



# Technologies for Safe and Efficient Transportation

**A U.S. DOT UNIVERSITY TRANSPORTATION CENTER**

**Carnegie Mellon University**

**UNIVERSITY of PENNSYLVANIA**

## **Program Progress Performance Report for University Transportation Centers**

**Agency:** US DOT  
Research and Innovative Technology Administration  
UTC Program

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**Project Title:** **Technologies for Safe and Efficient Transportation (T-SET)**  
National University Transportation Center

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**Signature:** \_\_\_\_\_

## **Major Goals and Objectives of the Program**

### **Research, Development, Deployment**

The CMU-Penn T-SET UTC focuses on safety. Our research is specifically targeted at improving the safety of automotive drivers and passengers, bicyclists and pedestrians, and the safe usage of trucks and mass transit vehicles.

The thrusts of the T-SET UTC are structured along 5 core areas: In-Vehicle Technologies, Infrastructure Technologies, Human-Vehicle Interactions, Mobility/Data Analytics and Policy.

#### **Metrics:**

- Faculty scientific leadership as reflected by the number of publications and citations of faculty work in transportation-related areas;
- The number of staff, faculty and students involved in leadership positions in academic, industry and government transportation organizations;
- New research collaborations in fields related to this work;
- Successful technology deployments and their impact; and
- Patents and start-ups.

### **Education and Workforce Development**

Education and workforce development are important complements of the T-SET research program.

#### **Metrics:**

- Number of transportation-related courses,
- Students participating in transportation research projects,
- Advanced degree programs funding T-SET UTC students,
- T-SET UTC-funded graduate students,
- T-SET UTC-funded students who receive degrees,
- Institutional educational partnerships, and
- Participants in workforce and educational programs.

### **Technology Transfer**

The CMU-Penn UTC will fully use the resources and the experience of these university centers to promote enterprises arising from its research program. Faculty who already created startups in the past, serve as mentors to colleagues interested in this activity.

#### **Metrics:**

- Simple adoption of the innovation by a transportation operator, company or public, to more formalized outcomes such as licensing, patents, commercialization, and spin-off companies.
- Quantify numbers of meetings, attendance, publications, and social media and website activity.

### **Collaboration**

Collaboration is the heart of the entire T-SET program. CMU and Penn seek to ensure our research and development program leads to deployment of technologies in the transportation systems serving our communities and state, providing pilot applications for global use. The CMU-Penn team will collaborate with related centers on the two campuses, state and local public partners, non-profit community partners and industry partners.

- Number and diversity of members of both the T-SET Consortium and Advisory Council, and by the
- Number and impact of deployments achieved through collaboration.

## **Accomplishments Under Major Goals**

### **Research, Development and Deployment**

Below is a listing of outreach efforts T-SET staff and management personnel have engaged in over the past six months in support of advancing Research Development and Deployment projects:

Participated in a press conference with Pittsburgh Mayor Peduto and Council Members Gillman and Gross to announce the expansion of the Surtrac adaptive signal testbed from 24 intersections to 49 intersections. When operational toward the end of 2014 or early 2015, CMU will have a large testbed that also includes connected vehicle communication components.

- City of Pittsburgh Chief Innovation Officer Debra Lam
- Red Light Enforcement Camera Company
- Jim Sloss, City of Pittsburgh
- CMU Urban Systems Symposium
- Southwestern Pennsylvania Commission Regional Operations Planning Committee
- East Liberty Development Inc
- DOT Connected Vehicle Pilot Program Public Meeting in DC
- Press Conference with Pittsburgh Mayor Peduto on the SURTRAC Baum Center Adaptive Signal Project
- CMU Smart Infrastructure Incubator Symposium
- Trafficvision Visit to CMU
- Mayor of Pittsburgh's Chief of Staff Kevin Acklin
- Visit to the University of Michigan Transportation Institute
- Chuck DiPietro from the Southwestern Pennsylvania Commission
- Pennsylvania Turnpike Commission
- ITS America Leadership Circle Conference
- ITS America DC Fly-in Technology Showcase
- DC Autonomous Vehicle Demo
- Meeting with the Buhl Foundation

### **Education and Workforce Development**

T-SET held three seminars as part of our Faculty Seminar Series that presents research to the CMU student body. These seminars are webcast and made available to Consortium members and the general public.

Gave a presentation to an international group of 50 Bosch managers who were having an educational workshop at CMU.

Participated as a member of a panel advising on a training program for Michigan DOT engineers. The program is broad-based and includes ITS components, freight logistics and multi-modal integration. Some of the T-SET UTC research helps provide input for the training components.

Participated as a member of a business roundtable to offer ideas and guidance for making the Community College of Westmoreland County business program relevant to current needs.

Participated in a workshop with faculty and researchers of Heinz College, the College of Engineering and representatives of other universities and cities to explore a new initiative involving broad urban systems research -- a subset of which would be transportation.

Gave lecture to CMU Civil and Environmental Engineering class (Introduction to Transportation Engineering) about CMU's University Transportation Center research along with overview of autonomous and connected vehicle technology.

- Pittsburgh City Councilwoman Natalia Rudiak Open Data Seminar
- Pennsylvania Governor's School for the Sciences Opening Ceremony
- Meeting with Pittsburgh City Councilwoman Theresa Kail Smith
- Pennsylvania Highway Information Association

### **Technology Transfer & Collaboration**

Participated in two-day event in Washington, DC to give members of Congress rides in CMU's autonomous vehicle. The event included a press conference hosted by T&I Chairman Bill Shuster and included remarks by USDOT Undersecretary Peter Rogoff (designate) and NSF Deputy Executive Director Cora Marret.

Participated in a one-day meeting in Ann Arbor, MI of researchers from CMU and the University of Michigan Transportation Institute to explore research collaboration opportunities in the fields of autonomous vehicle policy, cyber security, and connected corridors.

Gave presentation on the keys to effective implementation of transport R&D results at a EU-US symposium in Paris and participated in deliberations and recommendations of 50-member group of researchers and practitioners.

Presented design and collaboration practices to implement highway context sensitive solutions as part of an FHWA sponsored webinar series at FHWA context sensitive solutions webinar on Level of Service and other performance metrics

Presented the results of Connected and Autonomous Vehicle 2040 Vision project at AASHTO's annual meeting of its Subcommittee on Highway Transport at PennDOT's request.

Presented the final results of Connected and Autonomous Vehicle 2040 Vision project to PennDOT Secretary Barry Schoch and his technical project team.

Presented the policy implications of connected and autonomous vehicle technology at OTMA's Annual Transportation Fair.

Presented the results of Connected and Autonomous Vehicle 2040 Vision project along with its policy implications to SPC's Policy Committee. (SPC is the Pittsburgh region's MPO.)

Participated on panel offering ideas to the Urban Land Institute on improved use of technology for Port Authority of Allegheny County. ULI was hired by Port Authority of Allegheny County to recommend strategic ways to enhance their transit service and operations.

Held the formation meeting of the Pittsburgh Chapter of Women's Transportation Seminar where a temporary board was formed.

- Presented to Takata about Autonomous Vehicles
  - University of Pittsburgh Institute of Politics Infrastructure Committee
  - Chamber Meeting with Mayor's Chief of Staff Kevin Acklin
  - Pittsburgh Chamber Benchmarking Trip to Denver
  - Summer Meetings of UTC and CUTC in Lincoln
  - Dave Roger President of the Hillman Foundation
  - Campus Visit from Staff of the Governor's Office to learn about Traffic21/T-SET Research
  - Attended the Intelligent Transportation Society of America Annual Meeting in Philadelphia
  - Attend Board Meeting of the Local Government Academy
  - Attend Oakland 2030 District Kick-Off Event
  - Meeting with Liz Burkett from Collins Engineering
  - Pittsburgh/Philadelphia Joint Legislative Reception in Harrisburg
  - PennDOT SHRP2 Capability Self Assessment Workshop
  - Pennsylvania Safety Symposium in Harrisburg
  - Present T-SET Research at Pittsburgh Mayor's Televised Clean Tech Forum
  - Present T-SET and Traffic21 Research to the Southwestern PA Commission at Indiana University of PA
  - Attend Pittsburgh Supercomputing Center Meeting with PA Lt. Governor Jim Cawley
  - T-SET UTC Consortium Meeting at CMU
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- Meeting with IBM Dublin Researchers
  - Present Traffic21/T-SET Research at the Intelligent Transportation Systems World Congress in Detroit
  - Meeting with City of Pittsburgh Chief of Innovation and Performance Debra Lam

## **Plans for Next Reporting Period**

Activity Plans for April 2014 through September 2014:

### ***Research***

Enhance connected vehicle test bed Pittsburgh

### ***Education and Workforce***

Teach ITS Course at Carnegie Mellon University

Recruit Women in Transportation Fellow

Present T-SET research at the PSU Transportation Engineering & Safety Conference

Present T-SET research at Transportation Research Board

Host Transportation Research Fair at Carnegie Mellon University

Transportation Club host meetings with Transportation Leaders from community

### ***Collaboration***

Hold T-SET Consortium Meeting in Philly

Host meeting of Advisory Group

### ***Technology Transfer***

Conduct two T-SET Faculty Seminars

Host UTC Safety Conference

### ***Diversity***

Host Events for Women's Transportation Seminar

Recruit female UTC work-study students

## **2. PRODUCTS**

**See Appendix A for specific research project products including publications, technologies, and inventions.**

### **General Program Products**

Weekly distribution of T-SET newsletter with 910 subscribers and an above industry average open rate.

Presence on social media, 332 followers on Twitter

### **T-SET in the Media**

Efforts have been made to promote T-SET UTC activities through the media. Below are some examples of T-SET media exposure from September 2013 – April 2014. Click on hyperlink to view articles.

[3 Driverless Car Projects that May Change How the World Travels](#) Solutions for State and Local Governments

[Race for the Mission Viejo Council seat](#) Orange County Register

[The Secret History of the Robot Car](#) The Atlantic

[Establishing a Robotics Fellowship at Penn Engineering's GRASP Lab](#) UPenn Almanac

[Mazda will let you keep your high-beams on without annoying everyone](#) PCWorld

[Pittsburgh Mayor Peduto Credits CMU's UTC for Expanding Real-Time Traffic Signals](#) Friendship Community Group Fall Newsletter

[CMU-developed smart headlights help drivers cut down on glare](#) Pittsburgh Business Times

[Deputy Executive Director Stan Caldwell Speaks at Clean Technology Roundtable \(23 minute mark\) - July 31, 2014](#)

[Robot Dramas: Autonomous Machines in the Limelight on Stage and in Society](#) The Huffington Post

[Pennsylvania STICs to innovation for improved road safety](#) USDOT Fastlane Blog

[Could Pittsburgh be a hub for clean technology?](#) Pittsburgh Business Times

[Heinz Students Break Down Barriers to Urban Development in State Transportation Policies](#) Heinz College Blog

[Grandview traffic problems will garner extra police attention](#) SoPghReporter

[Toyota-ITC Gift Will Support Penn Research on Automotive Electronic and Computer Systems](#) Penn News

[Timed Travel: Amateur transit spotter tries to fill PAT's real-time information void](#) Pittsburgh City Paper

['Performance parking' can lower average parking rates while raising more money for Pittsburgh](#) Pittsburgh Post-Gazette

[Shuster praises driverless car after second ride, in D.C.](#) PublicOpinionOnline

[Driverless Car: Congress Gets Taken for a Ride and Loves It](#) Newsmax

[Driverless Cars, a Convergence of Technological Innovations](#) KC Infazine

[Members of Congress Channel Their Inner George Jetson on Unique Ride](#) ABCNews

[Self-driving car wheels Rep. Bob Gibbs around the U.S. Capitol](#) Cleveland.com

[Demonstrating a driverless future](#) Phys.org

[Self-Driving Cadillac SRX Tested By Lawmakers In Publicity Campaign](#) Investing.com

[Capitol Hill gets a front-seat look at driverless car, new push for roads](#) The Washington Times

[GM And Carnegie Mellon Take On Google And Bring Autonomous Cadillac SRX To Capitol Hill](#)

## Appendix A.

### **Mobility Analytics Center**

PI: Sean Qian, CMU

#### **Products Associated:** Databases, Software/Netware

We focused on integrating and learning large-scale transportation data sets that are immediately available to collect and the most promising from public agencies and travelers. We are developing a database that integrates multi-modal transportation data, and a web application to disseminate information for decision making.

**Impact:** We chose the City of Pittsburgh as a demonstration city. Pittsburgh has been successful in moving towards smart cities and smart transportation systems, with ample resources for us to collect and work with large-scale citywide data.

The mobility data center will

- Provide archived and real-time traffic data of every element of multi-modal transportation systems
- Reveal the behavior information for both passenger transportation and freight transportation
- Serve as a key managerial instrument for legislators, transportation planners, researchers, and engineers
- Serve as a key information platform for individual travelers and transportation industries.

#### **Impact in other disciplines**

The mobility center will allow open data access for research in other discipline, such as economics, engineering, operations research, social science.

#### **Task List**

- First we carefully chose one of the prevailing web-based Geographic Information System (GIS) tools, base on which our data engine will be built.
- We interviewed data resource providers in the City of Pittsburgh to gauge range of opportunities, and barriers to data sharing and to data exchange. We developed a memorandum among data providers to ensure their participation in developing this data engine.
- We proposed standardized data formats for those data sets, identified its ability of real-time accessibility, and examined the health conditions of traffic sensors.
- We are building a pilot transportation network model for the City of Pittsburgh that describes individual travel activities on roadway systems, transit systems and parking systems. Travel demand and travelers' behavior among those three systems are estimated and forecast using the all available data sets combined.

#### **Goals & Timeline**

We will keep developing the database and front end of the mobility data center, and find two case studies to illustrate the validity and effectiveness of the data analytics in decision making for both travelers and public agencies. The development is expected to end at the end of March 2015.

### **AUTOMATED DETECTION WITH REARVIEW CAMERAS**

PI: Vijayakumar Bhagavatula, CMU

**Other Collaborators:** Shayok Chakraborty

Dr. Shayok Chakraborty joined this project as a post-doc in August and we are currently doing a literature survey to identify all the developed methods to detect objects in images obtained from rear cameras on vehicles. This will be followed by an analysis of existing approaches, development of new object detection methods and evaluation of those methods on video data sets.

**Impact:** When completed, this project has the potential to reduce the number of backover accidents.



**Impact on other disciplines:** Methods being developed for object detection in videos from rear cameras can be useful for other object detection applications in computer vision.

#### **Task List**

1. Collection of images and image sequences representing the conditions of back-over accident cases.
2. Development of methods for object detection in image sequences from rear cameras
3. Evaluation of the object detection performance of the developed algorithms.

#### **Goals & Timelines**

Preliminary data collection (November 30, 2014)

Development of initial object detection method (December 31, 2014)

Evaluation of the performance of initial object detection method on the acquired image sequences (January 31, 2015)