

Pennsylvania Department of Transportation

RESEARCH PROGRAM

ACTIVITIES REPORT

F.Y. 2018-2019



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This is a report of research, innovation implementation, and technology transfer efforts carried out by the Pennsylvania Department of Transportation through the State Planning and Research Program of the Federal Highway Administration, U.S. Department of Transportation and the Pennsylvania Motor License Fund. The report describes activities during state fiscal year 2018-2019, covering July 1, 2018 through June 30, 2019.



INTRODUCTION

Dear Colleagues:

I am pleased to present the F.Y. 2018-2019 Research Program Activities Report, which details the efforts accomplished over the year in Pennsylvania-focused research projects, transportation pooled fund studies, technology transfer and program management and PennDOT's Local Technical Assistance Program (LTAP).

PennDOT is committed to moving Pennsylvania forward by investing in research project activities that attempt to solve real-world transportation issues addressing construction, design, maintenance, operations and safety, planning and policy and technology transfer. This report will demonstrate the broad diversity in the size, scope and content of the various research projects initiated under PennDOT's Research Program.

As another successful year ends, we look forward to F.Y. 2019-2020 where the Research Program Management Section (RPMS) will continue to initiate research projects that will move Pennsylvania forward and enable PennDOT to meet its strategic goals while identifying projects that will build upon one another.



Mr. Laine A. Heltebride, Bureau Director

Bureau of Planning & Research

Research Division Vision

To build relationships throughout the Department so that the Research Division is the go-to unit for research studies and innovation implementation.

Research Division Mission

The Research Division manages and coordinates research, education and technology transfer programs and projects on behalf of PennDOT. The Research Division strives to support PennDOT's strategic agenda by addressing vital transportation needs of the Commonwealth.

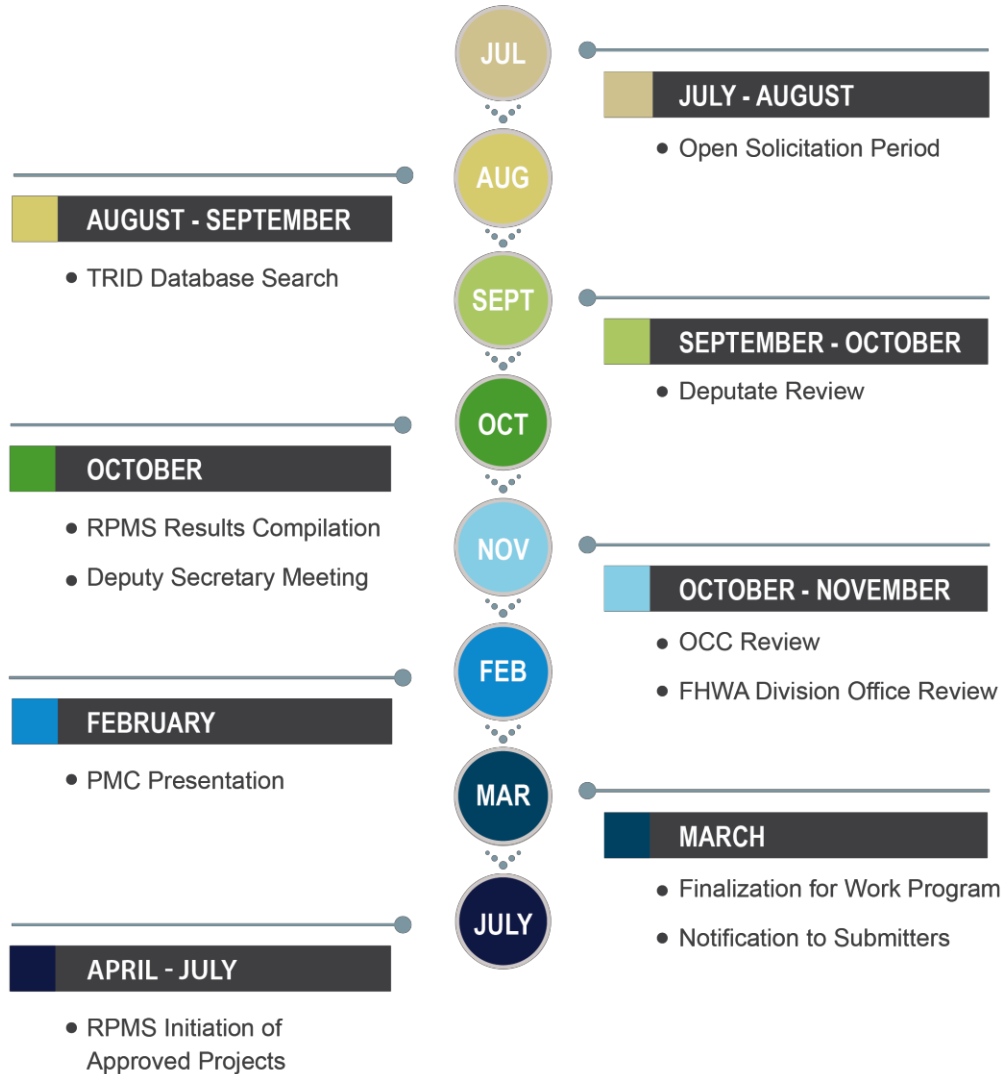
Research Program Overview

PennDOT's Research Program is developed, administered and managed by the Research Program Management Section (RPMS) of the Bureau of Planning and Research's Research Division. The RPMS has implemented an effective annual Research Program Solicitation Process, in accordance with the following steps:

1. Open Solicitation Period
2. Transport Research International Documentation (TRID) Search
3. Deputate Review of Topics Received During Solicitation Period
4. Results Compilation
5. Deputy Secretary for Planning Approval
6. Office of Chief Counsel (OCC) Review
7. FHWA Division Office Review
8. Program Management Committee (PMC) Presentation
9. Work Program Finalization
10. Notification to Submitters
11. Project Initiation

The RPMS staff works with the Bureau Directors, District Executives and Deputy Secretaries to prioritize all received Research Innovations Deserving Exploration and Analysis (IDEA) forms. From the amount of funding available to initiate new research projects, the staff ensures that the projects selected and initiated support PennDOT's key focus areas and that the Department obtains usable results from the projects as they are completed.

PennDOT Research Program Solicitation Process



In F.Y. 2018-2019, approximately \$1.8 million was provided to fund important research projects that addressed the vital transportation needs of Pennsylvania in the areas of construction, design, maintenance, operations and safety, planning and policy and technology transfer.

These investments are detailed on the following pages.

RESEARCH PROJECTS: F.Y. 2018-2019

Project Name	PennDOT Technical Advisor (TA)	Principal Investigator (PI)	F.Y. 2018-2019 Funds	Start Date	End Date
Request for Proposals (RFPs)					
Pennsylvania State Association of Township Supervisors (PSATS)					
PennDOT Local Technical Assistance Program (LTAP)	Brian Wall	Karen Atkinson	\$580,324.79	12/29/15	12/28/18
Department of General Services (DGS) University Master Agreements					
University of Pittsburgh (PITT) Projects					
Stormwater Analysis and Water Quality Assessment of Urban Areas	Daryl St. Clair	Xu Liang	\$81,021.00	02/14/17	10/13/18
Curb-Ramp Design (CRD) and Inspection System (CIS)	Rich Yakupkovic	Jon Pearlman	\$35,400.00	06/05/17	08/30/20
Carbon Nanotubes for Structural Highway Concrete	Steve Hurlbert	Steven Sachs	\$48,235.00	10/31/18	10/30/20
Temple University (TEM) Projects					
Environmental and Cost Effectiveness of Partially Grouted Riprap for Scour Countermeasure	Mittal Patel	Bechara Abboud	\$67,292.00	05/05/14	08/30/19
Electronic Construction Model Definition	Leroy Posey / Allen Melley	Joe Coe	\$65,525.00	01/04/19	09/03/20

RESEARCH PROGRAM ACTIVITIES REPORT – F.Y. 2018-2019

Project Name	PennDOT Technical Advisor (TA)	Principal Investigator (PI)	F.Y. 2018-2019 Funds	Start Date	End Date
Penn State University (PSU) Projects					
Effect on Aggregate Compaction Using Excavator Mounted Hydraulic Plate Compactors	Joe Cribben	Tong Qiu	\$109,998.96	06/27/18	06/27/19
Characterization of Reclaimed Asphalt Pavement (RAP) Asphalt Binder Properties Using Impact Resonance Testing (IRT)	Tim Ramirez	Mansour Solaimanian	\$9,802.90	03/01/19	10/01/20
Waterless Bridge Joint Cleaning	Justin Bruner	David Klinikowski	\$4,826.51	01/25/19	06/25/19
Pennsylvania Traffic Records Integration Plan	Robert Ranieri	Vikash Gayah	\$46,734.19	09/04/18	07/04/19
Optimizing Use of Crumb Rubber Modifier (CRM) With PA Asphalt Mixes	Tim Ramirez	Mansour Solaimanian	\$9,802.90	03/01/19	03/01/21
Other Contracting Mechanism					
Electronic Construction Management System (ECMS) Projects					
Project Management	Laine Heltebridle	McCormick Taylor Rick Shannon	\$14,939.88	03/11/16	12/09/20
Implementation	Laine Heltebridle	McCormick Taylor Michelle Goddard	\$10,837.51	02/15/17	12/09/20
2018 Research Symposium	Doug Zimmerman	McCormick Taylor Michelle Goddard	\$49,416.08	11/06/17	11/06/18
Joint Statewide Connected and Automated Vehicle Strategic Plan	Mark Kopko	Gannett Fleming, Inc. Eric Rensel	\$144,471.12	07/10/17	07/09/18
PA Flex Beam	Bill Koller	Modjeski & Masters Scott Eshenaur	\$176,489.79	11/07/17	04/03/19

RESEARCH PROGRAM ACTIVITIES REPORT – F.Y. 2018-2019

Project Name	PennDOT Technical Advisor (TA)	Principal Investigator (PI)	F.Y. 2018-2019 Funds	Start Date	End Date
Electronic Construction Management System (ECMS) Projects					
Quarter Inch Specification	Brian Wall	Penn State University Mansour Solaimanian	\$23,445.48	05/22/18	12/16/19
Double Chip Seal on Paving Fabric	Brian Wall	Penn State University Mansour Solaimanian	\$4,569.81	07/01/18	09/01/20
The Effect of Post-Consumer Recycled Asphalt Shingles (PCRAS) on Pavement Performance	Neal Fannin	Penn State University Mansour Solaimanian	\$65,593.69	06/11/18	01/11/21
MU-3 Stream Surveys – Mussels	Toni Zawisa	Michael Baker Robert Bondi	\$184,901.24	07/26/18	07/23/21
Stream Restoration Municipal Partnership and Standards	Daryl St. Clair	Stantec Consulting Elizabeth Kanner	\$30,028.44	12/07/18	12/31/19
PennSTART	Mark Kopko	HNTB Vijay Varadarajan	\$63,681.81	07/31/18	11/08/19

RESEARCH PROJECTS SPOTLIGHT

PUB 447: Approved Products for Low Volume Local Roads – Quarter Inch Specification Research Project

Currently in PUB 447 $\frac{1}{2}$ " aggregate is used in the single seal chip seals process, which works extremely well on more heavily traveled sections of municipal roads. The downside of the $\frac{1}{2}$ " aggregate is that it produces a rough surface which is noisy to drivers and in residential areas makes the surface rough to walk and bike on. With that being said, a request was made to PennDOT to evaluate finer aggregates that could be used on residential streets. Upon this request, PennDOT initiated a research project to study the possible use of $\frac{1}{4}$ " aggregate for single seal chip.

The *Quarter Inch Specification* research project tested $\frac{1}{4}$ " aggregates from numerous approved statewide sources, over three (3) construction seasons. During that time, the researcher worked with numerous municipalities on using a $\frac{1}{4}$ " size aggregate on roads with less than a 500 Average Daily Traffic (ADT) count. The use of $\frac{1}{4}$ " aggregates showed much success in the field and in laboratory testing. The end product will be the development of a Quarter Inch Specification that will be included in PUB 447.



Source: Tom Welker, PennDOT

Joint Statewide Connected and Automated Vehicle Strategic Plan

PennDOT completed its Statewide Connected and Automated Vehicle Strategic Plan, which will assist Pennsylvania in preparing for connected and automated vehicle advancements. The Strategic Plan looked at all of Pennsylvania, built upon existing research, identified the steps PennDOT should take to prepare for these technologies, defined a comprehensive set of focused, reasonable and deployable applications, considered various levels of investment, and provided PennDOT with information pertaining to the early deployment of connected and automated vehicles.

The research team provided the Department forty-five (45) objectives across nine (9) business areas: Maintenance and Operations; Design and Construction; Planning and Research; Information Technology and Security; Driver Licensing and Motor Vehicles; Modal Considerations; Policy and Legal; Outreach and Collaboration; and Workforce Requirements.



Source: PennDOT - Secretary Richards announcing the start of the AV Task Force in Pittsburgh, PA

Going forward, the Strategic Plan will be used as the foundation for policy and procedural decisions relating to connected and automated vehicles. The Department will work with the applicable business to work towards completing the objectives by working with key stakeholders and addressing the proposed actionable steps.

TRANSPORTATION POOLED FUND PROJECTS: F.Y. 2018-2019

Project Name	PennDOT Technical Advisor (TA)	Lead Agency	F.Y. 2018-2019 Funding
Continuous Asphalt Mixture Compaction Assessment using Density Profiling System (DPS)	Neal Fannin	Minnesota	\$25,000.00
Connected Vehicle Pooled Fund Study	Mark Kopko	Virginia	\$50,000.00
Developing Implementation Strategies for Risk Based Inspection (RBI)	Mike Winslow	Missouri	\$50,000.00
Development of an Integrated Unmanned Aerial Systems (UAS) Validation Center	Richard Runyen	Indiana	\$25,000.00
Pavement Structural Evaluation with Traffic Speed Deflection Devices (TSDDs)	Janice Arellano	Virginia	\$45,000.00
Exploring Non-Traditional Methods to Obtain Vehicle Volume and Class Data	Greg Dunmire	FHWA	\$50,000.00
Enhanced Traffic Signal Performance Measures	Daniel Farley	Indiana	\$30,000.00
National Partnership to Determine the Life Extending Benefit Curves of Pavement Preservation Techniques (MnROAD/NCAT Joint Study – Phase II)	Steve Koser	Minnesota	\$50,000.00
Building Information Modeling (BIM) for Bridges and Structures	Paul Brandl	Iowa	\$20,000.00
Performance Engineered Concrete Paving Mixtures	Patricia Baer	Iowa	\$15,000.00
Evaluating New Technologies for Roads Program Initiatives in Safety and Efficiency- ENTERPRISE [PHASE II]	Doug Tomlinson	Michigan	\$30,000.00
Stormwater Testing and Maintainability Center	Rich Heineman	Oregon	\$25,000.00
Improving the Quality of Highway Profile Measurement	Colin McClenahan	South Dakota	\$20,000.00
Clear Roads Phase II	Jon Fleming	Minnesota	\$25,000.00
Roadside Safety Research for MASH Implementation	Hassan Raza	Washington	\$50,000.00
Enhancement to the Intelligent Construction Data Management System (Veda) and Implementation	Dan Clark	Minnesota	\$25,000.00
Transportation Management Center (TMC)	Eric Sponsler	FHWA	\$25,000.00

RESEARCH PROGRAM ACTIVITIES REPORT – F.Y. 2018-2019

Project Name	PennDOT Technical Advisor (TA)	Lead Agency	F.Y. 2018-2019 Funding
Evaluation of Low-Cost Safety Improvements	Jason Hershock	FHWA	\$30,000.00
Traffic Control Device (TCD) Consortium	Justin Smith	FHWA	\$25,000.00
Technology Transfer Concrete Consortium (TTCC)	Neal Fannin	Iowa	\$8,000.00
Regional and National Implementation and Coordination of ME Design	Lydia Peddicord	FHWA	\$10,000.00
Improving the Quality of Pavement Surface Distress and Transverse Profile Data Collection and Analysis	John Van Sickle	FHWA	\$15,000.00
Aurora Program	Jason Norville	Iowa	\$25,000.00
Structural Design Methodology for Spray Applied Pipe Liners in Gravity Storm Water Conveyance Conduits	Sheri Little	Ohio	\$29,221.00

TRANSPORTATION POOLED FUND PROJECT SPOTLIGHT

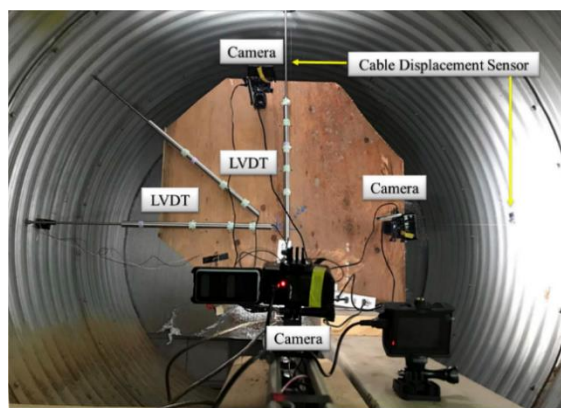
Structural Design Methodology for Spray Applied Pipe Liners in Gravity Storm Water Conveyance Conduits

Spray applied pipe liners is a trenchless technology that provides a method to structurally rehabilitate concrete and metal gravity storm water conveyance conduits with minimal impact to the travelling public. The liner consists of a cementitious or resin-based material that is applied in an existing host storm water conveyance conduit via a centrifugal remote applicator or by manual application. Sufficient soil support and stabilization of the host conduit is required prior to placement of the spray applied liner. The liner will provide the structural load carrying capacity without the requirement to adhere to the host conduit.

No single structural design methodology for a spray applied pipe liner currently exists. Vendors either apply design equations outlined in ASTM F1216, which are for Cured-in- Place Pipe (CIPP), or they use a variety of design approaches and conservatively select the maximum pipe liner material thickness.

The AASHTO Subcommittee on Bridges and Structures, T-13 Culverts and the AASHTO NTPEP Technical Committee on Spray Applied Pipe Liners collectively agree that the technology would be well accepted and utilized; provided the spray applied pipe liner creates a fully structural solution. However, the committees have identified the lack of a nationally accepted structural design standard as a roadblock to implementation.

Several DOT's have implemented structural spray applied pipe liners despite the lack of a national design standard or with the understanding that they will be designed according to CIPP design equations. Other DOT's are waiting for a national design standard to be developed prior to implementing the technology.



1st Control Test Setup – 60 in. Intact Circular Corrugated Metal Pipe – Inside Instrumentation

Note: LVDT = Linear Variable Differential Transformer

Currently, seven (7) state DOT's are participating in this pooled fund project – Delaware, Florida, Minnesota, New York, Ohio, Pennsylvania and Texas.

LOCAL TECHNICAL ASSISTANCE PROGRAM (LTAP)

The Local Technical Assistance Program (LTAP) is a national technology transfer initiative sponsored by the Federal Highway Administration (FHWA). There is a national network of fifty-eight (58) LTAP Centers - one (1) in each state, Puerto Rico and regional centers serving American Indian tribal governments dedicated to transferring transportation technology through training, technical assistance and other customer services to municipal elected officials and their staff.

The Pennsylvania Local Technical Assistance Program (LTAP) is housed in the Bureau of Planning and Research and has been in existence since 1983. PennDOT LTAP is designed to help Pennsylvania's municipalities, which maintain over 77,000 miles of roadways, make the best use of their roadway maintenance dollars. Also, PennDOT LTAP was created to share transportation knowledge, improve road maintenance and safety skills, and put research and technology into practice at the municipal level.

On a yearly basis, the PennDOT LTAP training and technology transfer program trains and assists municipal employees in effective and efficient maintenance procedures, essential safety practices and infrastructure management processes. Historically, PennDOT LTAP has augmented this training with one-on-one technical assistance sessions and the dissemination of pieces of information highlighting practical technological advances. PennDOT LTAP services include:

Training:

LTAP training takes many forms and is offered at little or no cost to municipalities. Training events include: scheduled workshop training, Roads Scholar courses, on-site roadshows and local product demonstrations.

Technical Assistance:

LTAP Engineers are available by phone, email and in person to help municipalities troubleshoot specific maintenance and safety problems on their roadways.

Newsletters and Technical Information Sheets:

The PennDOT LTAP newsletter is distributed twice a year to each Pennsylvania municipality, FHWA, metropolitan and rural planning organizations and other LTAP centers. The newsletter covers new programs, practices, technologies, legislation, reminders, and money-saving tips applicable to municipal maintenance and safety efforts.

In F.Y. 2018-2019, PennDOT LTAP provided the following services to Pennsylvania municipalities:

- **4,421** individuals representing **710** Pennsylvania municipalities attended LTAP classes.
- **202** classes for **36** course titles were held throughout Pennsylvania.
- **105** classes addressed maintenance topics and **98** addressed safety topics.
- **478** one-on-one technical assistance sessions were provided.



Source: Local Technical Assistance Program (LTAP), Roadmasters Roundtable

Build a Better Mousetrap National Competition

On a yearly basis, PennDOT LTAP holds a statewide Build a Better Mousetrap Competition. The statewide competition is open to all Pennsylvania municipal employees or crew who have designed and built an innovative gadget or developed an improved way to do a job. All entries are judged by a committee of municipal road employees in accordance with the following criteria:

- Cost savings/benefits to the community
- Ingenuity
- Transferability to others
- Effectiveness

Statewide winners were announced at the Pennsylvania State Association of Township Supervisors (PSATS) Annual Conference which was held in April 2019 at the Hershey Lodge. The 2019 statewide 1st place winner was East Brandywine Township, Chester County for the Spreader Rack entry. With this honor, the Spreader Rack entry was advanced to the Build a Better Mousetrap National Competition to compete for national recognition. The 2019 national level winners were announced at the annual LTAP National Conference which was held in August 2019 in Stowe, Vermont, at which East Brandywine Township's Spreader Rack entry placed 1st in the maintenance category. At this conference, Lou Ferretti and Karen Atkinson from the Pennsylvania Local Technical Assistance Program (LTAP) accepted the Mousetrap Award for East Brandywine Township.

Details on PennDOT LTAP Build a Better Mousetrap 2019 statewide winner are listed below.

Pennsylvania LTAP - Build a Better Mousetrap 2019 Winner – 1st Place



Source: East Brandywine, Chester County

Problem Statement:

When the salt spreaders were not being used, they were stored on the floor taking up space. When a spreader needed to be moved and mounted to the truck, it took two employees to hook the spreader to a chain so that it could be moved with a backhoe.

Discussion of Solution:

The road department created a portable storage rack for the spreaders. It holds four (4) spreaders that can be moved throughout the building and outside to a lift for truck mounting.

Labor, Equipment, Materials Used:

The rack was built using scrap lumber and the only material purchased were the wheels that swiveled. Approximately 10-man hours were used to build the rack.

Cost:

\$50 for the swivel wheels and bolts.

Savings/Benefit to the Community:

This saves time for the department by utilizing one employee and no manned equipment to install and remove salt spreaders from the trucks.



Source: NLTAPA
Karen Atkinson (PSATS) Louis Ferretti

PENNDOT RESEARCH DIVISION F.Y. 2018-2019



Contact Information

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RESEARCH COLLABORATION ACTIVITIES

2018 Research Symposium

The 2018 Research Symposium held on September 27-28, 2018 in Harrisburg, PA turned out to be a great success. The first day featured an opening session assembly/forum, with six (6) breakout sessions for a total of twenty-six (26) presentations from six (6) Pennsylvania Universities and a “research fair” that included a poster session and informational booths.

On Day two, PennDOT and FHWA staff met and discussed what was heard on the first day and to identify potential research projects that could be submitted for consideration for PennDOT’s F.Y. 2019-2020 Research Program. From discussions held on the second day, twenty-six (26) potential research projects were identified in the following five (5) topic areas:

- Asset Management
- Bridges
- Pavement and Materials
- Safety
- Traffic Operations and Connected and Automated Vehicles

The Symposium included over 120 transportation subject matter experts and university representatives from the following agencies/organizations and Pennsylvania Universities:

- Pennsylvania Department of Transportation
- Federal Highway Administration
- Pennsylvania Turnpike Commission
- Carnegie Mellon University
- Drexel University
- Lehigh University
- The Pennsylvania State University
- The University of Pittsburgh, and
- Temple University

An After-Action Survey was conducted, and the consensus was: overall the event went well, a number of lessons were learned for planning and hosting similar events in the future, and that this type of event should be held on a more routine basis. That being said, the plan is to hold a Research Symposium every three (3) years. The next Research Symposium is anticipated to be held in September 2021.

Impactful Resilient Infrastructure Science and Engineering (IRISE) Consortium

IRISE Consortium F.Y. 2018-2019 activities included the following:

- Participated in the development of an Annual Work Program.
- Attended a brainstorming session that identified a range of research topics of common interest to the IRISE Steering Committee members and the university faculty.

- Aided in defining the research topics identified in the brainstorming session so Problem Statements could be prepared in a standard format.
- Reviewed, commented and prioritized Problem Statements.
- Reviewed and approved the Annual Work Program that included completed Project Scopes of Work.

Below are two (2) planned projects set to begin in F.Y. 2019-2020 under the IRISE agreement:

“Early Opening of Concrete Pavements to Traffic” - The purpose of this project is to develop a strategy that can be implemented by IRISE members for the optimal timing of the opening of new concrete pavements to traffic.

“Improving Bridge Assessments” – The purpose of this project is to establish a framework capable of leveraging emerging SHM and NDE techniques to provide improved performance assessment of bridges. In particular, the proposed framework would focus on addressing the principal challenges associated with studying the service life of bridge structures, which are related to (a) the long-time scales (which requires accelerated aging), and (b) the diverse outputs related to bridge condition (in terms of data collected through Structural Health Monitoring Data (SHMD), Non-Destructive Evaluation (NDE), and visual inspection). The primary focus would be on identifying the synergies among bridge degradation remaining service life, and the results taken from the multimodal sensing technologies (such as SHMD & NDE).

University Transportation Research Center (UTC) Center for Integrated Asset Management for Multi-Modal Transportation Infrastructure Systems (CIAMTIS)

The Pennsylvania State University (PSU) was awarded a University Transportation Research Center (UTC) grant from the United States Department of Transportation (USDOT) in 2018. PSU partnered with Lehigh University, University of Delaware, Morgan State University, George Mason University, Virginia Tech and West Virginia University to form a seven (7) university consortium whose specific research area is asset management and multi-modal transportation infrastructure.

Part of a UTC award requires the UTC to obtain matching funds from non-Federal sources. During F.Y. 2018-2019, PennDOT and PSU have been negotiating a partnership agreement. Once this agreement is fully executed, it will enable collaboration between PennDOT, PSU and other CIAMTIS partners on a multitude of research, education, and technology transfer activities. The Partnership will provide sufficient flexibility to accommodate the needs of PennDOT, while being commensurate with the goals of the overall USDOT University Transportation Centers (UTC) program initiatives. It is envisioned that collaborative activities within the Partnership will be multi-modal, with a focus on highway and rail transportation modes.

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TECHNOLOGY MAINTENANCE
TRANSFER CONSTRUCTION
INNOVATIONS ! SAFETY


 **PENNDOT**

 REAL TIME
INCIDENT
DETECTION **LTAP**  POOLED
FUND
PROGRAM  **IDEA**

 OPERATIONS  APPROVED PRODUCTS

 PAVEMENT
EVALUATION CLEAR ROADS
POLICY  

DESIGN  **KEY**  **FOCUS**    

 **RESEARCH** **AREAS** **TRANSPORTATION**
IMPLEMENTATION  **PLANNING**