplished at fixed weigh stations. Unfortunately, bridges with load restrictions are not typically near these weigh stations.

Enforcement by the local and state law enforcement is usually very limited or non-existent because staffing and equipment are beyond the resources of the bridge owners, which may be local agencies, counties, cities, Tribal governments, states, or federal agencies.

A possible answer to this enforcement could be to install weigh-in-motion (WIM) or some other nondestructive evaluation (NDE) on the structure or in the pavement at each end of the bridge. These systems could be calibrated to be triggered to identify when the load restriction amount is exceeded. Photo enforcement or other types of enforcement could be used in conjunction with the WIM or other NDE.

Use of such a system will extend the life of the structure by reducing the number of overweight vehicles crossing it.

Expected Phase I Outcomes

Under this research, requirements should be developed for the hardware and software for a system to detect when a bridge's load restriction amount is exceeded. This system could use current WIM technology or other existing or new NDE methods. The system should be vandalism proof. A system should be developed to collect the truck weight data and truck

[1] https://www.fhwa.dot.gov/bridge/nbi.cfm

[2] https://www.ecfr.gov/current/title-23/chapter-I/subchapter-G/part-650/subpart-C/section-650.313#p-650.313(c)

identification information, translate the data to a usable format for non-professionals, and be able to transmit the information offsite. This information could be shared with enforcement agencies in a manner similar to red-light cameras, which record the information, or it could be transmitted directly to a transportation management center or a truck size and weight enforcement office to monitor.

Additionally, a prototype of a system should be developed. A final report shall be developed that outlines the potential technical opportunities, a review of similar technologies and applications, and a proposed plan to develop, test, and explore market opportunities for the proposed innovation.

Expected Phase II Outcomes and Deliverables

Further prototype development of a commercialized economical solution for states and local owners to procure, install, and implement, providing a much-needed level of safety. This prototype should be tested at remote bridge locations that currently have a load restriction to demonstrate its durability and functionality. An important criterion for the system should be that it is a low-cost solution that can be purchased and installed by any bridge owner, large or small.

22-FH2: Artificial Intelligence (AI) Video Analysis of Dilemma Zone Conflicts at Signal-Controlled Intersections

Edge computing is a resource-efficient platform that emphasizes processing data, making and executing decisions near the point (or edge) of data generation. It is well suited for time-critical and data-intensive tasks, such as processing videos from traffic surveillance cameras.

Vehicles caught in a dilemma zone—measured in traveling time/distance range to the intersection stop bar, within which about 90 percent of drivers will decide to brake whereas 10 percent of drivers will decide to accelerate at the time of phase change from green to yellow—may induce angle and rear-end crashes. Other imminent trajectory conflicts, due to sudden lane changing and unpredictable pedestrian/cyclist movements at the intersection, may also arise due to nature in traffic control or intersection geometry. Detecting such conflicts is the first step in devising countermeasures to mitigate their potential harm.

Artificial intelligence (AI)-based machine vision algorithms have become more powerful and easier to implement in analyzing real-time videos to identify objects of interest (vehicles, pedestrians, cyclists) and estimate their sizes and speeds. This project will leverage edge computing and AI in machine vision to address the critical needs of protecting road users from harmful traffic conflicts. It supports DOT's strategic goals of safety and innovation.

This project will develop an edge server-based AI application for analyzing videos from multiple cameras monitoring different approaches of intersection(s) to perform different analytics:

1. Analyze videos covering 200–600 ft. (or alternative practical distance ranges) upstream of the intersection to track vehicle behaviors such as lane changing and speeds, and determine the types (car or truck) and number of vehicles that would be caught in the dilemma zone at the time of upcoming phase change from green to yellow.
2. Analyze videos covering the intersection area to identify vehicles, pedestrians, and cyclists crossing the intersection and log different types of trajectory conflicts, including vehicle-to-vehicle (V2V), vehicle-to-pedestrian (V2P), vehicle-to-bicycle (V2B), and bicycle-to-pedestrian (B2P).

The above analyses may be performed by different software applications running in parallel on the edge server. Outputs from the analyses give insights of what detected conflicts may cause severe traffic crashes, and what changes in intersection signal operation or geometry may be warranted to defuse them.

If the prototype deems successful in logging and classifying dilemma-zone-related trajectory conflicts at less than 20 percent false positive rate, it can be implemented at any 5G Internet-ready signalized intersections with video surveillance. The target customers are state DOTs, counties, and cities that operate signal intersections. U.S. DOT can also be a potential buyer of this type of product.

Resources:

- 5G and edge computing, Verizon white paper: https://www.verizon.com/business/solutions/5g/edge-computing/5g-and-edge-computing/?gclsrc=aw.ds&&gclid=EAIaIQobChMIv4Sz1u2z7wIVi5-zCh2WPA2pEAAYAiAAEgKWUPD_BwE
- IBM solutions for 5G and edge computing: https://www.ibm.com/cloud/edge-computing
- Edge computing service expands with deployments in nine U.S. cities: https://www.traffictechnologytoday.com/news/cloud-computing/edge-computing-service-expands-with-deployments-in-nine-us-cities.html

Expected Phase I Outcomes

A proof-of-concept report with the following expected details:

- A conceptual design consisting of one edge server and two or more signal-controlled intersections connected to the edge server via (5G) high-speed Internet.
- The edge server can receive live updates of all signal timing decisions and live video streaming from all cameras installed at the intersections.
- Separate applications running on the edge server for analyzing videos covering upstream areas of the intersection(s) and videos covering the intersection(s).

- Include architecture design showing:
    - data generation points and data flow paths;
    - where video files are stored and processed; and
    - how analyses outputs are formatted, stored, and transferred as inputs to signal timing decision making.

Other outcomes: Identify potential collaborating agencies that are interested in testing and implementing this type of product; identify candidate intersections that have the required data generation and data communication capabilities.

Expected Phase II Outcomes and Deliverables

A prototype edge server with all developed software pre-installed. A setup module is provided to allow users to configure it to be connected to/de-coupled from any signalized intersections that meet the data generation/communication requirements. The applications on the edge server are scalable and can monitor/process videos from up to 10 or more signalized intersections. Ideally, communication between signal intersection(s) and edge server is via 5G wireless Internet, and the edge servers are nodes on wired (fiber/cable) high-speed Internet.

The analysis outputs are archived and easily retrievable by users for identifying time-of-day (and other) patterns of different types of conflicts detected.

The software has features for de-identified data collection at intersections to observe movements, and the capability of shared learning between applications that process videos from different approaches or different intersections.

22-FH3: Concrete Curing Quantification

This topic seeks to evaluate the quality of concrete curing operations to maximize the performance of concrete infrastructure. State highway agencies have identified the need to ensure the quality of curing of concrete infrastructure being constructed in their programs. Good curing practices lead to fewer issues related to volume instability, cracking, and surface defects. To date, many agency specifications related to curing are prescriptive, and FHWA has observed that these prescriptive type specifications are not sufficient in cases with extreme conditions (e.g., dry conditions, high wind speeds). The challenge of applying prescriptive specifications to extreme conditions can be especially relevant in the applications that state transportation agencies typically construct, such as bridge decks and pavements.

The solution to this challenge could be a device that determines how much curing operations have prevented the loss of water to the environment. The system should be able to accurately identify moisture lost to poor curing operations versus a reduction in free water due to hydration or other reactions present in cement-based systems. The idea is that the device would collect and store data points at a frequent enough interval that could inform ongoing construction practices.

The system would utilize an interface (cloud-based or on-board the device itself) that would allow a contractor and ultimately an agency to assess the quality of curing operations. The expectation is that the data points, or some other characteristic of the data (e.g., the rate of change of the data), could be used to establish quantifiable thresholds with data taken automatically for an agency to ensure compliance with its specifications.

The proposed solution supports FHWA's Annual Modal Research Plan (AMRP)[3] by developing and enhancing tests and processes related to the performance-engineered mixtures (PEM) initiative for concrete pavements. 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.

The opportunity for commercialization in the U.S. is extremely high. Many public agencies build concrete infrastructure with large, exposed surface areas susceptible to evaporation where curing processes are critical to ensuring good performance.

Overall, this SBIR topic seeks to create a device that could be embedded into a concrete element and determine the quality of curing that the concrete experiences after placement. The device should be able to take regular measurements that can be used by a contractor to make decisions about curing and by an agency to assess curing. If needed, the post-processing of the data to analyze measurements 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. Specific stakeholders who could be involved in the evaluation and testing phase include the FHWA Office of Infrastructure R&D, one or more progressive state highway agencies, 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 the different techniques proposed for the system, the detailed scientific basis for the operation of the system, and a description of the proposed prototype(s). The report should include an estimated timeline for the prototype(s) production, evaluation, and accuracy verification. The Phase I report should present an estimated market size of the final protype, discuss critical opportunities and obstacles to implementation, and illustrate a practical and tentative plan for verification and demonstration to be conducted in Phase II.

[3] https://www.transportation.gov/administrations/assistant-secretary-research-and-technology/rdt-annual-modal-research-plans

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 should further refine 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 concrete mixture types (e.g., paving, structural bridge deck, pre-cast) and environments (e.g., dry, humid, high wind, hot, cold) to increase the likelihood of effective implementation. Another final outcome is the delivery of at least two final prototype units to FHWA for evaluation on shadow projects with owner agencies.

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.

22-FR1: Traction Motor Seizing Device

Traction motors on locomotives tend to seize on a weekly basis on most major freight railroads in the U.S. When this occurs, the train must be stopped to remedy the non-rotating wheel and avoid damage to the rails (or the axle would have to be "dragged" into the nearest siding). One remedy is to jack the affected truck onto a dolly and relocate it nearby, where it can be repaired without disturbing revenue service. Commercially available dollies can be carried to the site in pieces. However, they weigh about 150 pounds each and require multiple people to assemble and install. Once on the dolly, the locomotive can be off the mainline, but the train's speed is limited as well as the number of miles (as little as 10) that the dolly can travel while supporting the affected truck. The weight and travel speed limitations created by a dolly are problematic in remote regions, where the responding crew is often a single technician and the distance to a suitable location for removing the pinion can be many miles away. Another option for repairing a seized traction motor would be accessing the gear box from below using a torch or thermal lance, which exposes the technician to other risks as well as danger from adjacent traffic. A safer more efficient solution is being sought to unseize traction motors on locomotives.

Expected Phase I Outcomes

The Phase I project is expected to result in a proof-of-concept report that describes a safer, more efficient solution for unseizing traction motors on locomotives and includes a stand-alone proof of concept design. The report should address system performance and industry need, use, costs, and design improvements.

Expected Phase II Outcomes and Deliverables

The Phase II project is expected to result in the development of a prototype for evaluation and testing leading to commercialization. Prototype development should include testing for usability

and safety evaluations to ensure the technicians' safety. Important criteria for the solution are that the prototype can be used in a time-efficient and safe manner, and that it is a functional and feasible solution. Ease of use is important. Documentation should discuss ways to enter the gear box opening and access the pinion shaft, and use of the system whether the gear case is removed or not.

22-FR2: Locomotive-Mounted Track Safety Assurance System (LOSAS)

This research challenge is to develop a high-performing sensor suite and associated processing algorithms to advance the state-of-the-art in railroad locomotive-mounted systems for general situational awareness, ground hazard detection, track inspection, bridge inspection, and similar operational and track safety objectives. The goal is to maximize the utility of the locomotive platform (locomotives lead every train) to assess the safety of the track system. Systems developed under this topic will not interface with any locomotive controls or Positive Train Control system during the early phases of development. This research and development activity supports DOT strategic priorities State of Good Repair and Innovation. In addition, this effort will support recent initiatives towards advancing the application of intelligent transportation systems in the rail industry.

Many thousands of locomotives are currently equipped with forward-facing video recorders that provide valuable situational awareness data to rail operators. This topic seeks to create a more comprehensive data collection system by leveraging advancements in sensors and algorithms that are in development and testing in the autonomous automotive vehicle industry and other areas. The solution could be a replacement for the existing forward-looking video systems, or an additional locomotive system. It is envisioned that a mature and useful system will employ a suite of sensors and fuse these sensor outputs to create information reports that provide valuable safety data to railroad operations, maintenance, and planning stakeholders. In addition, such a system may help support autonomous train operation.

The system should have the following basic characteristics:

- Robust and reliable, suitable for mounting on the exterior of a locomotive and for continuous duty (when the locomotive is moving)
- Autonomous, unattended operation
- Automatic data transfer via cellular, satellite, or other means not requiring human intervention
- All-weather functionality
- Precise data geo-location

The types of sensors and data collected are left up to the designers, but the most useful system will be sensitive to railroad track operational safety issues. The following examples are supplied for information only. Many of these data could be used for defect or hazard detection (immediate

issue reporting) and for change detection purposes (reporting how conditions are changing over time by comparing data from repeated runs over the same track).

- Ground hazard identification – Landslides, wash outs, significant ballast deterioration, floods, drain blockage, fallen trees, etc. Issues that are related to the geography, weather, and other natural phenomena that may affect operational safety.
- Track and bridge inspection – Rail breaks; missing fasteners, including broken and displaced spikes, clips, insulators, tie plates, joint bars, etc.; crosstie damage or displacement; low ballast levels; displacement of track relative to fixed references; track and bridge clearances; missing equipment; plate cutting; gaps between ballast and ties, etc.
- General situational awareness – Obstacles in track or other areas of the right-of-way that may affect operational safety. Application to first-pass train operations to ensure the track system is ready for revenue service.

The commercialization potential for this solution is limited only by the number of locomotives that exist worldwide. The railroad industry is embracing autonomous inspection technology at all levels of the industry. The envisioned system should have widespread appeal if pricing and performance targets are reasonable and useful.

Sources:

- https://railroads.dot.gov/elibrary/laser-triangulation-track-change-and-defect-detection
- https://www.its.dot.gov/
- https://www.its.dot.gov/research_areas/automation/index.htm
- https://ieeexplore.ieee.org/document/8612054
- https://www.youtube.com/watch?v=2Fcmh7SLPBI

Expected Phase I Outcomes

Phase I outcomes include a proof-of-concept report which should provide a detailed description of the performance requirements, preliminary system designs, sensor identification, software requirements, and results of simulations or other activities to demonstrate that the requirements for the locomotive-mounted track safety assurance system are realistic and attainable.

Expected Phase II Outcomes and Deliverables

Phase II outcomes include progressing the technology through laboratory and early field testing to demonstrate the efficacy of the design and the usefulness of the system outputs for general situational awareness, ground hazard detection, track inspection, bridge inspection, and similar operational and track safety objectives. 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.

22-FT1: Reduction of Transit Bus Collisions with Other Vehicles

Transit bus collisions with privately-operated motor vehicles (POV) in large, urban areas have been the number one source of bus transit fatalities from 2008 to 2020, based on National Transit Database[4] (NTD) data. Almost half of all bus transit fatalities and almost half of all bus transit injuries are the result of bus collisions with POVs. As indicated in FTA's 2021 Bus Safety Data Report[5], the majority of fatality victims were the passengers in the POVs. This type of collision is also the leading source of bus transit injuries; the majority of the injured were passengers on transit buses.

This research challenge is to identify the leading causal factors that contribute to this type of transit bus collision fatality and/or injury and propose mitigation strategies to reduce the incidences of fatalities and/or injuries that result from transit bus collisions with privately-operated motor vehicles. The applicant must research past collision investigations and identify the leading hazards and/or contributing factors that caused the collision fatalities and/or injuries, and then propose effective mitigations that would reduce the occurrences of these collision fatalities and/or injuries or identify solutions that address the leading contributing factors. This research aligns with DOT's and FTA's Safety priority.

FTA requires detailed safety event reporting from large bus transit agencies. These large agencies are required to provide the NTD with detailed reports of each bus collision that results in a fatality within 30 days of the event. Large agencies are also required to submit detailed reports when an event results in injuries requiring immediate transportation for medical attention for two or more people. In addition, transit agencies, insurance pools, and state and regional organizations perform investigations after bus collisions and may share relevant data on causal and contributing factors.

All types of solutions are welcomed, and offerors are encouraged to learn from transit agencies to inform root causes, which can lead to their innovative solutions. Creative thinking is

[4] https://www.transit.dot.gov/ntd/ntd-data

[5] https://www.transit.dot.gov/sites/fta.dot.gov/files/2021-09/Bus-Safety-Data-Report-Summary-09-23-2021.pdf

encouraged in the proposed solutions, which could include engineering solutions, improved training solutions, or fatigue management solutions. Options could also include a way to reduce the number of bus passenger injuries, or ways to reduce fatalities in POVs through full re-design or retrofits of the bus equipment. Proposed solutions or mitigations may involve different strategies, such as developing an innovative training program, compiling an effective best practices guide, or developing a strategy to "engineer-out" the associated hazards and risks through revised specifications for new bus design or new or modified parts for retrofits.

Proposed mitigations involving an engineering solution could involve designs for retrofits or new bus design in which a proof of concept for a collision fatality and/or injury reduction method should be presented based on the findings.

As an example, if one leading contributing factor of the occurrence of the collisions was that transit bus operators did not see the vehicles, solutions such as lane-assist, improved positioning of bus mirrors, or other measures that could help reduce the occurrences could be an area where further development and testing would be required. Bus agencies would be interested in purchasing effective modifications to buses or newly designed buses with built-in features that would reduce the likelihood of these collisions. It is possible that artificial intelligence could assist in reducing the number of collisions, but this is unknown until the leading contributors of these collisions are identified.

Expected Phase I Outcomes

The Phase I outcome includes a proof-of-concept report that contains research on collision investigations, classifications of the different root causes of transit bus collisions with non-transit vehicles, and identification of the hazards and/or known contributing factors that led to the collisions, with a ranking of the leading hazards and/or contributing factors.

The report should include proposed methods or strategies for addressing the contributing factors and/or specific hazards identified through the research. This may include ideas for developing prototypes, if not possible prototype design(s), and general cost estimates for developing prototypes for testing.

If a transit partner(s) is already known, identify potential partnership with one or more urban bus agencies to test proposed mitigations—e.g., training modules, retrofitted bus equipment, specifications for future procurements.

Expected Phase II Outcomes and Deliverables

Expected Phase II outcomes include prototype development and testing. Testing will require a partnership with at least one urban bus transit agency. (Note: The recently passed Bipartisan Infrastructure Law includes funding for testing by bus operators to reduce visibility impairments.) The testing phase would require monitoring the effectiveness of the mitigations.

If the program requires transit bus operators to drive modified or new bus equipment, analysis from the pilot should consider feedback from operators regarding the effectiveness of the desired improvements.

If the program requires improved training curriculum and methods, testing prior to and after the training would be used to measure its effectiveness. Monitoring the number of bus collisions with POVs and/or the number of resulting fatalities and/or injuries over a defined period of time would assist in identifying improvements to the proposed mitigations/solutions and support determinations as to the effectiveness of the mitigation efforts.

22-FT2: Connecting Individuals in "Food Deserts" to Healthy Foods

"The U.S. Department of Agriculture defines food deserts as areas where people live more than 1 mile from the impact of a supermarket in urban areas, or 10 miles away in rural areas."[6] Barriers to accessing grocery stores and healthy food choices is a reality in many low-income communities, creating many "food deserts" in the inner city, as well as rural areas.

The goal of this research topic is to address: How can improved connections to mobility options be used to reduce food deserts and provide options for all individuals to access affordable and quality groceries and healthy food? Various forms of technological solutions can be used to help individuals access grocery stores and healthy food choices through public transportation, shared rides, or other forms of mobility.

This subject is related to an important element of the Department of Transportation's (DOT) Goals, Strategic Objectives, and Strategies. One of DOT's Infrastructure goals has a Strategic Objective of "Project Delivery, Planning, Environment, Funding and Finance," with the strategy of "[building] partnerships with stakeholders to facilitate the financing, development, and implementation of multimodal transportation projects that improve connectivity, accessibility, safety, and convenience for all users."

Commercialization of potential technological solutions can be made through an app, technological software, or some other form of information-sharing downloaded to smartphones, tablets, and/or computers.

Technology ownership should not be a barrier; if an individual does not own or have personal access to technological tools, then access to these items may be available through community gathering activity centers such as religious organizations, education institutions (K to post-graduate), community centers, libraries, etc. A consideration to be applied to this research topic is to provide options for connecting individuals without access to technology to these community

[6] "Food Insecurity and Food Deserts: How Are They Related?" Institute for Food Laws and Regulations: https://www.canr.msu.edu/news/food-insecurity-and-food-deserts-how-are-they-related

resources. The ability to access this information can provide the initial step towards accessing healthy foods.

The proposed research will develop a technological solution that can provide access by connecting individuals to public transit resources, as well as to public transit, to decrease the impact of food deserts and increase access to healthy food options in low-income areas located in inner cities and suburban/rural areas.

Some resources regarding food deserts and food insecurity include, but are not limited to:

- Food Insecurity and Food Deserts: How Are They Related? - Institute for Food Laws and Regulations (msu.edu): https://www.canr.msu.edu/news/food-insecurity-and-food-deserts-how-are-they-related
- Exploring America's Food Deserts - The Annie E. Casey Foundation (aecf.org): https://www.aecf.org/blog/exploring-americas-food-deserts
- National Highway System - FHWA HEPGIS Maps (dot.gov): https://hepgis.fhwa.dot.gov/fhwagis/

Expected Phase I Outcomes

Phase I outcomes include a proof-of-concept report that contains a literature review on the major transportation barriers to accessing healthy foods, and potential solutions that utilize public transit resources to mitigate food deserts. The report should also identify the recommended technology solution that mitigates food deserts through access to public transportation. The approach should identify two or three communities where a prototype design or model could be implemented as a pilot in Phase II.

Expected Phase II Outcomes and Deliverables

Develop a prototype based on the concept of operations and pilot test the solution. The technological solution (i.e., tool) should be easy to use and access by the public through personal technology equipment and/or public centers such as libraries, community centers, etc. Additionally, the tool should be easy for transit agencies to implement/incorporate with their existing technology platforms.

22-FT3: Blockchain-Enabled Transit Incentivization

The emergence of blockchain technology has been highlighted over the past few years for the new and promising innovations the technology enables. The impact of blockchain, such as secure digital transactions, is rapidly growing and manifesting itself in many ways, including how people interact and pay for services, how transactions are secured and verified, and how scarce resources are managed and mobilized.

This proposed SBIR research, blockchain-enabled transit incentivization, will include the development of an operational concept to determine the feasibility and effectiveness of novel

incentivization strategies using blockchain technology, such as a tokenized gamification through a smart phone application, to manage modality use by commuters.

As more employees return to offices and worksites, there will be fewer available parking spaces than demanded by commuters in many large employment locations. This potential scarcity of shared parking resources, as well as the uncertainty of finding an open space without coordination, presents an opportunity to influence commuters' decisions in real time. A novel strategy utilizing blockchain technology would provide a dynamic approach to incentivizing alternatives to driving. For instance, travelers can spend tokens to reserve a parking space or receive tokens for agreeing to use a different mode of transportation. As spaces are reserved and become scarcer, the system may offer increasing incentives, or tokens, for travelers to choose not to reserve a space or to take a different mode, such as public transportation and other shared mobility options. Blockchain technology could facilitate tracked, trusted payment transactions and provide verification to ensure that users can access a reserved parking space or earned incentives. Moreover, the use of blockchain technology could ensure real-time, transparent information on incentives to travelers; provide secure decentralized management of tokens and guarantee the credibility of data; enable the use of novel gamification strategies amongst users as a further incentive; and facilitate the coordination and scaling of the system to multiple facilities.

This research aligns with DOT's and FTA's Transformation/Equitable and Accessible Mobility goals. Active management and incentivization of travel options allows more efficient use of transportation resources, provides dynamic coordination of a range of mobility solutions, and can enhance how transit agencies and communities coordinate and operate transportation services that are focused on enhancing traveler mobility and promoting equity, while considering climate impacts. Blockchain-enabled transit incentivization tools could potentially include individualized, curated incentives that incorporate equity considerations, with incentives promoted to individual users based on their location as well as personal circumstances.

Commercialization potential includes operators of public transit systems, who could use the blockchain model to promote mobility management practices for their own parking resources, or partnerships with local employers to promote transit-based mobility options in their service area. Similarly, commercialization potential also exists for state and local entities that want to incentivize transit and other mobility alternatives and manage scarce parking or curbside resources. Longer-term commercialization potential includes private entities, such as commercial buildings, employers, or universities that may adopt the technology to dynamically manage scarce parking resources and incentivize mobility alternatives to ensure maximum public access to their site.

Expected Phase I Outcomes

In Phase I, the expected outcome is a proof-of-concept report that presents an operational concept for the blockchain-enabled transit incentivization—initially a smart-phone-based app supported by a custom private blockchain set up to manage the pilot (if funded for Phase II). The

report should also identify candidate testing locations (up to three) where a prototype is embraced and beneficial to both the employers and the employees.

Expected Phase II Outcomes and Deliverables

Phase II outcomes will include the development of a prototype app for blockchain-enabled transit incentivization in partnership with a major employer or community for a pilot program, and the collection of key data about the viability of gamification in transit incentivization using blockchain. A pilot program is not a requirement of Phase II, but if done, a controlled pilot deployment is preferred to collect data on the effectiveness of the approach.

22-FT4: Tools and Applications Towards Moving to Zero-Emissions

Moving to zero-emissions transit fleets requires public transit agencies to rethink and retool maintenance systems and bus routes and build out new charging infrastructure. In many cases, these changes will also require organizational structure shifts, worker retraining/reskilling, and new tools and applications to help transit agencies transition to zero-emission fleets. Decisions around bus models and fuel types must accommodate the unique climate, terrain, service hours, and route length for each transit agency's operations. However, not all transit agencies have the resources or the expertise to research and analyze what options would be best for them.

This proposed research would explore the creation of a tool or application that can help transit agencies select the right battery electric bus for their unique systems—taking into consideration terrain, climate, length of route, etc.—and to create models to predict the greenhouse gas (GHG) emission impacts of this change in transportation type. The emissions models could be part of the tool or application or could be separate from it. This research aligns with DOT's and FTA's Climate and Sustainability and Environmentally Sustainable Systems priorities.

Transit agencies would be the main customer of a commercialized tool or application to use to help them make more informed choices about battery electric bus purchases. DOT would not be a customer since transit agencies make purchasing decisions on their own. FTA publishes the bus testing reports for each bus model tested but does not direct purchasing decisions. This tool would help transit agencies make decisions about which buses to purchase and help move the nationwide transit bus fleet towards zero emissions.

FTA's Bus Testing program website can be found here: https://www.transit.dot.gov/research-innovation/bus-testing

The Bus Testing Report database can be found here: https://www.altoonabustest.psu.edu/

FTA's Transit Greenhouse Gas Emissions Estimator tool can be found here: https://www.transit.dot.gov/regulations-and-guidance/environmental-programs/ftas-transit-greenhouse-gas-emissions-estimator

Expected Phase I Outcomes

The Phase I proof-of-concept report should describe the methods and results of a feasibility study to identify the potential solution to develop, prototype, and test a tool or application that can help transit agencies make decisions regarding which electric bus model(s) to purchase based on their geographic needs and characteristics (e.g., distance per charge, peak vs. non-peak, gravel vs. smooth roads, steep/grade inclination, urban vs. rural).

Expected Phase II Outcomes and Deliverables

Phase II outcomes include the development of a market-ready prototype that can be deployed in a variety of zero-emissions fleet transition types and market for large, small, and rural transit agencies. The prototype should include integration of transit emissions information to create models to predict the GHG emission reduction of transit fleets for future planning/funding/policy purposes for such transit agencies.

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 Pipeline Safety Research Program sponsors research and development projects focused on providing near-term solutions for the U.S.'s pipeline transportation system that will improve safety, reduce environmental impact, and enhance reliability. This includes ensuring that PHMSA's R&D program implements the Administration's priorities through R&D investments that promote safety and environmental protection, climate change, economic recovery and rebuilding, and transportation as an engine for equity.

Recent R&D projects are focused on leak detection; detection of mechanical damage; damage prevention; improved pipeline system controls, monitoring, and operations; and improvements in pipeline materials. These projects are addressing technological solutions that can quickly be implemented to improve pipeline safety and limit environmental impact of PHMSA-regulated infrastructure.

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.

22-PH1: Nondestructive, Streamlined Testing and Monitoring of Metal Cylinders and Tanks to Prevent Packaging Failure

Recertifying cylinders and tanks is a costly and time-consuming process that ensures a minimum level of safety for the transportation of hazardous materials. During operation and in between recertifications, cylinders and tanks can encounter a variety of chemical and physical stresses that can accelerate package failure. The early identification of packages that have experienced excessive physical strain and are susceptible to rupture or chemical interaction that causes embrittlement may prevent catastrophic failures from occurring in unsafe manners.

Live and continuous monitoring or rapid checkpoints for inspection use technology such as high-frequency sound modulators or metrology in fiber optics coupled with software to rapidly identify defects. This research topic seeks a technology for nondestructive testing and monitoring of metal cylinders and tanks to prevent packaging failure, which may include the use of ultrasound, fiber optics, or a combination of both, with identified and recommended needs for checkpoint versus continuous monitoring. This approach may provide an equivalent or greater level of safety than current inspection practices while also reducing the need to pull packages out of circulation for inspections and recertification.

To be commercialized, the technology must be accessible and capable of being directly integrated into new packagings or built to be compatible with existing form factors. Customers transporting contents under pressure or bulk hazardous materials in tanks cover fuel, petrochemical, and specialized gas industries.

Expected Phase I Outcomes

The Phase I proof-of-concept report should include details on the recommended technology and requirements.

The report should also provide information on estimated cost savings, incident reductions, and new methodology for measuring packaging performance that is in compliance with regulations or may be used to develop new regulations/policies.

Expected Phase II Outcomes and Deliverables

Phase II will include the fabrication of a prototype device or package to be used. Testing will include data collection from testing of the prototype that may be used to identify criteria for new performance-based regulations. Utilizing a testing phase with a small group of users would help ensure effectiveness and user input. Commercialization plans should also consider the optimization required for implementation and distribution into market.

22-PH2: Autonomous Vehicle Leak Detectors

A recent cover article in ASTM International's *Standardization News* proclaimed, "Drones Move into the Mainstream."[7] Automation in transportation, particularly in the arena of automated delivery vehicles, is currently a very hot topic with many potential applications. Using autonomous delivery vehicles for hazardous material transportation could improve safety, as no individual would be in the immediate vicinity of the hazard in case of accidental release. While there are obvious advantages to removing humans from the delivery of hazardous materials, there are still numerous obstacles to overcome on the path to realization of hazardous goods transport via autonomous vehicles.

One of the significant obstacles is the lack of in-situ leak detection. Currently, the driver or pilot of the hazardous cargo can detect leaks either by on-board sensors or by simply recognizing the leak. In an autonomous shipment, this would be impossible without accurate and reliable leak detectors. The detectors would be required to work in varied environmental conditions, sense

[7] https://www.standardizationnews.com/standardizationnews/july_august_2020/MobilePagedArticle.action?articleId=1598421#articleId1598421

multiple or specified materials, and communicate remotely with first responders and/or shippers to allow mitigation of the problem.

PHMSA is seeking prototype, remotely operated leak detectors. The detectors must be broadband detectors or tunable to specific compounds. They must be able to communicate with a central processing station and report leaks to the appropriate authorities. System redundancy is also requested.

Expected Phase I Outcomes

Phase I will include a proof-of-concept report that details the process for identifying the recommended solution and includes specification requirements and design options for the leak detection prototype to be developed in Phase II.

Expected Phase II Outcomes and Deliverables

Phase II will result in a prototype of the leak detector with lab or field testing to demonstrate its effectiveness.

22-PH3: Vibration Sensing System to Monitor for Potential Excavation Damage

Approximately 22 percent of serious incidents in PHMSA's regulated pipeline operations are caused by excavation damage[8]. In an effort to limit harm to the public and environment from excavation, additional solutions should be developed to monitor for imminent risks. PHMSA is seeking the development of new or improved technology systems to monitor for and detect vibrations from excavation damage threats (e.g., excavation activities for new utility installation in close proximity to pipelines) and notify the pipeline operator via appropriate means.

In partnership with the new technology provider, pipeline operators would install this solution permanently onto the pipeline in the ground. This solution would likely utilize existing fiber optic sensing systems and would include the appropriate algorithm to interpolate the data and determine methods to connect the fiber optic cables to the pipeline. Some fiber optic technologies on the market may already have the ability or at least potential for capabilities to detect vibrations, but additional research may be needed to improve or more fully test the systems in pipeline operations. Furthermore, this solution would need to account for the legacy nature of distribution pipeline networks, which do not include a network infrastructure to tap into.

[8] Calculation based on an analysis of PHMSA's dataset at https://www.phmsa.dot.gov/data-and-statistics/pipeline/pipeline-incident-20-year-trends.

Pipeline operators would be able to compare the excavation alert from this new system to active one-call tickets to determine if digging is scheduled or if it is an unauthorized digging activity. The solution should model different threats and non-threats in order to limit false negatives. The notification system should account for the lack of disbursed network technology in distribution natural gas pipelines.

This R&D project would fall under PHMSA's threat prevention programmatic element. Potential buyers of this solution would include oil and natural gas pipeline companies. The solution may also be applicable to other underground utilities.

Expected Phase I Outcomes

Phase I will result in a proof-of-concept report outlining the feasibility of the vibration sensing system. The report should detail the design and requirements for the prototype and modeling results tied to the sensing notification system. A prototype of the system, or mock-up of it, is expected at the end of Phase I.

Expected Phase II Outcomes and Deliverables

Phase II should include two deliverables, the first being a functional prototype, and the second being a full-scale test of the system proving its capability to industry partners. PHMSA should be provided with a report outlining the full-scale testing of the system, as well as a path forward for commercialization.

22-PH4: Underground Natural Gas Storage (UNGS) Advanced Leak Identification and Well Control Solutions

In October of 2015, a leak was discovered on an Underground Natural Gas Storage (UNGS) well near Aliso Canyon, California. The operator attempted to control the well multiple times through top-kill efforts. Meanwhile, the operator started to drill a relief well which would be utilized to intersect the leaking well, and pump fluids down at the bottom of the leaking well to seal it. During the eighth attempt, more than four months following the leak, utilizing the relief well was deemed successful and controlled the well failure. The natural gas leak led to the temporary relocation of more than 8,000 households as well as children from two schools. The incident resulted in the estimated release of 4.62 billion cubic feet of natural gas.

PHMSA recognizes the criticality of UNGS systems to the nation's energy infrastructure and is statutorily charged with ensuring the safe operation of these facilities. PHMSA is interested in research to improve safety in the full life cycle of UNGS facilities to include emergency response.

PHMSA is seeking solutions to aid UNGS facilities in identifying leaks and controlling well blow-outs/rupture failures. A successful proposal would offer technology solutions to identify leaks and control well blow-outs within a short time span, thereby limiting the risk to public

safety and the environment. The well control methods should, however, not impact the continued viability of the storage facility.

This solution would be a two-tiered system—the first tier being a system to identify leaks, which would include sensors and an interpolation package to determine if a leak or blow-out is occurring. The second tier is a system to quickly mitigate the blow-out. Currently, operators rely on "well-kill" attempts where operators attempt to pump heavy fluids down the well to stop the release. PHMSA is seeking a solution that could expeditiously stop the release through a technology solution.

This R&D project would fall under PHMSA's Underground Natural Gas Storage (UNGS) programmatic element. Potential buyers of this solution would include UNGS operators and entities specializing in response to well blowouts.

Expected Phase I Outcomes

The Phase I proof-of-concept report will outline the feasibility of an advanced leak identification and well control system. The report should discuss the prototype design and requirements, and potential opportunities for a Phase II project.

Expected Phase II Outcomes and Deliverables

Phase II should culminate in a functional system ready for commercialization. PHMSA should be provided with a report outlining the full-scale testing of the system, as well as a path forward for commercialization.