

Semi-Annual Progress Report for REPS

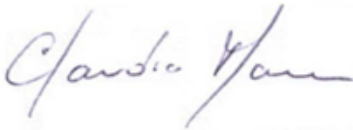
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Table of Contents

1. ACCOMPLISHMENTS	3
1.1 What are the major goals and objectives of the program?	3
1.1.1 Research Goals	3
1.1.2 Education, Technology Transfer, and Workforce Development Goals	3
1.2 What was accomplished under these goals?	3
1.2.1 Research	3
1.2.2 Education & Workforce Development	7
1.3 How have the results been disseminated?	8
1.3.1 Press & media coverage.....	8
1.3.2 Outreach & Engagement	8
1.4 What Do You Plan to Do During the Next Reporting Period to Accomplish The Goals And Objectives?	9
1.4.1 General Plan and Actions for the Upcoming Reporting Period	9
1.4.2 Research	9
1.4.3 Education & Workforce Development	12
2. PARTICIPANTS & COLLABORATING ORGANIZATIONS	12
3. OUTPUTS	13
3.1 Publications, conference papers, and presentations	13
3.1.1 Peer-Reviewed Journal Publications	14
3.1.2 Conference Papers (Proceedings)	14
3.1.3 Conference Presentations	15
3.2 Policy Papers	15
3.3 Websites or Internet Sites	15
3.4 New Methodologies, Technologies, or Techniques	16
3.5 Inventions, Patents, and/or Licenses	16
3.6 Other Products.....	16
4. OUTCOMES	16
4.1 Increased understanding and awareness of transportation issues	16
4.2 Passage of new policies, regulations, rule making, or legislation	17
4.3 Increases in the body of knowledge	17
4.4 Improved processes, technologies, techniques and skills in addressing transportation issues	17
4.5 Enlargement of the pool of trained transportation professionals	17
4.6 Adoption of new technologies, techniques or practices	17
5. IMPACTS	18
5.1 The effectiveness of the transportation system	18
5.2 Technology transfer (include transfer results to entities in government or industry, adoption of new practices, or instances where research outcomes have led to the initiation of a start-up company) ..	18
5.3 The increase in the body of scientific knowledge	18
5.4 Transportation workforce development	18
6. CHANGES/PROBLEM	18
6.1 Changes in approach and reasons for change	18
6.2 Actual or anticipated problems or delays and actions or plans to resolve them.....	18
6.3 Changes that have a significant impact on expenditure.....	19
6.4 Significant changes in use or care of human subjects, vertebrate animals, and/or biohazards	19
6.5 Change of primary performance site location from that originally proposed	19
7. SPECIAL REPORTING REQUIREMENTS	19

1. ACCOMPLISHMENTS

1.1 What are the major goals and objectives of the program?

The Research and Education for Promoting Safety (REPS) Tier 1 University Transportation Center is a collaborative initiative aimed at enhancing transportation safety through multidisciplinary research. This center integrates cutting-edge research from civil engineering and computer science to tackle challenges related to infrastructure, traffic operations, and cybersecurity. The REPS team is composed of prominent researchers from four universities in the U.S.: Howard University (HU-Lead), San Jose State University (SJSU), the University of Maryland (UMD), and the University of Nevada, Las Vegas (UNLV).

1.1.1 Research Goals

The goal of REPS is to develop integrative solutions that improve safety by eliminating traffic-related fatalities, reducing transportation infrastructure failures, and enhancing public transit efficiency. Through research, education, and technology transfer, our team is dedicated to preparing safety professionals with the skills needed to tackle evolving technological and safety challenges. The research aligns with USDOT's strategic goals of Safety and Transformation, focusing on preserving transportation systems, reducing cybersecurity risks, and implementing technology transfer activities.

REPS is organized around three key thrust areas, each addressing critical aspects of transportation safety:

- **Thrust Area 1: Safe Design and Systems to Increase Transportation Safety**

This thrust projects aimed at improving transportation safety by designing and implementing innovative systems. The research area explores topics such as the impact of enforcement and education on reducing impaired driving, integrating Adjudication Citation and Enforcement (ACE) data, and the role of mental states on driver safety. It also examines the potential of big data analytics to develop smart cities and prevent accidents.

- **Thrust Area 2: Critical Infrastructure Cybersecurity**

This thrust projects aimed at enhancing cybersecurity in critical transportation infrastructure as systems become increasingly digitized. This research area explores the use of Blockchain and AI technologies to improve data collection, processing, and security, particularly in railways.

- **Thrust Area 3: Safe Public – Protecting Communities from Safety Risks**

This thrust projects aimed at protecting communities from transportation-related risks by advancing traffic safety research. The aim is to reduce road fatalities through the development of advanced tools, monitoring traffic, and improving safety models. By using local data, Crash Modification Factors (CMFs) will be updated for better safety outcomes. The research area also includes testing various technologies to improve road network performance and infrastructure reliability.

1.1.2 Education, Technology Transfer, and Workforce Development Goals

REPS supports national transportation innovation by engaging communities, educational institutions, and organizations through research, technical training, workforce development, and technology transfer. REPS works to strengthen transportation systems, improve infrastructure efficiency, and expand opportunities for American workers and businesses.

Through its partnerships with local and state Departments of Transportation, industry leaders, and federal agencies, REPS promotes safety, innovation, and long-term economic growth. Its programs focus on advancing emerging technologies, supporting career preparation in science and engineering, and developing a skilled workforce that enhances mobility, resilience, and productivity across the nation's transportation network.

1.2 What was accomplished under these goals?

1.2.1 Research

Eleven research projects were undertaken in Year 1. Of these, two have been published in the USDOT database, four are currently under peer review, four are finalizing their final reports, and the remaining project will be completed

The Research and Education for Promoting Safety (REPS)

in Summer 2026. Thirteen projects for Year 2 began during this reporting period. The table below summarizes the status of all projects.

Project Status for 10/01/2025–03/31/2026

Project Title	% Completed	Milestones Achieved	Obstacles/Constraints
Year 1			
<u>Investigating the Impact of Enforcement and Education on Reducing Drug-Impaired Driving</u>	100	Final project report under peer review. Paper 1 (“What Really Drives Behavior Change? Causal Analysis of Impaired Driving Prevention Factors Using Machine Learning and Survey Data”) was presented at the 2026 TRB Annual Meeting and is under review at <i>Transportation Research Record</i> . Paper 2 (combined law enforcement data) is in progress.	
<u>Smart AI-Technology Employment for Crash Data Analysis</u>	96	Finalizing final report	
<u>Freeway and Arterial Performance and Safety Analysis with High-Resolution Vehicle Trajectory Data</u>	96	Finalizing final report	
<u>Enhancing Road Safety for All Road Users</u>	96	Finalizing final report	
<u>Effective Practices to Integrate Traffic Citation and Adjudication (TCA) Data</u>	96	Finalizing final report	
<u>Quantum Machine Learning and Railway Deterioration and Operations</u>	98	Under PEER review	
<u>Machine Learning and Railway Track Deterioration Part 1: Degree of Railroad Ballast Fouling Using Gaussian Process Regression</u>	98	Under PEER review	

Project Title	% Completed	Milestones Achieved	Obstacles/Constraints
<u>Machine Learning and Railway Track Deterioration Part 2: Multiway Analytics Applied to Railway Track Geometry and Ballast Conditions</u>	98	Under PEER review	
<u>Enhancing Transportation Safety for At-Risk Road Users through Behavioral Monitoring and Smart Infrastructure</u>	80	Produced PedAlert, a mobile software system to reduce pedestrian distraction at intersections. Work presented at DCQI; abstract and proceedings accepted for ASCE ICTD 2026; additional abstract accepted for Howard Research Month 2026. Codebase publicly available on GitHub.	
Year 2			
<u>Using Artificial Intelligence to Uncover How Safety Perception Influences Travel Behavior Shifts: Comparative & Longitudinal Analysis for the Future of Autonomous Vehicle, Transit and Ride-hailing Services</u>	30	Advanced the research framework and safety-perception taxonomy; calibrated the AI classification system using initial Waymo and Uber discourse in San Francisco. Next steps: refine taxonomy, expand data collection to San Francisco and San Jose, initiate perception-to-mode mapping.	Ambiguity between safety categories affects classification consistency; ongoing model calibration and human validation needed; scaling constrained by manual checks.
<u>Exploring AI-Driven Approaches to Quantify and Mitigate Driver Distraction</u>	8	Preliminary literature review is complete	
<u>Digital Twin and Automation of Pipeline Data for Predictive Maintenance and Risk Analysis incorporating Bayesian Network</u>	30	The team developed the first version of the modeling layer for a Dynamic Bayesian Network (DBN)-based digital twin for pipeline infrastructure. The DBN model was subsequently optimized to improve its robustness, and the codebase for the digital twin's data transmission and fusion layers was successfully implemented.	
<u>Developing a Data Fusion Tool for Improved Traffic Crash Exposure Analysis and Modeling</u>	7	Evaluated commercial and public datasets and identified gaps in non-motorized mobility coverage; Meetings held with data providers to assess data availability and integration feasibility; Development of a data fusion framework initiated using available public datasets, with initial focus on non-motorized exposure.	Cost and licensing limitations associated with proprietary mobility datasets; Ongoing vendor discussions regarding data access; Alternative open data sources being explored.

Project Title	% Completed	Milestones Achieved	Obstacles/Constraints
<u>Using Large Language Models to Generate Synthetic Data for Proactive Pedestrian Safety Prediction: Overcoming Data Collection Barriers in Surrogate Safety Analysis</u>	5	Budget and resource requirements documented; computational resources assessment underway. API integration testing and local environment setup for LLM-based synthetic data generation in progress.	Early-stage; identifying/securing computational resources and data access.
<u>Adaptive Cyber Threat Detection for Rail SCADA Systems: A Hybrid Machine Learning and Statistical Approach</u>	40	Literature review on SCADA vulnerabilities and anomaly detection completed. Exploratory analysis on 18,290-sample dataset informed preprocessing and feature selection. Baseline models (Isolation Forest, VAE) trained on clean data to establish normal-behavior reference for intrusion analysis.	
<u>Cybersecurity Assurance via AI-Driven Digital Twins for Transportation Safety</u>	10	Foundational components delivered: Computer Engineering team completed firmware environment/architecture definition and communication pipeline design; Mechanical Engineering team completed sensor installation, initial signal validation, and digital twin modeling framework definition.	
<u>LLM-Orchestrated Multi-Layer Digital Twin Network for Cyber-Resilient Traffic Management</u>	5	Literature survey complete; research gap identified in digital twins for traffic control. Open-source datasets being explored. One undergraduate researcher selected.	Open-source datasets may not capture proposed use cases; alternative data sources being explored.
<u>Observational Intersection Traffic Safety Analysis</u>	10	The team completed installation of three advanced camera-instrumented intersections in collaboration with a local vendor and received a quote for the software license required for edge computing and storage of traffic events.	A graduate student could not be recruited specifically for the project for the Spring 2026 Semester. This reduced productivity. An available student with requisite computer vision training has yet to be identified.
<u>Artificial Intelligence for Drug-Involved Crash Narrative Analysis and Traffic Safety Insights</u>	20	Title revised to better reflect approved scope. Analysis of 1,167 crash narratives complete; 15+ meaningful DUI-indicating attributes identified. Work continues through analysis, refinement, and integration into UNLV research and educational activities.	Complex parametric interactions require extensive manual ground-truth validation to quantify AI/NLP performance.

Project Title	% Completed	Milestones Achieved	Obstacles/Constraints
<u>Leveraging Emerging Data for Traffic Safety Analyses</u>	1	A graduate student has been identified and will be appointed as a Research Assistant beginning the 2026 Summer term (mid-May). The student will advance this project as part of his dissertation research, building on related prior efforts.	Project approved on March 29, 2026, we have just initiated efforts
<u>Immersive AR/VR learning to enhance pedestrian safety</u>	10	Project team established with undergraduate researchers; AR/VR equipment procured; initial workflow, team roles, and task assignments defined.	
<u>A Probabilistic Intelligence-Driven Framework for Predictive Cyber Defense in Railway Systems</u>	40	Focused literature review on railway cybersecurity and probabilistic modeling completed; initial Bayesian Network model structure developed and refined with key variables and states identified for critical nodes.	

1.2.2 Education & Workforce Development

During this reporting period, REPS provided comprehensive education, training, and professional development opportunities across its partner institutions HU, UNLV, SJSU, and UMD. Some activities are included below, and some others are described in detail in section 4.5.

- At HU, education and workforce development integrated classroom learning, hands-on research, and mentoring to build a transportation talent pipeline. Undergraduates were trained in mobile technology development, programming, open-source tools, and interdisciplinary collaboration while contributing to a smart-infrastructure system and smartphone applications for pedestrian-distraction prevention, and strengthened research communication skills through posters, conference presentations, proceedings contributions, and a peer workshop. These activities were anchored in coursework totaling 50 enrollments across Fall 2025 (CIEG 465, 579, 639) and Spring 2026 (CIEG 407, 416, 445-05, 504). The Spring 2026 undergraduate research course served as a capstone, with four students completing individual projects on transportation safety topics (first/last-mile transit and pedestrian-vehicle conflict, high-risk pedestrian crash conditions, WMATA Metrorail pedestrian safety, and in-vehicle driver monitoring); all four submitted abstracts to Howard University Research Month, and four were accepted for poster and lecture presentations at the College of Engineering and Architecture Student Research Expo. One additional undergraduate was mentored in human-centered research on pedestrian safety and wearable technology. Beyond the university, the Engineering Ambassador programs extended these efforts through STEM mentoring at Jackson-Reed High School.
- At UNLV, REPS research findings were integrated into the educational experience while expanding student training and professional development. Year 1 pedestrian-related findings from crash data analysis were incorporated into course materials, and ongoing Year 2 DUI work is being prepared for similar integration. During Fall 2025 (October–December counted toward this reporting period), project context was embedded into two transportation courses: an introductory undergraduate course (70 students) and a graduate Freight Transportation course (8 students) that included service-learning class projects addressing real-world freight safety challenges. Faculty also supported the ITE UNLV Student Chapter and CEEC in hosting weekly career development events—including practitioner visits, field trips, site visits, and resume review sessions. Graduate mentorship supported doctoral research on “Data Analytics for Road Safety” and on AI-based approaches to extract knowledge from crash report narratives, and a Master’s thesis on flashing yellow arrow left-turn signal safety.
- At SJSU, graduate students actively engaged in applied research projects through faculty-led research initiatives. These opportunities provided hands-on experience that allowed students to contribute to real-world transportation research, develop technical and analytical skills, and prepare for professional careers in the field.

- At UMD, faculty and students advanced research in quantum machine learning applications for transportation infrastructure through active participation in major conferences. The team participated in the Defend the Railroad Conference and presented two papers at the 105th Transportation Research Board Annual Meeting on railway cybersecurity and quantum machine learning for rail safety, expanding its visibility in the transportation research community and engaging with peers at the intersection of cybersecurity, emerging computing, and rail safety.

1.3 How have the results been disseminated?

The results of REPS's research projects have been disseminated through multiple channels, including scientific publications, presentations at major conferences, various professional forums, broadcast media coverage, and community engagement activities. Across the REPS consortium institutions, research outputs were shared through key publications and professional societies, as well as through specific outreach activities at partnering institutions as described in detail in section 3.

1.3.1 Press & media coverage

Nothing to report this period.

1.3.2 Outreach & Engagement

Across the REPS consortium institutions, comprehensive outreach and engagement activities connected research findings with diverse stakeholders, including students, educators, community members, industry professionals, and policymakers. Institutions disseminated research through academic presentations, community workshops, public events, and professional conferences spanning local, regional, national, and international venues. Activities emphasized knowledge transfer, capacity building, and public engagement in transportation safety and emerging technologies.

- At HU, outreach and engagement activities during the reporting period reached academic and professional audiences at the departmental, university, and national levels. In January 2026, the team presented "What Really Drives Behavior Change? A Causal Analysis of Impaired Driving Prevention Factors Using Machine Learning and Survey Data" at the Howard University CEE Graduate Seminar, engaging about 20 faculty and graduate students in a discussion of causal inference methods for transportation safety. In March 2026, current UTC research activities were showcased in a poster session at the U.S. DOT 2026 National Safety Summit (Safety21), connecting the team with the national UTC community. At the university level, student research reached broader audiences through the Howard University Research Month Conference and the College of Engineering and Architecture Student Research Expo (see Section 1.2.2 for details).
- At UNLV, outreach and engagement activities during the reporting period connected with diverse audiences through community events, safety campaigns, educational programs, and professional conferences, carried out in partnership with the Nevada Office of Traffic Safety and other partners. Activities included collaborating with the Nevada chapters and sections of ASCE, ITE, and ITS America to organize the 34th Annual Nevada Fall Transportation Conference; supporting the "Safe Santa 2026" community outreach event at the Boulevard Mall (December 2025), which raised traffic safety awareness among parents and elementary- and middle-school-age children, particularly from socio-economically challenged communities, through activities such as distributing bicycle helmets and reflective stickers; and providing administrative and organizational support for the 2025 Nevada Traffic Safety Summit hosted by the Nevada Department of Transportation and the Nevada Office of Traffic Safety, an event that drew more than 300 registrants. In addition, as noted in the Education and Workforce Development section, faculty supported the ITE UNLV student chapter and the Department of Civil and Environmental Engineering and Construction (CEEC) in hosting weekly community engagement and career development activities throughout the academic year.
- At SJSU, research outcomes were disseminated to both academic and professional audiences through peer-reviewed publications and high-visibility channels, including proceedings of the Human Factors and Ergonomics Society Annual Meeting and a feature in the Transportation Research Board Weekly Newsletter, extending the reach of project findings to a broad community of researchers and practitioners in transportation safety.
- At UMD, the research team actively engaged with the transportation research community through conference participation, attending the Defend the Railroad Conference and presenting two papers at the Transportation Research Board Annual Meeting: "Railway Cybersecurity: A Holistic Perspective" and "Quantum Machine Learning for Railway Safety".

1.4 What Do You Plan to Do During the Next Reporting Period to Accomplish The Goals And Objectives?

1.4.1 General Plan and Actions for the Upcoming Reporting Period

During the upcoming reporting period, REPS will advance all thirteen Year 2 projects toward their scheduled milestones while continuing the dissemination of Year 1 outcomes.

Pedestrian safety work will progress through the enhancement of the PedAlert framework with a machine-learning-based distraction detection module using smartphone inertial sensors, alongside continued development of an immersive AR/VR prototype for pedestrian safety training. AI-driven behavioral research will advance through refinement of the safety-perception taxonomy, expanded data collection across San Francisco and San Jose, initiation of perception-to-mode mapping, and ongoing data collection for driver distraction studies. Data-centric projects will move forward with continued development of the traffic crash data fusion framework, completion of the LLM-based synthetic surrogate safety data pipeline, and initiation of validation experiments.

In parallel, cybersecurity and digital twin projects will reach key development stages, including execution of the hybrid machine learning pipeline for rail SCADA anomaly detection, integration and testing of the cyber-physical digital twin system, development of a digital twin for traffic control, and refinement of the Bayesian network model for predictive cyber defense in railway systems. The pipeline digital twin project will advance its automated predictive maintenance framework and present preliminary findings at the American Petroleum Institute Pipeline Conference. Across all projects, the team will continue engaging undergraduate researchers, preparing conference and journal submissions, and sharing preliminary results with stakeholders to ensure broad research dissemination and workforce development impact.

At UNLV, Year 2 research efforts will advance across multiple fronts, including continued development of the AI/NLP-based analysis of DUI-related crash narratives, finalization of software licensing and data-access arrangements for instrumented study intersections on the Regional Transportation Commission network, and analysis of vehicle trajectory data to identify high-risk roadway segments. Graduate and undergraduate researchers will be engaged beginning in Summer 2026 to support software development, data processing, and analysis. UNLV will also continue leveraging related efforts funded by non-federal sources (e.g., NDOT, RTC of Southern Nevada) to augment and extend these activities.

1.4.2 Research

During the upcoming reporting period, the team will focus on three main areas. First, the remaining Year 1 project will be finalized, including completion of peer review and publication processes for the research projects outlined in Section 1.2. Second, all Year 2 projects will continue advancing toward their respective milestones, as summarized in the table below, which outlines pending deliverables and their proposed completion dates. Third, planning for Year 3 projects will be initiated, with submissions prepared for USDOT approval.

Pending Milestones of Research Projects

Project Title	Pending Milestones	Timeline to Complete
<u>Enhancing Transportation Safety for At-Risk Road Users through Behavioral Monitoring and Smart Infrastructure</u>	This work builds on the Year 1 PedAlert framework by enhancing the existing geofencing and location-tracking system with a machine-learning-based distraction detection module using smartphone inertial sensor data, including accelerometer and gyroscope measurements. An MLP classifier will be developed, trained, and integrated to classify pedestrian behavior as distracted or non-distracted, enabling context-aware decision-making beyond the rule-based approach established in Year 1. The project will also implement and evaluate an end-to-end prototype that fuses geospatial context with behavioral inference to deliver selective, real-time alerts and assess system performance under realistic intersection scenarios.	09/30/2026
<u>Using Artificial Intelligence to Uncover How Safety Perception Influences Travel Behavior Shifts: Comparative & Longitudinal Analysis for the Future of Autonomous Vehicle, Transit and Ride-hailing Services</u>	During the next reporting period, the project will refine and stabilize the safety-perception taxonomy, with clearer distinctions between operational and interpersonal safety categories and strengthened human-audit protocols to improve classification reliability. Data collection will be expanded and structured across San Francisco and San Jose to ensure a more balanced and comparable dataset. The team will implement perception-to-mode mapping to link safety narratives with traveler behavior and begin developing the prototype dashboard to explore trends across time, location, and user profiles.	9/30/2026
<u>Exploring AI-Driven Approaches to Quantify and Mitigate Driver Distraction</u>	Research protocols will be developed and data collection will be ongoing.	9/30/2026
<u>Digital Twin and Automation of Pipeline Data for Predictive Maintenance and Risk Analysis incorporating Bayesian Network</u>	The team will attend the American Petroleum Institute Pipeline Conference to present preliminary findings. In parallel, development of the complete automated pipeline for predictive maintenance will be undertaken.	12/31/2026
<u>Developing a Data Fusion Tool for Improved Traffic Crash Exposure Analysis and Modeling</u>	Technical discussions with commercial providers will continue, and alternative data sources will be pursued as needed. Development of the data fusion framework will also advance, with preliminary exposure measures generated for both motorized and non-motorized modes. Initial testing and validation of the framework will be conducted, and preliminary results will be shared with project stakeholders in preparation for conference and journal submissions.	09/30/2026

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Project Title	Pending Milestones	Timeline to Complete
<u>Using Large Language Models to Generate Synthetic Data for Proactive Pedestrian Safety Prediction: Overcoming Data Collection Barriers in Surrogate Safety Analysis</u>	The local environment setup and API pipeline development will be completed, and a methodology for LLM-based synthetic surrogate safety data generation will be developed. Data generation experiments will then be initiated alongside initial model validation. Based on the preliminary results, a conference or journal submission will be prepared.	09/30/2026
<u>Adaptive Cyber Threat Detection for Rail SCADA Systems: A Hybrid Machine Learning and Statistical Approach</u>	The experimental setup will be executed across all models, and the complete hybrid machine learning pipeline will be developed and its performance assessed.	12/31/2026
<u>Cybersecurity Assurance via AI-Driven Digital Twins for Transportation Safety</u>	The team will complete and validate the cyber-physical system—including encrypted embedded systems, sensor calibration, digital twin development, and integration testing—and then advance into cyber attack modeling, AI-driven anomaly detection, and survivability evaluation. Realistic attack scenarios will generate labeled datasets for training and evaluating AI-based detection models, and physical validation will map cyber anomalies to safety implications. The period will conclude with end-to-end system demonstrations under normal and attack conditions, along with delivery of final datasets, models, and reports..	12/31/2026
<u>LLM-Orchestrated Multi-Layer Digital Twin Network for Cyber-Resilient Traffic Management</u>	A digital twin of the traffic system will be developed and subsequently used for anomaly detection, validation, and mitigation evaluation.	01/30/2027
<u>Observational Intersection Traffic Safety Analysis</u>	The team will secure the necessary equipment and software licenses for three test intersections in Las Vegas, develop a protocol for accessing video feeds on the RTC network in collaboration with the local MPO (RTC-SN), and develop software to detect, track, and analyze road-user trajectories at intersections.	12/01/2026
<u>Artificial Intelligence for Drug-Involved Crash Narrative Analysis and Traffic Safety Insights</u>	The team will continue to advance the AI/NLP-based analysis of DUI-related crash narratives by expanding the dataset analysis, refining the identified DUI-indicating attributes, and strengthening the analytical framework, with parallel efforts directed toward the development and submission of a journal article.	09/30/2026
<u>Leveraging Emerging Data for Traffic Safety Analyses</u>	The team will develop a structured approach for using surrogate safety risk indicators—based on trajectory-derived metrics—to identify roadway segments with elevated operational risk, and will prepare and submit at least one manuscript to a peer-reviewed journal.	12/01/2026

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Project Title	Pending Milestones	Timeline to Complete
<u>Immersive AR/VR learning to enhance pedestrian safety</u>	Complete development of the AR/VR prototype, including realistic intersection scenarios and core simulation features. Integrate user interaction, traffic logic, and data logging, followed by internal testing and system optimization.	12/15/2026
<u>A Probabilistic Intelligence-Driven Framework for Predictive Cyber Defense in Railway Systems</u>	Preliminary conditional probability tables will be developed using literature-informed estimates, and model dependencies will be validated. The complete probabilistic-driven pipeline for cyber defense will then be developed.	12/31/2026

1.4.3 Education & Workforce Development

During the upcoming reporting period, all REPS partner institutions will continue to strengthen undergraduate and graduate education, mentoring, and workforce development by integrating hands-on research, professional development, and dissemination into the student experience. Students will have opportunities to co-author reports and publications, present at conferences, and engage directly with the transportation industry and state DOT partners.

- At HU, undergraduate mentoring will continue through the transportation research course, with student participation in Howard University Research Month and the College of Engineering and Architecture Student Research Expo. Students will be engaged in Year 2 development of the PedAlert system—including sensor data processing, machine-learning model training, and integration with the geofencing framework—and in the Immersive AR/VR pedestrian safety project through prototype enhancement, testing, and data analysis. Summer research participation will further expand undergraduate training, with students contributing to literature review, data analysis, project documentation, and conference submissions.
- At UNLV, workforce development will continue through mentorship, teaching, and community engagement. Faculty will mentor undergraduate and graduate students on research activities and integrate REPS findings into coursework. One undergraduate student will participate in Summer 2026 research through the NSF Research Experience for Undergraduates (REU) Site: Smart Cities, Advancing Mobility (Award #2349616), and additional graduate and professional staff will be engaged to support project goals. Faculty will also continue guiding the ITE UNLV Student Chapter in weekly career development and community engagement activities.
- At SJSU, K–12 outreach will expand through multiple new educational resources. The "Safe Streets Start with YOU!" Essay Contest will invite high school students to explore how STEM and emerging technologies can improve transportation safety in their communities. SJSU will also develop a set of elementary lesson plans on transportation safety, including PowerPoint presentations, handouts, and classroom-ready activities, and release a new "How We Move Safely" card set, building on the earlier "How We Move" and "How We Move Goods" series, to support classroom discussion and exploration of safe mobility.
- At UMD, undergraduate, graduate, and high school students will be mentored through STEM Fridays and research courses, featuring hands-on workshops designed to build practical skills in railway engineering while strengthening research communication and presentation abilities.

2. PARTICIPANTS & COLLABORATING ORGANIZATIONS

Several state governments and industrial partners are in the process of partnering with REPS to provide financial and in-kind support and facilities to the Center:

Organization Contributions to REPS

Name of Organization/Entity	Location	Contribution to Project	Contribution type(s)
Union Pacific	U.S.	Match funding for Mineta Summer Transportation Academy 2026	Financial support

The Research and Education for Promoting Safety (REPS)

Name of Organization/Entity	Location	Contribution to Project	Contribution type(s)
California SB 1 (Road Repair & Accountability Act 2017)	U.S.	Match funding for research and workforce development	Financial support
Tufayel Chowdhury, Metrolinx	Toronto, Canada	Practitioner input on agency needs and research applications	Advisory input
Iteris, Inc.	Washington, DC	Potential access to mobility data for traffic analysis	Potential data collaboration
Austin V. Angulo, SUNY Buffalo	Buffalo, NY	Transportation engineering expertise via Howard-UB collaboration	Collaborative research
Nuria Fernandez, AMDC Consulting LLC	Alexandria, VA	Transportation planning and policy consulting	In-kind; collaborative research
Keith Foxx, FOXSTEM Engineering Services	Washington, DC	Engineering and program management advisory	In-kind support
Charles Glass, Maryland Environmental Service	Millersville, MD	Environmental/infrastructure expertise; state-level data	Collaborative research; facilities
Madeline Hairfield, DC Government	Washington, DC	Government research program management; DC-area funding	Financial; in-kind support
Md Sami Hasnine, Virginia Tech	Blacksburg, VA	AI and transportation modeling expertise	Collaborative research
Charnelle Hicks, CHPlanning, Ltd.	Philadelphia, PA	Urban planning and infrastructure consulting	In-kind; collaborative research
Nina Grooms Lee, CDO Solutions	San Ramon, CA	AI strategy and data advisory	Collaborative research; in-kind
Odessa L. Phillip, Assedo Consulting, LLC	Laurel, MD	Engineering advisory for workforce and capacity-building	In-kind support
Gonzalo Rivero, WMATA Data Lab	Washington, DC	Transit data analytics; WMATA operations data access	Collaborative research
Jinghui Yuan, Oak Ridge National Laboratory	Oak Ridge, TN	National lab R&D; high-performance computing	Collaborative research
Jeff Morales, InfraStrategies LLC	Sacramento, CA	Infrastructure policy and program delivery advisory	In-kind; collaborative research
National Science Foundation	Alexandria, VA	Support for NSF REU: Smart Cities site at UNLV	Financial support
Nevada Office of Traffic Safety	Carson City, NV	Synergistic support enabling data access	In-kind; collaborative research
Nevada Department of Transportation	Carson City, NV	Access to relevant data	In-kind; collaborative research
Clark County Office of Traffic Safety	Las Vegas, NV	Access to data and subject-matter experts	In-kind; collaborative research
Various state/local agencies (e.g., RTC of Southern Nevada, Henderson, Las Vegas)	Nevada	Access to data and subject-matter experts	In-kind; collaborative research

3. OUTPUTS

3.1 Publications, conference papers, and presentations

Metadata for each publication

Citation	Publication status	Federal support ack. (Y/N)	DOI	Open-access URL
D. D. Alabintei and N. Attoh-Okine, "Kolmogorov–Arnold networks for accident risk prediction at highway–rail grade crossings," <i>J. Transp. Eng., Part A: Syst.</i> , 2026.	Accepted	Y	10.1061/ JTEPBS/ TEENG-9381	Will become available in the next issue
Y. Huang, B. Yang, X. Ren, Y. Lu, M. Lan, and X. Gong, "Spatio-temporal cokriging crime predictions using social media data: A multi-type case study in San Jose, California," <i>Comput. Urban Sci.</i> , vol. 5, no. 1, p. 72, 2025.	Published	Y	10.1007/ s43762-025-00233-6	https://journal.hep.com.cn/cus/EN/10.1007/s43762-025-00233-6

3.1.1 Peer-Reviewed Journal Publications

1. D. D. Alabintei and N. Attoh-Okine, "Kolmogorov–Arnold networks for accident risk prediction at highway–rail grade crossings," *J. Transp. Eng., Part A: Syst.*, 2026, doi: [10.1061/JTEPBS/TEENG-9381](https://doi.org/10.1061/JTEPBS/TEENG-9381). (Accepted)
2. Y. Huang, B. Yang, X. Ren, Y. Lu, M. Lan, and X. Gong, "Spatio-temporal cokriging crime predictions using social media data: A multi-type case study in San Jose, California," *Comput. Urban Sci.*, vol. 5, no. 1, p. 72, 2025, doi: [10.1007/s43762-025-00233-6](https://doi.org/10.1007/s43762-025-00233-6).

3.1.2 Conference Papers (Proceedings)

1. S. N. Abdul, S. Prakriti, M. Ahmed, and S. Sharma, "Smart infrastructure system to reduce pedestrian distraction at intersection," poster presented at the District of Columbia Quality Initiative (DCQI) Conf., Washington, DC, USA, Oct. 2025.
2. S. N. Abdul, S. Prakriti, M. Ahmed, and S. Sharma, "An open-source iOS system for reducing pedestrian distraction near intersections," poster accepted for presentation at Howard Research Month, Washington, DC, USA, 2026.
3. S. N. Abdul, S. Prakriti, M. Ahmed, and S. Sharma, "Software infrastructure system to reduce pedestrian distraction at intersections," in *Proc. Int. Conf. Transp. Develop. (ICTD)*, American Society of Civil Engineers (ASCE), 2026. (Accepted for poster presentation)
4. L. Zeng and C. Marin, "Not waiting for crashes: Reliable prediction of pedestrian close calls from statewide video," poster accepted at the ASCE Int. Conf. Transp. Develop. (ICTD), 2026. (Upcoming)
5. J. Nias and K. Campbell, "Designing for distraction: Exploring group awareness through wearable technologies," poster presented at the DCQI Conf., Washington, DC, USA, Oct. 2025.
6. S. Kamanmalek, J. Decuir, and B. Blackwell, "An interdisciplinary framework for evaluating behavioral interventions and safety strategies for distracted pedestrians," poster presented at the Int. Conf. Transp. Develop. (ICTD), American Society of Civil Engineers (ASCE), 2026.
7. W. H. Lo, A. Chu, Y. Luo, E. E. Etu, N. Attar, G. Liu, and G. Huang, "The impact of mental states, scenarios, and modalities on informative takeover requests in automated driving," oral presentation at the 69th Int. Annu. Meeting Human Factors and Ergonomics Soc. (HFES), Chicago, IL, USA, Oct. 2025.
8. K. A. Islam and S. Nambisan, "A framework to identify higher risk road segments: Integrating vehicle trajectory and crash data," accepted presentation at the 10th Int. Road Safety Simulation Conf., Naples, Italy, Jun. 2026. (Based on peer-reviewed abstract; invited to submit full paper for publication.)
9. S. Nambisan and S. Koneti, "Safety analysis of flashing yellow arrow left turn traffic signal operations,"

accepted presentation at the 10th Int. Road Safety Simulation Conf., Naples, Italy, Jun. 2026. (Based on peer-reviewed abstract; invited to submit full paper for publication.)

10. N. Das, M. Mahdy, J. Park, and P. Shrestha, "From text to insight: Automating drug-involved crash detection using large language modeling," in *Proc. 11th Int. Conf. Construct. Eng. Project Manag.*, Jeju, South Korea, Nov. 2025. (Peer-reviewed full conference proceedings.)
11. K. A. Islam, S. Nambisan, A. Singh, and S. Nellutla, "Rural-urban disparities in safety outcomes on California state highways," presented at the 8th Conf. Transp. Res. Group India (CTRG), Guwahati, India, Dec. 2025, paper no. 285. (Peer-reviewed full conference abstract.)

3.1.3 Conference Presentations

1. L. Zeng, R. Yan, and C. Marin, "What really drives behavior change? Causal analysis of impaired driving prevention factors using machine learning and survey data," lecture presented at the Transp. Res. Board (TRB) Annu. Meeting, Washington, DC, USA, Jan. 2026.
2. L. Zeng, R. Yan, and C. Marin, "What really drives behavior change? A causal analysis of impaired driving prevention factors using machine learning and survey data," presented at the CEE Graduate Seminar, Howard Univ., Washington, DC, USA, Jan. 2026.
3. L. Zeng, "UTC current research summary," poster presented at the 2026 National Safety Summit of U.S. DOT University Transportation Centers, Washington, DC, USA, Mar. 2026.
4. L. Zeng and C. Marin, "Not waiting for crashes: Reliable prediction of pedestrian close calls from statewide video," poster accepted at the ASCE Int. Conf. Transp. Develop. (ICTD), 2026. (Upcoming)
5. L. Zeng and C. Marin, "Not waiting for crashes: Reliable prediction of pedestrian close calls from statewide video," academic podium presentation accepted at the 67th Int. Meeting Transp. Res. Forum, Norfolk, VA, USA, Apr. 2026. (Upcoming)
6. S. Hossain, "A cross-classified generalized ordered logit model for changing motor vehicle crash injury severity patterns," poster accepted at the ASCE Int. Conf. Transp. Develop. (ICTD), 2026. (Upcoming)
7. W. H. Lo, A. Chu, Y. Luo, E. E. Etu, N. Attar, G. Liu, and G. Huang, "The impact of mental states, scenarios, and modalities on informative takeover requests in automated driving," presented at the 69th Int. Annu. Meeting Human Factors and Ergonomics Soc. (HFES), Chicago, IL, USA, Oct. 2025.
8. H. Cornet, "Understanding public safety perceptions and travel behavior shifts in transit, autonomous vehicles, and ridehailing services," presented at the Annu. Meeting Transp. Res. Board (TRB), Washington, DC, USA, Jan. 2026.
9. D. D. Alabintei and N. Attoh-Okine, "Quantum machine learning for railway safety," presented at the 105th Transp. Res. Board Annu. Meeting, Washington, DC, USA, Jan. 2026, paper #TRBAM-26-00350.
10. S. Nambisan, "Walking together toward safety: Smarter streets, safer communities," session moderator, 34th Annual Nevada Fall Transportation Conf., organized by the Nevada Chapters/Sections of ASCE, ITE, and ITS America, Las Vegas, NV, USA, Nov. 2025. (Invited)

3.2 Policy Papers

Nothing to report.

3.3 Websites or Internet Sites

- The REPS website was redesigned during this reporting period and is available at <https://reps.howard.edu/>.
- "Be a Safety Designer!" Poster Contest information, requirements, and winning submissions are posted on the program website: <https://transweb.sjsu.edu/workforce-development/elementary-program>.
- "Safe Streets Start with YOU!" Essay Contest information, requirements, and submission instructions are posted on the program website: <https://transweb.sjsu.edu/workforce-development/essay-contest>. Winning essays will be published on the same site.
- The website developed through the Year 1 project *Freeway and Arterial Performance and Safety Analysis with High-Resolution Vehicle Trajectory Data* is available at <https://shredder.research.unlv.edu/lattice>, providing outputs including short-term traffic condition prediction and traffic emissions estimation (with emissions analyzed from a health-impact perspective).

3.4 New Methodologies, Technologies, or Techniques

REPS advanced several new methods and technologies for studying and improving transportation safety during this reporting period:

- Developed an open-source mobile software infrastructure system—PedAlert—that integrates smartphone sensors, geospatial data, and real-time alerts to reduce pedestrian distraction near intersections, featuring hardware-independent geofencing using GPS and motion APIs for distracted walking detection. (HU)
- Implemented a modular system architecture comprising user device management, location tracking, distraction detection, and alert delivery modules to enhance scalability and interoperability, with open-access development practices maintained through a public GitHub repository (<https://github.com/abdufnafay1/PedAlert>). (HU)
- Advanced methodological approaches that integrate wearable computing with ecological momentary assessment (EMA) to examine pedestrian distraction and situational awareness in real-world contexts, using smartwatch-based interfaces to deliver context-sensitive prompts for investigating attention patterns, behavioral decision-making, and group dynamics during urban mobility activities. (HU)
- Combined human-computer interaction (HCI) techniques with transportation safety research through low-burden data collection on wearable devices, enabling more ecologically valid observation of how individuals navigate complex environments and providing scalable techniques for capturing behavioral insights to inform future pedestrian safety interventions. (HU)
- Advanced Artificial Intelligence (AI) and Natural Language Processing (NLP) approaches for analyzing DUI-related crash narratives, refining key DUI-indicating attributes and strengthening the analytical framework to improve understanding of contributing factors and patterns associated with drug- and alcohol-impaired driving. (UNLV)
- Developed computer vision methods for extracting knowledge from video feeds of intersection operations, supporting tracking and conflict analysis for observational traffic safety studies. (UNLV)
- Leveraged emerging large-scale vehicle trajectory data to develop novel techniques that identify high-risk roadway segments using surrogate safety indicators. (UNLV)

3.5 Inventions, Patents, and/or Licenses

Nothing to report.

3.6 Other Products

Nothing to report.

4. OUTCOMES

4.1 Increased understanding and awareness of transportation issues

At HU, research dissemination activities increased awareness of transportation safety issues across academic, professional, and student audiences. Findings presented at the 2026 TRB Annual Meeting and the CEE Graduate Seminar broadened awareness of the causal factors that drive behavioral change in impaired driving prevention, offering evidence-based guidance for designing more targeted educational campaigns. Participation in the 2026 National Safety Summit further extended awareness across the national UTC community, and dissemination at the DCQI conference raised awareness among interdisciplinary audiences of pedestrian distraction as a multidisciplinary safety challenge (see Section 3.4 for methodology).

At UMD, TRB presentations helped broaden recognition of how quantum machine learning techniques can be applied in transportation engineering. These approaches have strengthened insights into railway system challenges by improving the accuracy of rail track defect prediction and enhancing overall safety evaluation. The presentations also drew greater attention to cybersecurity vulnerabilities within railway systems and the need for more robust protective frameworks.

At UNLV, REPS activities contributed to increased understanding and awareness of transportation issues among elected and appointed officials and the general public, while expanding the body of knowledge through peer-reviewed presentations and publications. The program also advanced processes, technologies, techniques, and skills for

addressing transportation challenges, and enlarged the pool of trained transportation professionals through formal coursework and co-curricular activities at the college and university levels, outreach in the K–12 system, and continuing education opportunities for current workforce members.

4.2 Passage of new policies, regulations, rule making, or legislation

Nothing to report this period

4.3 Increases in the body of knowledge

At HU, the TRB 2026 presentation advanced methodological knowledge by applying advanced causal inference methods, including LiNGAM-based causal discovery and the DoWhy framework, to identify the causal drivers of behavioral change in impaired driving prevention. The accepted paper “Not Waiting for Crashes: Reliable Prediction of Pedestrian Close Calls from Statewide Video” contributes new methods for proactive pedestrian safety analysis using video-based surrogate safety measures, and the accepted poster “A Cross-Classified Generalized Ordered Logit Model for Changing Motor Vehicle Crash Injury Severity Patterns” extends the crash injury severity literature through advanced econometric modeling.

The REPS team at UNLV is contributing to the body of knowledge in two main directions. Ongoing work on AI/NLP-based analysis of DUI-related crash narratives is yielding a more rigorously validated analytical approach, producing stronger insight into the characteristics and contributing factors of DUI-related crashes and supporting continued research and educational use. In parallel, analysis of large-scale vehicle trajectory data is improving understanding of higher-risk roadway segments, enabling more proactive interventions to enhance safety.

4.4 Improved processes, technologies, techniques and skills in addressing transportation issues

REPS activities at HU refined internal research workflows for integrating behavioral research with emerging technologies, strengthening team capabilities in interdisciplinary study design, data collection protocols, and the translation of complex technical concepts into clear design frameworks and visual communication artifacts. Student engagement in these activities further developed research and communication skills directly applicable to complex mobility challenges.

At UNLV, REPS research continues to advance processes, technologies, techniques, and skills for addressing transportation safety challenges through the methodological efforts detailed in Sections 3.4 and 4.3.

4.5 Enlargement of the pool of trained transportation professionals

REPS activities at HU expanded the pool of trained transportation professionals by building concrete research and professional-readiness skills. Through the Spring 2026 transportation research course and additional mentored engagement in the human-centered research track, four undergraduates developed competencies in research methodology, data analysis, technical writing, scholarly communication, and conference presentation. Students also gained direct exposure to career pathways spanning human factors, behavioral research, public safety technology design, and human-centered AI applications for mobility systems.

At UMD, REPS activities expanded workforce expertise in quantum machine learning for civil infrastructure and in railway cybersecurity through probabilistic, intelligence-driven threat detection frameworks.

As documented in Sections 1.2.2 and 1.4.3, the REPS team at UNLV has been actively working to enlarge the pool of trained transportation professionals through formal educational activities and co-curricular and extra-curricular engagements. These efforts reach multiple levels of the current and future workforce, including K–12 students, undergraduate and graduate trainees, and professionals already active in the transportation industry.

4.6 Adoption of new technologies, techniques or practices

At HU, technology adoption was supported through the release of the PedAlert mobile software infrastructure as an open-source GitHub repository (<https://github.com/abdulnafay1/PedAlert>), enabling reuse by researchers, practitioners, and developers in pedestrian safety and smart-city applications.

At UNLV, REPS continues to foster the adoption of new transportation safety tools and methods through integration into research workflows, coursework, and collaborative engagements with state and local agencies (see Sections 3.4, 4.3, and 4.4).

5. IMPACTS

5.1 The effectiveness of the transportation system

Nothing to report this period.

5.2 Technology transfer (include transfer results to entities in government or industry, adoption of new practices, or instances where research outcomes have led to the initiation of a start-up company)

At HU, technology transfer has been actively demonstrated through several initiatives aimed at public safety and research impact. The REPS team has developed and implemented a Smart Infrastructure System and accompanying smartphone application for real-time pedestrian distraction prevention. Notably, the PedAlert software infrastructure has been made publicly accessible as an open-source repository on GitHub, encouraging continuous development, collaborative innovation, and broader applications within the pedestrian safety and smart city domains. Access the published repository at [GitHub](#).

In the area of drug-impaired driving research, the REPS team has advanced technology transfer through the development of an AI-driven, automation-enabled framework for causal effect analysis in transportation safety, available at [this link](#). Additionally, the pilot phase of the CROSS AWARE project—a smartwatch-based diary system—is underway; more information is available at [this link](#).

5.3 The increase in the body of scientific knowledge

At the field level, REPS contributions at HU advance the body of scientific knowledge in transportation safety through the methodological and conceptual contributions detailed in Section 4.3, including new causal-inference approaches for policy evaluation, video-based methods for proactive pedestrian safety analysis, and advanced econometric modeling of crash injury severity.

At UNLV, REPS research is advancing data-driven and AI-supported approaches for analyzing crash narratives, intersection operations, and vehicle trajectory data (see Sections 3.4, 4.3, 4.4, and 4.6), extending the transportation safety discipline’s shift toward proactive, evidence-based analytical frameworks that complement traditional reactive approaches.

5.4 Transportation workforce development

At HU, REPS contributed to transportation workforce development across multiple levels of the talent pipeline. Undergraduate training prepared students for modern workforce needs integrating human-computer interaction, behavioral science, and data-informed design (see Section 4.5). Beyond the university, the Engineering Ambassador programs extended HU’s impact through STEM mentoring at Jackson-Reed High School, strengthening the long-term K–12-to-university pipeline.

At SJSU, REPS expanded workforce development upstream through the “Be a Safety Designer!” Poster Contest, which engages elementary school students in transportation safety through creative learning. The contest introduces basic principles of safe system design while giving educators and families an accessible way to discuss transportation safety, helping build early awareness and long-term interest in the transportation industry.

At UNLV, REPS strengthens the transportation workforce pipeline at multiple levels (see Sections 1.2.2 and 1.4.3), including research and mentorship opportunities for undergraduate and graduate students (including NSF REU participation), integration of REPS research into transportation coursework, and co-curricular activities with the ITE UNLV Student Chapter, CEEC, K–12 outreach, and community events with state and local partners.

6. CHANGES/PROBLEM

6.1 Changes in approach and reasons for change

Nothing to Report

6.2 Actual or anticipated problems or delays and actions or plans to resolve them

Nothing to report this period.

6.3 Changes that have a significant impact on expenditure

Nothing to report this period.

6.4 Significant changes in use or care of human subjects, vertebrate animals, and/or biohazards

Nothing to Report

6.5 Change of primary performance site location from that originally proposed

Nothing to Report

7. SPECIAL REPORTING REQUIREMENTS

Nothing to Report