PROGRAM PROGRESS PERFORMANCE REPORT

Awarding Federal Agency: US Department of Transportation, Office of the Assistant Secretary for Research and Technology of the Department of Transportation (OST-R)

Federal Grant Number: DTRT13-G-UTC28

Project Title: Center for Advanced Infrastructure and Transportation (CAIT) National UTC Consortium Led by Rutgers, The State University of New Jersey

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Recipient Organization (Name and Address): Rutgers, The State University of New Jersey, Center for Advanced Infrastructure and Transportation, 100 Brett Road, Piscataway, NJ 08854-8058

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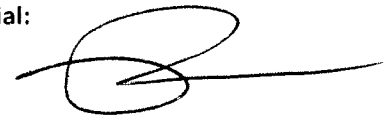
Signature of Submitting Official:



1. ACCOMPLISHMENTS: What was done? What was learned?

What are the major goals of the program?

The major goal of the CAIT National UTC Consortium is to build a program that will: 1) have a sharp focus on maintaining state of good repair of the nation's infrastructure and the interrelated activities of the Secretary of Transportation's strategic goals where the consortium can make significant impacts, and 2) foster intelligent, effective, and meaningful leveraging between institutions and stakeholders to achieve program goals and objectives.

State of Good Repair (SGR) has been identified as the consortium's **primary area of research** and Safety & Economic Competitiveness as secondary areas in which we believe our team's capabilities, resources, past experience, and track record qualify us to make significant impacts toward reaching the goals of the USDOT. To help fulfill these goals and objectives we will:

- **Sharply focus our research portfolio** to make significant and meaningful impacts during the lifetime of the grant. The UTC designation will be a catalyst for generating relevant and sustainable operations that can aid USDOT in fulfilling the objectives of its strategic plan.
- **Develop effective leveraging** with centers of critical mass and establish networks of researchers, laboratories, test-beds, proving grounds, and all other resources necessary to address the objectives of the strategic plan. Through intelligent leveraging, we will minimize potential duplication of effort and promote and encourage meaningful team work and collaboration.
- **Develop and enhance meaningful relationships with local, regional, national, and international stakeholders** to stay abreast of new problems and best practices; work together to address local challenges and needs; and partner in implementing research results and products.

The consortium will cultivate interest in the transportation industry through a comprehensive **education and workforce development program**. The education and workforce goals are to:

- Develop an educational program that will prepare current and future transportation professionals and researchers to be responsive to changes in the transportation field.
- Develop a strong multidisciplinary component that reflects changes in the organizational, intermodal, and global character of transportation, as well as the use of advanced materials and technologies relative to infrastructure.
- Develop educational activities with a focus on K-12 to foster an initial interest in transportation and create opportunities for the students to continue onto other programs, thereby sustaining awareness in transportation careers beyond the initial exposure.

The consortium supports knowledge sharing and is committed to move research results into practice through its **technology transfer initiatives**. The technology transfer goals are to:

- Ensure all research proposals include feasible implementation plans.
- Provide a forum to discuss the state of practice and innovative new technologies that support State of Good Repair, through conferences and symposiums.
- Continuously post reports and research findings in multiple online repositories and clearinghouses, such as the USDOT Research Clusters and CAIT website.

What was accomplished under these goals?

Major Goal Area	Major Activities	Specific Objectives	Significant Results	Key Outcomes
Research	Research Selection	Select projects that make significant and meaningful impacts during the lifetime of the grant	Several new projects have cleared the pre-proposal stage and are now being developed by the PI for full submission and review.	The peer-review panel has reviewed and approved **three research projects**.
	Development of accelerated infrastructure testing facility: Bridge Evaluation Accelerated System Testing (BEAST)	Supported by funding from NJDOT, FHWA, and Rutgers, CAIT construct a brand new facility that will create knowledge through UTC research projects and can validate existing research through and facility that will test the effects of heavy loads, extreme temperatures, and active weather on a full-scale concrete bridge deck. To reliably accomplish this, CAIT and its DOT and university partners are constructing the first full-scale accelerated infrastructure testing facility for the evaluation of new and advanced materials and devices: the Bridge Evaluation Using Accelerated System Testing (BEAST) facility. The facility will finally resolve unknown questions about the longevity and performance of preservation treatments and materials exposed to decades of heavy traffic loads and extreme weather patterns. The construction of the facility was completed in May 2015.		BEAST will provide new and valuable information about the longevity and effectiveness of preservation treatments and concrete materials used across the United States. The study will also provide answers about the long-term effects of weight, weather, and temperature variations on bridges in a short period of time.
	Utilization of Pneumatic Flow Tube Mixing Technique (PFTM) for Processing and Stabilization of Contaminated Soft Sediments in the NY/NJ Harbor	Supported by funding from NJDOT and leveraging our investments in sediment research, this project is going to demonstrate the viability of the Pneumatic Flow Tube Mixing (PFTM) method for the processing and handling of contaminated navigational dredged materials from the NY/NJ harbor complex. The Center for Advanced Infrastructure and Transportation (CAIT) will implement a pilot project at the Koppers Seaboard site, New Jersey. Rutgers Soil and Sediment Management Laboratory in collaboration with international partners will test the raw and amended DM throughout the entire process to initially determine the optimum design of the mix and subsequently monitor the produced amended DM to document the results and quality control parameters. The entire process will be managed by Rutgers CAIT.		The ultimate aim of the project is to determine if Pneumatic Flow Tube Mixing more efficiently achieves structural and environmental properties for amended dredged material while decreasing cost per cubic yard for dredged material amendment and placement than existing methods.

Update: Bridge Evaluation and Accelerated Structural Testing (BEAST) Facility

This Bridge Evaluation Accelerated Structural Testing (BEAST) facility will test the effects of many years of heavy loads and extreme temperature and weather patterns on a full-scale concrete bridge deck over a short period of time. The results of the study will give bridge engineers valuable new information about the longevity of preservation treatments and concrete materials that can be incorporated into future bridge repair and construction projects. As this is a first-of-its-kind facility, it is critical that the new facility be fully tested and optimized for performance. Presently, the team is developing plans for the initial experiment. The team is also fine-tuning the equipment to provide the needed environmental and physical loading conditions. The team is evaluating load response from the carriage onto a fabricated structural-steel girder-pair, as well as establishing maximum attainable temperature deltas inside the environmental chamber. This has resulted in a number of facility optimizations being implemented.

- The American Society of Civil Engineers (ASCE) New Jersey Section selected The Bridge Evaluation and Accelerated Structural Testing lab-a.k.a., the BEAST- for the 2016 Project of the Year. This is a significant accomplishment and noteworthy achievement in the field of civil engineering. The BEAST exemplifies CAIT's commitment to maintaining and improving the condition of infrastructure.

Unmanned Aircraft Systems (UAS) Update

There were three significant events tying together CAITs growing UAS activities and the overarching idea that UAS is an emerging field.

10/19/16 – At the annual ITS-NJ annual meeting, CAIT conducted a UAS flight from a mock crash scene and live streamed to the conference. The audience were able to see the crash scene in real-time and determine how they might mobilize or deploy resources or access traffic impacts based on this a comprehensive aerial video of the situation. The CAIT demo showed that UAS can be used to provide live traffic data at multiple locations, and could also be used as a first response in the case of an emergency, providing emergency responders with detailed video information of a crash site, before they even arrive.

11/03/16 – At the request of NJDOT Assistant Commissioner, William Kingsland, both Rutgers and NJIT presented our current UAS efforts. Rutgers also conducted a flight demonstration from a DOT maintenance yard showing real-time video of the various applications for NJDOT - from crashes, to traffic monitoring, to pavements, and other applications. Nearly 100 attendees from the numerous state agencies were in attendance, including NJDOT, State Police, NJDEP, DRBA, DVRPC, and others. It seems that NJDOT's notions towards drones are that they see the potential benefits UAS's can provide to the transportation world. It is clear that they want to start the conversation and would like to get the foundation in place so they can begin these projects.

12/05/16 –Senate President Sweeney invited the universities to attend the UAS roundtable at the NJ State House to discuss the current status of drone research and opportunities to collaborate. Rutgers, Rowan, NJIT, Stockton, and Stevens were all represented. The meeting was a fantastic display of the State legislature

showing their support for NJ Universities and this developing technology. It shows that our representatives recognize that this is an emerging field of technology with a wide range of application, and it showed how they would like to see New Jersey institutions to 'lead this charge' for our state.

Education and Workforce Development	Presented at the New Jersey State League of Municipalities Conference	Generate knowledge and skills for the municipal and county transportation community	This program promoted a safety culture within the workplace for public agencies.	More than 50 attendees learned about proper worker safety within their public works departments.
Technology Transfer	CAIT E Newsletter (March 2017)	Generate knowledge and support research projects and programs that have significant and meaningful impacts	CAIT recorded and delivered newsworthy items to showcase since January 2016.	Disseminated information about transportation research initiatives, applications, and training opportunities to practicing professionals.
	2017 UTC Spotlight Conference: Rebuilding and Retrofitting the Transportation Infrastructure (September 2017)	Brings together the ideas of those who generate new concepts that address transportation problems and opportunities, and those who own and manage transportation systems.	CAIT's Director, Dr. Ali Maher is a member of the planning committee, an honor that recognizes the center's contribution and leadership role in the areas of infrastructure and transportation.	CAIT will present on rehabilitating and restoring the current transportation infrastructure that will deliver efficient and effective performance and preserve resources for future generations.
	Hosted ITS NJ Annual Meeting (October 2016)	Support collaborative efforts and technology transfer	This event, co-hosted by CAIT, facilitates communication and generates research collaborations for Intelligent Transportation Systems research.	Disseminated the most current information on ITS practices and plans for the future.
	Planning for the 18th Annual Work Zone Safety Conference (March 2017)	Generate knowledge and support research projects that have significant and meaningful impacts	This conference promotes work zone safety awareness on our local and state roadways to a multi-disciplinary audience of construction, maintenance and operations, and public safety personnel.	A multi-disciplinary audience of transportation professionals were exposed to a variety of work zone safety concerns, and provided with an awareness of the necessity of an effective and safe work zone under this year's theme of "Work Zone Safety is in your Hands".
	Tech transfer activities for the National Center for Rural Road Safety	Support collaborative efforts and technology transfer with an impact on rural and local road safety.	As part of the NCRRS consortium, CAIT is leading several Tech Transfer efforts promoting rural and local road safety.	CAIT produced the second and third center Safety Sidekick Newsletter and blog, as well as developed and maintained social media presence.

	Tech transfer for the Northeast Regional Transportation Center	Generate knowledge and support resource sharing transfer for workforce development issues in the NE.	As part of the NETWC team, CAIT is leading the communication efforts for the project and developing and promoting tech transfer events.	CAIT maintains the NETWC website and social media presence.
	Rutgers NJ Asphalt Paving Conference (March 2017)	Further the professional and technical expertise of the asphalt paving industry.	As a co-sponsor of the Rutgers Asphalt Paving Conference, CAIT co-chaired and administered the conference planning committee.	Disseminated the most current information on asphalt practices, technologies, specifications, and projects.

What opportunities for training and professional development has the program provided?

This information has been integrated into the table above for the "what was accomplished under these goals?" section. Please see table above.

How have the results been disseminated?

This information has been integrated into the table above for the "what was accomplished under these goals?" section. Please see table above.

What do you plan to do during the next reporting period to accomplish the goals?

- **RESEARCH ACTIVITIES:**
  - **Ongoing Review of Research projects by the Research Advisory Board:** As previously described.
  - **Modify Agreements to Approve expenditure of Research Funds:** No research activities can start until the projects have been reviewed and approved as outlined in the prime proposal submitted to OST-R. CAIT has and will continue to issue modifications to the master agreements with each partner as research projects are approved.
  - **Ongoing Research:** Each of the consortium members will continue to perform SGR oriented research.
- **EDUCATION AND WORKFORCE DEVELOPMENT ACTIVITIES:**
  - Continue planning for the upcoming summer T.A.R.G.E.T. and other K-12 programs to support STEM and workforce development goals for the consortium.
  - Work with partner schools to develop new training seminars based on research.
- **TECHNOLOGY TRANSFER ACTIVITIES:**
  - Continue to promote consortium research and applications through vehicles like UTC Spotlight and quarterly newsletter.

2. <u>PRODUCTS</u>: What has the program produced?

Research projects awarded:

The Research Advisory Board has reviewed and approved three new research projects:

- "Long-Term Evaluation of Prestress Losses in Concrete Bridges using Long-Gauge Fiber Optic Sensors" (Princeton University)
- "Utilizing Unmanned Aircraft Systems for Infrastructure Management" (Rutgers University)
- "Refined Load Rating through Rapid Modal Testing" (Rutgers University)

Publications, conference papers, and presentations

Journal publications.

- *Deka, Devajyoti*. (2016). "The effect of mobility loss and car ownership on the feeling of depression, happiness, and loneliness." *Journal of Transport and Health*. http://dx.doi.org/10.1016/j.jth.2016.11.005.
- *Zolghadri, N.*, M.W. Halling, *N. Johnson*, and P.J. Barr (2016). Field Verification of Simplified Bridge Weigh-in-Motion Techniques. *J. Bridge Eng.*, Vol 21 Issue 10, Oct. 2016.
- *Chang, M*., Maguire, M., Sun, Y. (2017) "Eliminating Human Bias from Explanatory Variable Selection for Bridge Management Systems" *ASCE Journal of Infrastructure Systems*. *23(3)*
- *Bean, B*., Maguire, M., Sun, Y., "Predicting Utah Ground Snow Loads with PRISM" *ASCE Journal of Structural Engineering. Accepted January 2017*
- *Maguire, M., Chang, M.*, Sun, Y., Collins, W. N. (2017) "Stress Increase of Unbonded Tendons in Continuous Posttensioned Members" *ASCE Journal of Bridge Engineering*. 22(2).

Books or other non-periodical, one-time publications.

"Nothing to Report"

Other publications, conference papers and presentations.

- *Halling, M.W., N. Zolghadri, N. Foust, P.J. Barr* (2017). The Effects of Temperature Gradients on Dynamic Properties of a Highway Bridge. *TRB Testing and NDE of Transportation Structures Committee (AFF40)*, Washington D. C. Jan 2017. (Oral Presentation)
- *Tavakoli, R., Echols, A., Malakooti, M., Maguire, M, Pantic, Z*. *(2017)* "Design and Optimization of Road-Embedded Wireless Power Transfer Pads Based on Magnetizable Concrete Composite Material" IEEE-ECCE 2017 Conference. Cincinnati, OH. *Accepted January 2017*
- *Bean, B*., Maguire, M., Sun, Y. (2017) "Ground Snow Load Prediction in Utah" ASCE Congress on Technical Advancement, Duluth, MN. *Paper Accepted*
- *Greenberg, Michael R. Greenberg and Marc D. Weiner*, "Tunnels Under The Hudson with Water On The Rails: Assessing and Building Public Support for Funding a Critical Infrastructure Project," paper presented in November 2016 at the Association for Public Policy Analysis & Management (APPAM) 38th Annual Fall Research Conference in Washington, D.C..
- *Greenberg, Michael R. and Marc D. Weiner*, "Understanding the Public's Willingness to Pay for Critical Infrastructure Projects: Public Support for the Northeast Corridor's New York-New Jersey Hudson River Tunnels." Case Studies in Transportation Policy, currently under review.
- *Deka, Devajyoti, and Catrina Meyer*. "Comparison of Toll Payers with Alternative Route and Modes Users: Some Equity Implications." Paper presented at the 96th Annual Meeting of the Transportation Research Board, January 2017.
- *Dorafshan, S., Maguire, M*. "Bridge Inspection and Unmanned Aerial Vehicles: A State-of-the-Art Review" *Automation in Construction.* Elsevier*. Submitted November 2016, Under Second Review, Favorable Comments*
- *Deka, Devajyoti, Peter Jin, and John Betak*, "Practical Approaches for Making ADA Paratransit Facility Ownership and Location Decisions." Paper presented at the 96th Annual Meeting of the Transportation Research Board, January 2017.
- *Deka, Devajyoti, and Chihuangji Wang*. "Assessment of the Association of System-Related and Place-Related Variables with Bus Ridership in New Jersey." Paper presented at the 96th Annual Meeting of the Transportation Research Board, January 2017.

- *Herning, Gordana, Andres Roda, Ali Maher, and Sue McNeil*, "Resilience Considerations in Transportation Infrastructure," Symposium on Current Issues of Architecture and Construction, Armenia, November 21 2016.
- *Masoud, Emal, Clarke-Sather, Abigail R., and Righman, Jennifer*, "Application of Lean Philosophy in Bridge Inspection," The International Bridge Conference 2017, June 4-8, 2017, National Harbor, Maryland.
- *Imhoff, Paul*, "Reducing Roadway Runoff Volume & Nutrient Load with Biochar," 8th Annual Chesapeake Bay-Wide Stormwater Retreat, West Virginia, March 2017.
- Dr. Sue McNeil and Dr. Pei Chu from CAIT at UD made presentations on UTC related topics at the University of Calabria and the National Kaosiung Marine University, respectively.
- *Jalayer, Mohammad and H. Zhou*, "Exploratory Analysis of Run-off Road Crash Patterns." Paper presented at the 96th Annual Meeting of the Transportation Research Board, January 2017.
- *Bennert, Thomas*, "HighRAP Performance-Related Specification: Case Study on Interstate 295 in New Jersey." Paper presented at the 96th Annual Meeting of the Transportation Research Board, January 2017.
- *Jalayer, Mohammad, H. Zhou and B. Zhang,* "Evaluation of Navigation Performance of GPS Devices near Interchange Area Pertaining to Wrong-Way Driving." Paper presented at the 96th Annual Meeting of the Transportation Research Board, January 2017.
- *Liu, Xiang*, "Risk Comparison of Transporting Hazardous Materials in Unit Trains versus Mixed Trains." Paper presented at the 96th Annual Meeting of the Transportation Research Board, January 2017.
- *Li, Maoyun and Hao Wang*, "Study of Near-SurfaceShear Failure in Airport Asphalt Pavements Under Varying Aircraft Ground Maneuvering." Paper presented at the 96th Annual Meeting of the Transportation Research Board, January 2017.

Website(s) or other Internet site(s)

CAIT has established two internet sites:

- http://cait.rutgers.edu/cait/research to disseminate research results
- http://cait.rutgers.edu/cait/program-sites to inform about consortium program activities

Technologies or techniques

- CAIT and multiple DOT and university partners are creating the nation's first full-scale accelerated bridge deck testing facility in Piscataway, New Jersey. This facility, called the Bridge Evaluation Using Accelerated System Testing (BEAST), will test the effects of many years of heavy loads and extreme temperature and weather patterns on a full-scale concrete bridge deck over a short period of time. To leave the experiments undisturbed, observations will be recorded using a 24-hour closed circuit video recording system. The results of the study will give bridge engineers valuable new information about the longevity of preservation treatments and concrete materials that can be incorporated into future bridge repair and construction projects. Recently, the testing facility has been completed, and CAIT and its partners are working toward developing the first bridge deck sample for testing in the BEAST facility.

Inventions, patent applications, and/or licenses

"Nothing to Report"

Other products: outreach activities, courses and workshops

- CAIT won the prestigious designation as one of only 18 USDOT Beyond Traffic Innovation centers, tasked with identifying promising approaches that could solve transportation issues

specific to defined geographic regions. As such, The USDOT's *Beyond Traffic 2045* report presents the department's views on current and anticipated needs of the country's transportation network. Additionally, multiple Rutgers projects were referenced in the USDOT's *Research, Development, and Technology Strategic Plan (2017–2021),* notably CAIT's work since 2008 on the Long-Term Bridge Performance (LTBP) Program and the comprehensive online bridge data and performance analysis tool it developed with FHWA, the LTBP Bridge Portal. Also mentioned were the RABIT™ bridge condition assessment robot (also created in conjunction with the LTBP program) and CAIT's work on the team that developed workforce training program for the transit industry.

- On September 20, 2016, Javier Diez's wind energy startup company XPEED LLC was chosen as one of Best University Startups in the country and was featured in Washington, D.C at University Startup Demo Day, an event in the U.S. Capitol Building for members of Congress members and staff, VCs and others. CAIT provided the startup with UTC funding for the deflector work on this project, which allowed Diez's team to do their initial testing in the Appalachian Mountains. http://ored.rutgers.edu/content/two-startups-based-rutgers-inventions-chosen-best-university-startups
- On March 16, 2017, Dr. Franklin Moon and his team accepted the prestigious Charles Pankow Award for Innovation at ASCE's annual OPAL Awards Gala in Arlington, Virginia. The prize was awarded for Moon's Targeted Hits for Modal Parameter Estimation and Rating (THMPER™), a portable bridge evaluation tool that combines rapid testing, specially developed software, and a mobile data processing lab.

- Rutgers School of Engineering (SOE) doctoral student Milad Salemi was one of only two students invited to present his research at the 'Future Leaders in Transportation' workshop in December 2016. This event that was part of the USDOT 50th Anniversary celebration in which PHMSA collaborated with FHWA to encourage high school students to pursue STEM fields, and opening their eyes to the multi-faceted opportunities in the transportation industry. The invitation "STEMmed" from a PHMSA project Salemi is working on with SOE civil engineering faculty Dr. Hao Wang and Dr. P.N. Balaguru. CAIT supported Salemi's initial research with funds from its National UTC grant, laying the groundwork for the PHMSA research contract he is working on now.

- On September 16th members of CAIT staff participated in a UAS Disaster Response tabletop exercise, alongside members from the NJ Office of Homeland Security and Preparedness, U.S. Coast Guard, New Jersey State Police, NJDOT, and the Cape May County Office of Emergency Management. The exercise involved developing a concept of operations for a weather event disaster scenario, and utilizing emerging technologies to improve communications between emergency responders on the ground. In weather related emergency situations such as Super Storm Sandy, cellular communication is limited or completely lost due to infrastructure damage, creating additional challenges for emergency response crews in coordination and communication. It is important that these challenges be

addressed in order to help prepare for the next natural disaster. Also in attendance were American Aerospace Technologies and Verizon Communications, who are developing a test campaign using airborne communication systems to connect emergency response crews with each other, and the Regional Operations Testing Center.

3. <u>PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS</u>:

What individuals have worked on the program?

Program Director: Dr. Ali Maher

Project Directors: Dr. Sue McNeil (University of Delaware), Dr. Marvin Halling (Utah State University), Dr. Raimondo Betti (Columbia University), Dr. Lazar N. Spasovic (NJIT), Dr. Branko Glisic (Princeton University), Dr. Abdul R. Pinjari (University of South Florida), Dr. Soheil Nazarian (University of Texas at El Paso, Dr. Carin Roberts-Wollmann and Dr. Gerardo Flintsch (Virginia Polytechnic Institute).

Consortium Universities Involved:

Rutgers, The State University of New Jersey (Lead)
University of Delaware, Newark, DE
Utah State University, Logan, UT
Columbia University, New York, NY
New Jersey Institute of Technology, Newark, NJ
Princeton University, Princeton, NJ
University of Texas, El Paso, TX
University of South Florida, Tampa, FL
Virginia Polytechnic Institute, Blacksburg, VA

What other organizations have been involved as partners?

The consortium has collaborated with a number of external agencies across the United States:

New Jersey Department of Transportation	Trenton, NJ	Financial support and collaborative research on multiple projects, including ITS research and a time-accelerated infrastructure testing facility that will simulate extreme loads and environmental conditions in on a real bridge deck
Virginia Department of Transportation Virginia Center for Transportation Innovation and Research (VCTIR)	Richmond, VA	Collaborative research on multiple projects, including a time-accelerated infrastructure testing facility that will simulate extreme loads and environmental conditions in on a real bridge deck
Applied Research Associates, Inc.	Panama City, FL	Collaborative research on multiple projects, including a time-accelerated infrastructure testing facility that will simulate extreme loads and environmental conditions in on a real bridge deck
Drexel University	Philadelphia, PA	Collaborative research on multiple projects, including a time-accelerated infrastructure testing facility that will simulate extreme loads and environmental conditions in on a real bridge deck
ITS New Jersey (a state chapter of ITS America)	Trenton, NJ	Collaborative research and personnel exchanges for workshops, meetings, and conferences on ITS research
Parsons Brinckerhoff	New York, NY	Collaborative research and support on a number of research and technology transfer activities, including workshops, meetings, and conferences on ITS research
New Jersey Asphalt Paving Association	Trenton, NJ	Personnel resources, knowledge exchange, and technology transfer collaboration for annual paving conference
New Jersey metropolitan planning organizations (North Jersey Transportation Planning Authority, Delaware Valley	Newark, NJ; Philadelphia, PA; Vineland, NJ	Collaborative research and knowledge exchange for freight advisory committee and other improvement task forces and projects

Regional Planning Commission, and South Jersey Transportation Planning Organization)		
New York State Department of Transportation	Albany, NY	Personnel resources, knowledge exchange
Maryland State Highway Agency	Baltimore, MD	Personnel resources, knowledge exchange
Utah Department of Transportation	Salt Lake City, UT	Personnel resources, knowledge exchange, financial support
Idaho Department of Transportation	Boise, ID	Personnel resources, knowledge exchange, financial support
American Aerospace Technologies, Inc.	Bridgeport, PA	Personnel resources, knowledge exchange
University of Vermont	Burlington, VT	Collaborative research and partnership in the Northeast Regional Surface Transportation Workforce Center
Montana State University	Bozeman, MT	Collaborative research and partnership in the development of the National Center for Excellence in Roadway Safety
Clean Earth Dredging Technologies Inc.	Jersey City, NJ	Collaborative research, personnel exchange
JAFEC USA Inc.	San Jose, CA	Collaborative research, personnel exchange
ArtsBridge	Newark, DE	Collaborative research, personnel exchange
Cape May County	Cape May, NJ	Collaborative research on technology transfer events.
Delaware River Bay Authority	New Castle, DE	Collaborative research on technology transfer events.
MAGTUG	MidAtlantic	Served as a partner in delivering one-day meeting, helped with contacts, logistical support
Delaware T^2/LTAP	Newark, DE	Served as partner in delivering one-day meeting, helped with contacts and logistical support
Florida Department of Transportation	Tallahassee, FL	Financial support, knowledge exchange
Delaware Department of Transportation	Dover, DE	Collaborative research and financial support
National Cooperative Highway Research Program (NCHRP)	Washington, D.C.	Financial Support
McMahon & Mann Consulting Engineers, PC	Buffalo, NY	Collaborative research

Have other collaborators or contacts been involved?

- **collaborations with others within the lead or partner universities; especially interdepartmental or interdisciplinary collaborations**

Partner Meeting/Communication: The UTC partners communicated regularly throughout this reporting period.

Research Collaborations: The research selection process will yield many collaborative proposals to perform joint research with partners.

Ongoing collaborations for this reporting period include:

Accelerated Infrastructure Testing Facility: Bridge Evaluation Using Accelerated System Testing (BEAST)	• Utah State University • University of Delaware • NJDOT • VDOT	The consortium created a working group to exchange ideas and knowledge about the construction of a massive, time-compressed facility that will study the effects of extreme weather and temperatures on real concrete bridge decks.

	• Applied Research Associates • Drexel University	

• **collaborations or contacts with others outside the UTC**
Multiple DOT and University Partners

Additional ongoing collaborations include:

Northeast Regional Surface Transportation Workforce Center	• University of Vermont • CAIT • John J. Heldrich Center for Workforce Development	The objective of the new center is to forge relationships between private and public transportation agencies and an extensive network of education, labor, and workforce enrichment organizations to develop programs, resources, and opportunities aiming to prepare future transportation workers and provide current transportation workers with chances for career development.
National Center for Excellence in Roadway Safety	• Western Transportation Institute at Montana State University • CAIT	The center will offer training, technical support, and easily accessible information to transportation practitioners around the country, and provide national leadership in finding solutions to critical safety issues, especially on rural roads.

• **collaborations or contacts with others outside the United States or with an international organization (country(ies) of collaborations or contacts).**

Previously reported collaboration currently ongoing:

The Tokyo Institute of Technology is a research collaborator on the project titled "Utilization of Pneumatic Flow Tube Mixing Technique (PFTM) for Processing and Stabilization of Contaminated Soft Sediments in the NY/NJ Harbor"

4. <u>IMPACT:</u> What is the impact of the program? How has it contributed to transportation education, research and technology transfer?

The consortium's research activities and conclusions will be made available through workforce development and technology transfer efforts and reach over 12,000 transportation professionals nationwide, including consortium members, external university partners, government officials, and private industry partners.

What is the impact on the development of the principal discipline(s) of the program?

PROJECTS SELECTED DURING CURRENT REPORTING PERIOD

Outputs	Expected Outcomes	Impacts
"Long-Term Evaluation of Prestress Losses in Concrete Bridges using Long-Gauge Fiber Optic Sensors (Princeton University)	Potential products derived from this study include (1) the methodology for determination of prestress loss in a real structure and (2) methodology for the validation of long-term temperature and strain monitoring data. An outline of the methodologies will be available for future use in other projects.	Potential future implementations of this methodology include an integrated monitoring system for bridges and other structures with prestressed elements, and a research tool for better understanding of prestress losses in new concrete mixes (such as high performance concrete, "green" concrete and non-cementitious concrete).
"Utilizing Unmanned Aircraft Systems for Infrastructure Management" (Rutgers University)	This project could result in a training program for engineers regarding the best practices of how to implement UAS into their interchange inspections. It could provide additional information regarding flight planning, image	This research could lead to additional projects in identifying and developing best practices for other types of infrastructure assets. This could include utilizing UAS for traffic monitoring, highway inspections, bridge inspections, railway

	distances, sensor types, altitude, and safe distances necessary for a safe and productive inspection.	inspections, and other transportation assets.
"Refined Load Rating through Rapid Modal Testing" (Rutgers University)	The THMPER System might provide owners with an additional, cost-effective tool to address bridges that do not rate based on simplified procedures. The research team anticipates marketing the use of THMPER to perform rapid load rating of such bridges, and plans to provide webinars to help disseminate the results of this project and promote the use of THMPER.	Once validated, adopted as standard practice, and implemented at a large scale, the system is anticipated to significantly reduce the population of bridges that require posting. This reduction of posted bridges is expected to occur primarily due to the increased accuracy (decreased conservatism) associated with the ratings produced by THMPER. This will serve to significantly aid bridge owners in resource allocation and better prioritize bridge repair/replacement.

ONGOING RESEARCH PROJECTS DURING CURRENT REPORTING PERIOD

Outputs	Expected Outcomes	Impacts
"Infrastructure Issues Related to In-Motion Electric Wireless Power Transfer" (Utah State University)	The results of this particular phase of this project will answer some of the initial questions regarding feasibility of placing these units in pavement for use in long term installations. This work will also address the durability of different detailing practices so that the best practices can advance.	This project will provide transportation professionals and government agencies with an initial foundation in which to build an in-motion wireless charging on a large scale.
"Truck Route Choice Modeling Using Large Streams of GPS Data" (University of South Florida)	The overarching goal of this research is to utilize large streams of GPS data of truck movements to analyze the travel routes (or paths) freight trucks choose to travel between different origins and destinations. To this end, the project will develop truck route choice models for understanding the factors influencing freight-truck route choice patterns in metropolitan regions of Florida.	The findings of this research on truck route choice behavior will be communicated to the Florida Department of Transportation for potential use designing short-term truck routing policies aimed at congestion mitigation, improving reliability, and for maintenance of good repair. Besides, the truck route choice models developed in this research can potentially the Florida Department of Transportation, to improve their regional freight travel forecasting models for predicting truck traffic flows under alternative scenarios of highway network performance and truck routing policies.
"Installation of Thermocouples, and Analysis of Temperature Data from the 21st South Bridge" (Utah State University)	The main impediment of using global dynamic testing as a condition assessment technique, is that bridge dynamics are sensitive to changes in temperature, and less sensitive to small changes in bridge condition. Therefore an advance in finding a correlation between temperature and bridge dynamics can be used to isolate these effects, thereby	The long term collection of both temperature data as well as dynamic data on this bridge will be utilized by Utah State University and UDOT to validate design procedures in the future as well as assisting in understanding long term performance of UDOT's bridge inventory.

	allowing changes in dynamics to be an indicator of bridge condition.	
"Installation of Embedded Accelerometers in Precast Girders for the Nibley Utah Bridge" (Utah State University)	The work included in this proposal is the design and installation of embedded accelerometers, strain gages, and thermocouples throughout the bridge structure which can then be used for dynamic studies in the future. Additionally, this proposal covers the initial characterization of this bridge using the dynamic data and the comparison of that data with a validated structural model.	The expected outcome of this research is a report detailing the effects of temperature distribution on this bridge and therefore how the temperature affects can be considered and dealt with from future studies of dynamic condition assessment.
"Evaluating Electrical Resistivity as a Performance based Test for Utah Bridge Deck Concrete" (Utah State University)	The purpose of this research is to identify to what extent concrete resistivity measurements (bulk and/or surface) can be used as a performance based lab test to improve the quality of concrete in Utah bridge decks. By allowing UDOT to specify a required resistivity, concrete bridge deck concrete quality will increase and future maintenance costs will decrease.	From the developed protocols, engineers will have a faster, more economical, data driven performance based test for evaluating the durability of bridge deck concretes with respect to chloride induced corrosion and, potentially, other concrete attack phenomena.
"Investigating the effects of corrosion protection coatings on the ductility of welded wire reinforcement" (Utah State University)	Using the results from the laboratory testing, a statistical and mechanical models will be developed for the tested specimens. The results generated will, ideally, give engineers more information about the state of currently built WWR reinforced structures and the design guidance for new structures which may require more ductility than uncoated WWR.	Many state DOT and local agencies have already used coated and black WWR. In these instances, engineers will be assured of the effectiveness of their infrastructure through materials disseminated through the Wire Reinforcement Institute and USU LTAP. Furthermore, conference presentations will be made to academics and practitioners. Working with the surrounding DOTs (Utah, Idaho etc.) the results can ideally be developed into best practices and specifications.
"New Methodology for Evaluating Incompatibility of Concrete Mixes in Laboratory: A Feasibility Study" (University of Texas at El Paso)	The objective of this research project is to develop an easy to use, relatively inexpensive laboratory test and equipment to determine potential concrete mixture incompatibilities among the sulfate system, mineral and chemical admixtures.	It is the desire of the research team that the resulting test method to be practical enough so that it can be performed, ideally by the concrete producers, but also by a district laboratory during the mix design process.
"Evaluating corrosivity of geomaterials in MSE walls: determination of resistivity from power water chemistry" (University of Texas at El Paso)	The goal of this research is to develop a fundamentals-based model for calculating the electrical conductivity of pore water and moist soil. These models would allow evaluators to confidently judge the corrosivity of a geomaterial based on pore water chemistry.	This research will also allow the development of rigorous acceptance criteria for MSE backfill materials, and these acceptance criteria will be implemented in state and national protocols.

"Development of a Robust Framework for Assessing Bridge Performance using a Multiple Model Approach" (University of Texas at El Paso)	The primary product from this research is a robust, flexible framework to integrating disparate quantitative data sources on bridge performance using non physics-based models to provide reliable assessment and performance forecasting. This framework would be flexible in that it can readily integrate new data sources and multiple model forms if needed.	The proposed framework will be valuable not only for management decision-making for bridge owners at the state DOT level, but will also be valuable for research efforts into predictions of bridge performance. Adoption of the approach by state DOTs is dependent on showing value, and integrating smoothly with their existing management workflow.
"The Impact of Tolls on Access and Travel Patterns of Different Socioeconomic Groups: A Study for the Greater New York Metropolitan Area" (Rutgers University)	This research will analyze data from the 2011 household travel survey for the Greater New York Metropolitan area, conducted by the New York Metropolitan Transportation Council (NYMTC) and the North Jersey Transportation Planning Authority (NJTPA), to examine the potential impacts of tolls on the travel patterns of people in general and workers in particular. The impacts will be assessed regarding the use of alternative routes, modes, and destinations.	This research will inform policy makers and researchers about the potential impacts of tolls on the general population and workers belonging to different socioeconomic classes. The findings of the research can be used by the Federal Highway Administration (FHWA) and other branches of the USOT for education and training of transportation professionals. The research methodology will be particularly informative for researchers and professionals who evaluate toll projects.
"Ultra-Compact and Rugged Electrochemical Sensor for Monitoring Toxic Metals in Natural Water Sources" (Rutgers University)	The goal of this seed proposal is to build the framework necessary for the proposed platform and demonstrate proof-of-concept in the laboratory setting.	Multiple products that can be of use for the DOT will emerge from this research namely tools and platform technologies for non-destructive in-situ monitoring of the environment. The primary will be a probe that can be inserted tens of meters underground to map the levels of toxic compounds in water and sedimentation.
"Experimental Evaluation of the Engineering Behavior of Soil-biochar Mixture as a Roadway Construction Material" (University of Delaware)	The objective of this work is to advance a fundamental and mechanistic understanding of biochar's influence on soil strength-, deformation-, and flow-behaviors.	The long-term outcomes will impact some important policies and products that have practical significance to local and federal agencies that constantly deal with road-construction materials. The PI identifies Delaware Department of Transportation as the primary external client.
"Sustainable Geotextiles for Transportation Applications from Recycled Textiles" (University of Delaware)	The goal of this project is to explore the use of waste stream textiles as potential replacements for engineered geosynthetics in various transportation applications.	Collaborations with Goodwill of Delaware and Delaware County's Recycled Goods Manufacturing Initiative and SMART (Secondary Materials and Recycled Textiles) Industry Association will be established in order to disseminate research results and to interest recycled textile manufactures in exploring producing of a new product, geotextiles from waste stream textiles.
"Reducing Stormwater Runoff Volumes with Biochar Addition to Highway Soils"	The goal of this proposed research is to test the hypothesis that biochar addition to highway soils increases water infiltration,	The research proposed here will advance a new and environmentally sustainable stormwater technology that can potentially help the USDOT

(University of Delaware)	thus reducing stormwater runoff volume for treatment. Further, we hypothesize that biochar increases water infiltration through a multistep process: microbial populations are altered and increase, these population generate more extrapolymeric substances (EPS) that "glue" soil particles into aggregates, and soil aggregates increase preferential water flow and thus water infiltration.	meet the challenges of nutrient reduction in stormwater volume with at reduced costs. Results of this research will have important implications for the design, maintenance, and long-term performance of stormwater treatment systems containing biochar.
"Collaborative Proposal: The Connection Between State of Good Repair and Resilience: Measures for Pavements and Bridges" (Delaware, Virginia Tech, and Rutgers)	The goal of this research is to demonstrate the relationships among the concepts of resilience, other performance measures particularly related to state of good repair, and decisions related to improvement of pavements and bridges.	This research is most likely to inform policy and decision making. We will work with our clients at DelDOT and NJDOT to explore these ideas and present them in a form of value to DOTs.
"Prediction of Hydroplaning Risk of Trucks on Roadways" (Rutgers University)	The research goal is to develop an integrated hydroplaning model that can be used by transportation agencies to help reduce hydroplaning risk under various tire configurations and roadway conditions.	The research results will help state agencies better understand the mechanism of tire hydroplaning and design safer roadway considering comprehensive roadway characteristics (such as geometric design, drainage, pavement surface texture and groove, etc.). The quantification of pavement surface effects on hydroplaning will be useful in the selection of appropriate surface mixture and planning of pavement maintenance strategies.
"National University Transportation Consortium: A Speaker Recognition Based Damage Detection" (Columbia University)	In this proposal, we intend to cast the SHM problem within a statistical pattern recognition framework. It is an approach only based on data recorded during regular service operation and relies on the use of dense sensor arrays. With properly defined "damage sensitive features" (dsf), it would be possible to correlate these features from a dense array of data sets and establish their correlations. By looking at the variation in time of such correlations, it would be possible to learn about the regular operation of the bridge and determine events when damage has occurred.	The advances in computer and sensor technologies are pushing many areas (including structural health monitoring of civil structures) towards a greater use of measurement data, machine learning and statistical tools. This project will build on the results of a previous project and will continue the effort to extend to the diagnosis of the health of bridges and buildings methodologies that are currently used in other sectors of our society (e.g. bank security). If successful, it will represent a breakthrough in the way bridge inspections will be conducted in the future.
"Modeling the Impacts of Changes in Freight Demand, Infrastructure Improvements and Policy Measures on a Metropolitan Region" (NJIT)	The objective of the proposed study is to develop a modeling framework that would be able to ascertain the magnitude of impacts that an infrastructure improvement or a policy in conjunction with the changes in	The goal of every State DOT is to preserve transportation system investments, protect the environment, and utilize public resources in a responsible manner. The proposed framework can assist NJDOT to identify and elevate the

	truck traffic might have on a regional and local level as well.	opportunities and challenges associated with the movement of goods in New Jersey to the level of importance attached to the movement of people.
"Multi-Scale Condition and Structural Analysis of Steel Bridge Infrastructure" (University of Delaware)	The primary anticipated results of this research are the identification and quantification of the structural factors that are associated with significantly above- or below-average structural condition, and the exploration of structural behaviors that can be correlated to these observed condition trends.	It is envisioned that the research results could find application in the real world through enhanced recommendations for visual inspection practices and/or more durable future bridge designs. Similarly, the knowledge gained via this research could inform best practices for bridge retrofits on aging infrastructure.
"Lean Construction Applications for Bridge Inspection" (University of Delaware)	The desired outcomes are recommendations for improved and "lean" bridge inspection that could be used as content for a guide and online training for State DOTs and other relevant organizations that carry out bridge inspections.	By applying the concepts resulting from this research, State DOTs and bridge owners can improve the efficiency of their bridge inspections by cutting costs, improving safety, and reducing the impacts to the environment.
"Development & Implementation of NJ TRANSIT's Access Link Program" (Rutgers University)	Having a workforce and community that is able to make their own decisions for a transportation has been a good goal since the implementation of the Americans with Disabilities Act in the 1990s. By examining and analyzing the basis of the start of the program and its original goals and challenges, we can see how far it has come and where it needs to go.	By observing and documenting the historical record of NJ Transit's Access Link, policy makers are able to observe the significance of recognizing the value of inclusion and the process of demarginalization through a government program, which in turn could influence the direction of future policies.
"The Hudson River Rail Tunnel Like Study" (Rutgers University)	A summary academic report will be compiled and made available to planners and policymakers which will present an overview of the state of public opinion on the awareness of the need, the perceived importance of, and the willingness to pay for the refurbishing/replacement and/or supplementation of the North River Rail Tunnel links.	Public support for refurbishing and/or replacing these links is essential for transportation planners and policymakers. This effort will document the public opinion data to inform planners and policymakers.
"Improving the Durability of the Inverted T-Beam Bridge System" (Virginia Tech)	Inverted-T Beam systems have already been deployed, and VDOT is interested in future deployments and the development of standard details. Several cross-sections will be developed and standardized, and the topping mixture will be optimized to minimize cracking.	This project will develop further refinements to VDOT's new Inverted-T Beam system for rapidly constructed, highly durable short-to-medium span bridges.
"Characterization and Modeling of Recycled Pavement Sections" (Virginia	State DOTs are very interested in the use of recycling as a viable pavement rehabilitation procedure. This research will be a step	As part of the VDOT Accelerated Pavement Testing Program, VDOT has constructed recycled test sections. VDOT has been monitoring the

Tech)	forward in the understanding on the behavior and performance of recycled materials and recycled pavement sections. Furthermore, VDOT is planning to use the results of the associated project and this supplemental effort to guide on the adoption (or not) of the tested pavement materials.	performance of these sections, and the data collected from this effort will be used to understand the response and performance of recycled materials. This will allow engineers to better design more environmentally friendly and sustainable pavement solutions.
"Developing a Low Shrinkage, High Creep Concrete for Infrastructure Repair" (Utah State University)	The objective of this study is to develop concrete mixture that optimizes time dependent strains.	Concrete repairs represent a large tax payer burden, and the improvement of the lifetime performance of concrete repairs could save state DOTs a significant amount of maintenance funding.
"Development of Protocols and Instrumentation Plan for Accelerated Structural Testing Facility" (Rutgers University)	The protocols and instrumentation plan for the Bridge Evaluation and Accelerated Structural Testing facility will be developed.	The development of the protocols and instrumentation plan for the new facility will provide researchers with the ability to conduct experiments and aid in their acquisition of realistic and reliable data.
"Dynamic Effects and Friction Values of Bridge Moves for ABC Bridges" (Utah State University)	The results of this project will be incorporated into the AASHTO ABC Guide Specification through the NCHRP process.	This research will supply bridge designers with the specifications necessary for the development of bridges being constructed using Accelerated Bridge Construction techniques.
"Piezoelectric Energy Harvesting in Airport Pavement" (Rutgers University)	This project is conducting research into using piezoelectric technology embedded in pavement to harvest electricity, and will result in the development of smart pavements with multifunction to eventually generate renewable energy.	Initially, the results from this project will be implemented as a prototype in partnership with the FAA, and could lead to the development of smart pavements with multiple functions for future applications or environments.

PROJECTS COMPLETED DURING CURRENT REPORTING PERIOD

- "Load Testing and Analysis of 48 year old out-of-service Double Tee Girder Bridge" (Utah State University)
- "Carbon Fiber Shear Reinforcement for Prestressed Bridge Girders" (Virginia Tech)
- "Development of Concrete Mix Proportions for Minimizing/Eliminating Shrinkage Cracks in Slabs and High Performance Grouts" (Rutgers University)
- "Port Authority of New York and New Jersey Resiliency Initiative" (Rutgers University)
- "A Study on 3D Printing and its Effects on the Future of Transportation" Rutgers University)
- "Live-Load Testing and Finite-Element Modeling of a Fracture Critical Bridge" (Utah State University)
- "Unmanned Aerial Vehicle (UAV) based Traffic Monitoring and Management" (Rutgers University)
- "Initial Evaluation of the Albedo and Solar-Radiation Flux of Asphalt Pavements" (Rutgers University)
- "Long-Term Monitoring of a Geosynthetic Reinforced Soil Integrated Bridge System (GRS-IBS)" (University of Delaware)
- "Unmanned Aerial Vehicle (UAV) based Traffic Monitoring and Management" (University of Delaware)

Projects Previously Reported Completed:

- "Optimization of Pavement Surface Characteristics" (Virginia Tech)
- "Satellite Assessment and Monitoring for Pavement Management" (University of Delaware)
- "Methodological Framework for Optimal Truck Highway Parking Location and Capacity Expansion" (Rutgers University)
- "Development of a Risk Assessment Tool for Rail Transport of Flammable Energy Resources" (Rutgers University)
- "Bridge Health Monitoring using a Machine-Learning Strategy" (Columbia University)
- "Arrangement of sensors and Probability of Detection for Sensing Sheets Based on Large -area Electronics for Reliable Structural Health Monitoring" (Princeton University)
- "Bridge Retrofit or Replacement Decisions: Tools to Assess Sustainability and Aid Decision-making" (University of Delaware)
- "Using Information at Different Spatial Scales to Estimate Demand to Support Asset Management Decision Making" (University of Delaware)

What is the impact on other disciplines?

Previously Report Impacts on other disciplines:

"Bridge Health Monitoring using a Machine-Learning Strategy" (Columbia University)	The application of machine learning to bridge health monitoring extends the applicability of computer science concepts to physical applications. In this instance, the concepts are applied to structural engineering, but the potential exists that these concepts could be extended to applications in mechanical engineering as many systems and machines require monitoring to ensure proper functionality.
"Piezoelectric Energy Harvesting in Airport Pavement" (Rutgers University)	This project involves the application of piezoelectric devices to generate energy from airport pavement. This requires the expertise from various fields, such as civil engineering, electrical engineering, and materials science and engineering, and extends the applicability of these fields to new frontiers that have otherwise gone undeveloped.
"Arrangement of Sensors and Probability Detection for Sensing Sheets Based on Large-area Electronics for Reliable Structural Health Monitoring" (Princeton University)	The development and application of sensors and sensing sheets couples concepts from electrical engineering to applications of structural engineering. Additionally, applications can be further extended to fields such as mechanical engineering where monitoring of structures and machines may be necessary.
"Unmanned Aerial Vehicle (UAV) based Traffic Monitoring and Management" (Rutgers University)	The development of unmanned aerial vehicles requires collaboration among multiple engineering disciplines such as mechanical engineering and electrical engineering. The application of UAVs to transportation and infrastructure engineering further encourages the collaboration between multiple engineering disciplines. Additionally, it progresses the development of the technology and knowledge-base of each of the involved engineering disciplines.
"Development & Implementation of NJ Transit's Access Link Program" (Rutgers University)	The aim of this project is to observe and document the historical record of NJ Transit's Access Link. Through the observation of Access Link from this perspective, it provides the opportunity to trace the impacts of the program since its inception. In addition to the collaboration with historians, this project has the potential to be applicable to sociology as it enables us to observe the value and impacts of programs that seek inclusion and demarginalization. Additionally, the potential for collaboration with economic principles is present as the transportation is critical to the health of the nation's economy.

"Modeling the impacts of changes in freight demand, infrastructure improvements, and policy measures on a metropolitan region" (NJIT)	The objective of the proposed study is to develop a modeling framework that would be able to ascertain the magnitude of impacts that an infrastructure improvement or a policy in conjunction with the changes in truck traffic might have on a regional and local level as well. As this project deals with freight motion, this model could be potentially applicable to fields such as supply chain management.

What is the impact on the development of transportation workforce development?
It is anticipated that research projects will lead to the adoption of new practices, policies, or methods that will be disseminated to the transportation workforce through training. These training events will enhance the transportation industry through the creation of new career paths and an industrywide understanding of best practices and the USDOT state-of-good-repair mission. For example, Utah State University reports that UTC funding has resulted in a direct impact on the quality of their graduate and undergraduate programs in Civil Engineering. The impact has been felt most markedly in the discipline of Structural Engineering and Bridge Engineering. These students will graduate and many will become leaders in the transportation industry of the future. Also, the opportunity for the undergraduates to participate in these innovative projects encourages them to progress and pursue advanced degrees.

What is the impact on physical, institutional, and information resources at the university or other partner institutions?
It is anticipated that CAIT and its partners will share personnel and technological resources to streamline research, workforce development, and technology transfer efforts. For example, CAIT provides labor and online registration capabilities to record planned attendances to various conferences and workshops for other organizations, like ITS New Jersey.

What is the impact on technology transfer?
It is anticipated that research projects will lead to the adoption of new or more efficient practices or inform policy.

What is the impact on society beyond science and technology?
Workshops and conferences on advanced technologies, materials, and best practices will lead to the maintenance and construction of intelligent, resilient infrastructure systems that enhance commercial vitality and improve the safety, security, and quality of life for Americans who depend on them. For example, the project on electric wireless power transfer led by Utah State University will have an impact on all the traveling public and the way the future of transportation looks. In addition, the reduction of emissions and the positive effects on the urban environment will affect the overall population in many ways.

5. CHANGES/PROBLEMS

Changes in approach and reasons for change
"Nothing to Report"

Actual or anticipated problems or delays and actions or plans to resolve them
"Nothing to Report"

Changes that have a significant impact on expenditures
"Nothing to Report"

Significant changes in use or care of human subjects, vertebrate animals, and/or biohazards
"Nothing to Report"

Change of primary performance site location from that originally proposed
"Nothing to Report"

6. SPECIAL REPORTING REQUIREMENTS

"Nothing to Report"