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**Signature:** 

## 1. Accomplishments

The University of Michigan at Ann Arbor (UM), in partnership with Purdue University, University of Illinois at Urbana-Champaign (UIUC), University of Akron (UA), Central State University (CSU), and Washtenaw Community College (WCC), established the USDOT Region 5 University Transportation Center: Center for Connected and Automated Transportation (CCAT). The FAST Act research priority area for CCAT is promoting safety and CCAT will focus its efforts in the field of comprehensive transportation safety and congestion management by taking advantage of connected vehicles, connected infrastructure, and autonomous vehicles. This report documents the progress for the reporting period November 30, 2016 through May 31, 2017.

### 1.A Administrative

The team held a kick-off meeting on January 27, 2017. At the meeting several key areas were discussed and agreed upon:

- **Vision:** Maintain regional and national leadership in connected and automated transportation system research, education, and training.
- **Mission:** Significantly impact the evolution of the U.S. next-generation transportation systems with emerging technologies on safety, mobility, and sustainability. Provide national and regional leadership for connected and automated transportation research, science, education, training, and deployment.
- **Steering Committee:** Establish the consortium's role as a focal point for research and education activities in Region 5. Enable consortium members to share the research needs of their local partners, identify opportunities for collaborative research efforts, monitor program activities to ensure regional priorities are addressed, and coordinate educational, workforce, and technology transfer activities. Develop and implement the project selection process. Work directly with the Director to ensure grant requirements are met. Meet during the project selection process timeframe to select the CCAT research projects that will be awarded for that year. Ensure that the projects are:
  - Within the scope of CCAT
  - Collaborative within CCAT and/or the region

Steering committee members include representation from all consortium organizations and include Srinivas Peeta (Purdue), Imad Al-Qadi (UIUC), Ping Yi (Akron), Alan Lecz (WCC), Krishna Kumar Nedurnuri (CSU), Yafeng Yin (UM CEE), Debby Bezzina (UMTRI), and led by Henry Liu (UMTRI – CCAT director).

- **Advisory Board:** Guide and develop the CCAT strategy. An eclectic group of board members will work with the CCAT Director to develop overall center strategies. Board members will build new connections and opportunities for the consortium through their networks of stakeholders and funders. The advisory board has not yet been established but prospective members include Jim Sayer (UMTRI Director), Huei Peng (MTC Director), Srinivas Peeta (Purdue), Howard Lazarus (Ann Arbor City Administrator), Mike Shulman

# Program Progress Performance Report

(Ford), Gary Smith (GM), Colin Castle (Michigan DOT), Cynthia Jones (Ohio DOT), Eddie Curtis (FHWA), Steve Misgen (MN Metro Traffic), and Michelle Mueller (WCC).

- Organizational Structure:** CCAT is led by Henry Liu (UMTRI). The organization has two main focus areas: Outreach and Research. Each of those areas can be further broken down as depicted in Figure 1 below.

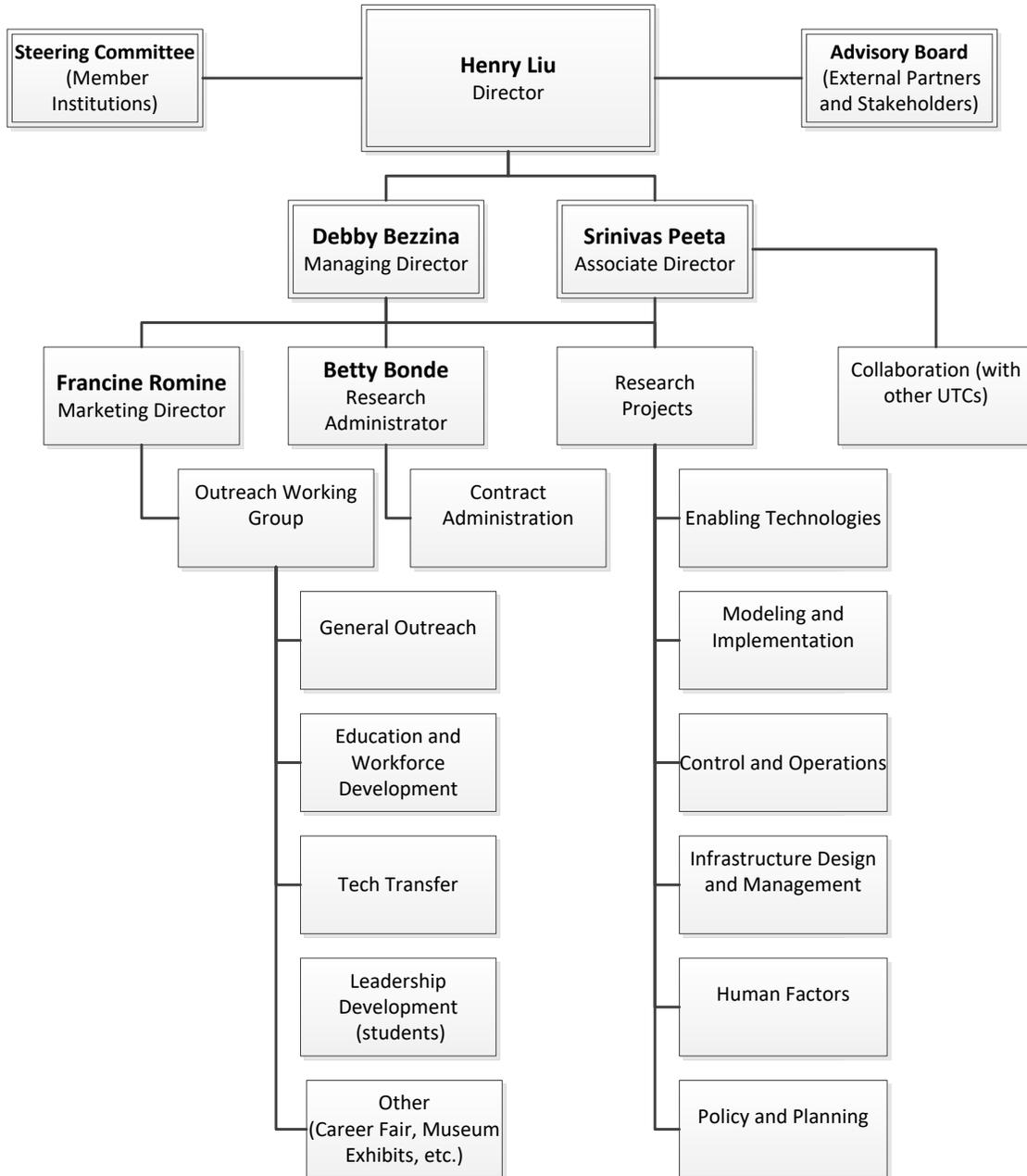


Figure 1: CCAT Organizational Structure

Additionally, we organized and held the OST-R site visit to formally launch the CCAT UTC. The site visit was held on May 10, 2017. OST-R attendees included Kevin Womack, Dawn Tucker-Thomas, and Amy Stearns. Each of the CCAT organization presented an overview of one of their projects selected for 2017. Tours and demonstrations were also arranged for the group and included a Simulator Lab tour and demonstration; the Mcity Traffic Control room tour and demonstration; the VAD installation facilities tour; the Navya AV demonstration drive; and a V2I/V2V demonstration drive on the streets of Ann Arbor.

## 1.B Research Progress

CCAT research targets six areas: (1) Control and Operations; (2) Infrastructure Design and Management; (3) Human Factors; (4) Policy and Planning; (5) Modeling and Implementation; and (6) Enabling Technology. In this reporting period, the following research projects were identified for 2017 CCAT funding:

### University of Michigan

1. **Driving Etiquette:** Apply the deep learning technique to establish standards and serve as basis to ensure autonomous vehicles drive "like safe human drivers." This project will collect a large amount of naturalistic driving video data from the Ann Arbor CV deployment and selected partner organizations' areas (equip 50 volunteers' cars with a smart phone). The data will be used to train algorithms to learn about "what is appropriate" (use a combination of machine learning and Monte Carlo tree search techniques).  
**PI:** H. Peng  
**Status:** Not Started. Final statement of work and project plan under development. Will be started in the Fall 2017 semester.  
**Research Thrust:** Enabling Technologies  
**CCAT Funds:** \$150,000  
**Cost Share:** None
2. **CAV Data Infrastructure and Access:** Develop process for general access to CAV data generated by researchers at UM. Also, develop code books for data deposits.  
**PI:** H. Liu  
**Status:** Not Started. Final statement of work, project plan, and budget under development. Planned start date of August 2017.  
**Research Thrust:** Infrastructure Design and Management  
**CCAT Funds:** \$31,696 (estimated)  
**Cost Share:** Contribution may be provided by other UM organizations that are heavy data users (Mcity, UMTRI)
3. **AV IQ Test:** Design an evaluation system to determine the intelligence of AVs.  
**PI:** H. Liu, Y. Feng  
**Status:** Not Started. Final statement of work and project plan under development.  
**Research Thrust:** Modeling and Implementation

**CCAT Funds:** \$150,00

**Cost Share:** None

4. **Development of an Augmented Reality Environment for Connected and Automated Vehicle Testing:** Using real vehicles as background traffic for CAV testing is not only costly, but also difficult to coordinate and control. To address the limitation, in this project we develop an augmented reality testing environment, in which background traffic is generated in microscopic simulation and provided to testing CAVs to augment the functionality of the test facility. The augmented reality combines the real-world testing facility and a simulation platform, in which movements of testing CAVs and traffic signals in the real-world can be synchronized in simulation, while simulated traffic information can be provided to testing CAVs' communication system.

**PI:** H. Liu

**Status:** Augmented reality framework complete and operating at Mcity. Two scenarios have been developed: (1) red light violation where a virtual vehicle is generated and will run the red light, the CAV under test will detect the virtual vehicle and stop to avoid the collision, even though the CAV has the right of way; and (2) railway crossing where a simulated train will be detected by the CAV and the CAV will stop and wait for the train. Several scenarios will be developed future reporting periods including CACC platooning, eco approach and departure, and signal priority.

**Research Thrust:** Modeling and Implementation

**CCAT Funds:** \$150,00

**Cost Share:** None

5. **CAV-Based Intersection Maneuver Assist Systems and Their Impact on Driver Behavior, Acceptance, and Safety (CAVIMAS):** Develop a concept of intersection maneuver assistance system in a simulated driving environment to empirically examine driver behaviors and mental models. Study driver behaviors related to use of (1) in-vehicle driver interfaces for warning, (2) automated intersection maneuver assistance controls, and (3) integrated driver display warning and vehicle control systems, including the drivers' perception and acceptance of these systems.

**PI:** S. Bao, A. Pradhan

**Status:** Planned start date June 2017.

**Research Thrust:** Enabling Technologies

**CCAT Funds:** \$150,00

**Cost Share:** None

6. **Enhancing Network Assignment Models:** Develop a simulation model for shared mobility that explicitly models the behaviors of both service operators and travelers.

**PI:** Y. Yin, N. Masoud

**Status:** Completed a literature review of existing network equilibrium models that consider shared-use mobility services and identified a few relevant studies. However, the literature review confirms that existing models cannot adequately model shared-use mobility services. In the next reporting period, a network equilibrium model will be

developed with distributed shared-use mobility system and the system-level matching model for the centralized assignment approach.

**Research Thrust:** Modeling and Implementation

**CCAT Funds:** \$35,044

**Cost Share:** \$121,182

7. **An Investigation of User Responses to Connected and Autonomous Vehicles using Prompted Choice Experiments:** Introduce users to CAV technologies utilizing MTC properties. Gather responses and analyze. Also compare these responses of users with CAV experience/knowledge, with previous studies that benchmarked the response of users without direct experience.

**PI:** T. Bills

**Status:** Planned start date September 2017

**Research Thrust:** Human Factors

**CCAT Funds:** \$31,000

**Cost Share:** None

## University of Akron

1. **Access Control at Major-Minor Intersection through CAV in Mixed Traffic:** This research studies gap characteristics and utilization at intersection entrances when CAV is mixed with ordinary vehicles (non-CAV) to improve intersection operations. The impact of data communication between the experimental vehicle and the RSU will be investigated on the reliability and effectiveness of the control logic implementation. The expected benefits on intersection efficiency improvements at different levels of CAV market penetration will be summarized.

**PI:** P. Yi

**Status:** Not started.

**Research Thrust:** Control and Operations

**CCAT Funds:** \$75,000

**Cost Share:** \$75,000

## Purdue University

1. **Development of dynamic network traffic simulator for mixed traffic flow under connected and autonomous vehicles:** This study will develop a unified car-following modeling framework that models mixed traffic streams under different market penetration rates of CAVs. It will also perform stability analyses to explore implications for safety and mobility.

**PI:** S. Peeta

**Status:** Planned start date August 2017.

**Research Thrust:** Control and Operations

**CCAT Funds:** \$76,735

**Cost Share:** \$76,735

2. **Develop in-vehicle information dissemination mechanisms to reduce cognitive burden in the information-rich driving environment:** This study will conduct interactive driving simulator-based experiments to understand the impacts of real-time information characteristics and multiple dissemination sources on driver cognition, and its effects on the driver decision-making process and ability to comprehend information safely. Data will be collected on driver route choice behavior and physiological factors (such as eye movements, brain electrical activity and heart rate) under real-time information provision. These physiological factors will be used to determine cognitive effects (such as cognitive workload, distraction, and level of engagement). The collected data will be used to develop behavior models to investigate the impacts of cognitive effects induced by real-time traffic information, situational factors (such as trip purpose and traffic congestion), real-time travel information characteristics (such as amount, content and source) and individual driver characteristics (such as age, gender and education). These models will be used to design safe and effective information dissemination mechanisms.

**PI:** S. Peeta

**Status:** Planned start date August 2017.

**Research Thrust:** Human Factors

**CCAT Funds:** \$119,595

**Cost Share:** \$120,650

3. **Non-connected vehicle detection using connected vehicles:** During the transition to CV technologies, there will be mixed traffic streams of CVs (with vehicle-to-vehicle communication capabilities) and non-CVs. To improve the efficiency and reliability of traffic operations under mixed CV environments, there is the need not only for observable CV location data, but also unobservable non-CV location/trajectory to realize efficient and reliable CV-based applications. This study proposes a hidden Markov model, which is a probabilistic inference approach, to identify non-CV locations/trajectories. This methodology will be integrated with a cooperative-situation awareness framework. The proposed model will be analyzed using real-world vehicle trajectory data to aid the situational awareness of CVs under low market penetration rates.

**PI:** S. Peeta

**Status:** Planned start date August 2017.

**Research Thrust:** Control and Operations

**CCAT Funds:** \$76,000

**Cost Share:** \$76,000

4. **Cooperative control mechanism for platoon formation of connected and autonomous vehicles:** This study focuses on CAV-based control mechanisms to holistically determine the acceleration/deceleration rate of each CAV in a platoon to maximize platoon performance. It designs a cooperative control mechanism for a CAV platoon under

realistic vehicle-to-vehicle (V2V) communication environments. Thereby, CAVs can leverage information from other CAVs through V2V communication to collaborate under a joint objective such as systematically optimizing platoon performance while incorporating consensus (for example, to maintain certain inter-vehicle time headway). The impact of information delay and topology of information that is exchanged among vehicles on platoon dynamics will be analyzed. The optimal time headway and platoon size to maximize fuel efficiency of the CAVs in the platoon will be determined.

**PI:** S. Peeta

**Status:** Planned start date August 2017.

**Research Thrust:** Control and Operations

**CCAT Funds:** \$75,805

**Cost Share:** \$80,000

5. **Design of urban landscape and road networks to accommodate CAVs:** There is a need for transportation planners and policymakers to revisit existing urban landscape and road network design guidelines and develop new design guidelines to accommodate the transition to full adoption of CAVs in the future. The transition period can be classified into: initial adoption of CAVs at low market penetrations, mixed CAV and non-CAV traffic, and full adoption of CAVs. We will analyze and develop urban landscape and road network designs to accommodate CAVs that can maximize safety and comfort for all road users, including motorists, public transit users, cyclists and pedestrians. Then, these designs will be evaluated based on a stated preference survey of road users to understand their perceived safety and comfort levels. The similarities and dissimilarities of different types of road users' preferences will also be studied using statistical and econometric methods. The results and insights will be used to develop urban landscape and road network design guidelines in a CAV environment.

**PI:** S. Peeta

**Status:** Planned start date August 2017.

**Research Thrust:** Infrastructure Design and Management

**CCAT Funds:** \$75,000

**Cost Share:** \$69,750

6. **Pedestrian-vehicle interaction in a CAV environment – explanatory metrics:** The motivation for this study is to measure the interaction between pedestrians and motorists, so that the variety of expected interactions between pedestrians and autonomous vehicles can be documented

**PI:** J. Fricker

**Status:** Planned start date June 2017.

**Research Thrust:** Human Factors

**CCAT Funds:** \$70,000

**Cost Share:** \$70,000

7. **AVs' impacts on energy demand and GHG emissions:** The potential impacts of automated vehicles (AVs) are far-reaching and complex. They include direct impacts on

safety, vehicle operations, energy, environment, and personal mobility, as well as secondary impacts on travel behavior and land use. The objective of the proposed work is to examine the potential effects of automation on energy demand and GHG emissions from vehicles. To achieve this, improved projections of future travel demand and patterns in response to AVs will be obtained using a behavioral experiment (survey and focus groups), and the energy and carbon intensity of vehicle travel will be estimated.

**PI:** K. Gkritza

**Status:** Planned start date July 2017.

**Research Thrust:** Planning and Policy

**CCAT Funds:** \$65,000

**Cost Share:** \$65,000

## University of Illinois at Urbana-Champaign

1. ***Operations of connected and autonomous freight trucks under congestion and infrastructure cost considerations:*** This proposal aims at developing an integrated connected and autonomous truck routing model that simultaneously considers interdependency between traffic lane/"track" use, platooning, and pavement deterioration and rehabilitation, such that the total life-cycle societal costs due to infrastructure investment, traffic delay, and pavement life-cycle costs are minimized.

**PI:** I. Al-Qadi, Y. Ouyang, J. Roesler, H. Ozer, H. Meidani

**Status:** The project plan and budget were finalized. Students to work on the project were identified and assigned to each task. A total of five part-time students will be working on the project, in addition to five researchers. Although work has started, the official starting date is August 2017 (Fall 2017 semester). By the end of the fall semester, the Vehicle-infrastructure instrumentation and integration via CAV task will be completed. Progress will be made toward modeling of pavement deterioration and rehabilitation during the fall with a plan to complete the work by the end spring semester.

**Research Thrust:** Modeling and Implementation

**CCAT Funds:** \$232,060

**Cost Share:** \$232,060

### 1.C Outreach Progress

In this reporting period, the outreach working group was established. The outreach working group meets monthly. Discussion topics include general outreach, education and workforce development, technology transfer, leadership development (students), career fairs, museum exhibits, and other outreach opportunities. The meeting is also used as a general program forum to coordinate CCAT activities. The following activities were completed:

## Washtenaw Community College (WCC)

WCC has three main areas that are currently being pursued as part of the CCAT outreach initiative. The following is a description of the outreach activity, accomplishments, training and professional development opportunities, and planned activities for the next reporting period.

- 1) Develop a certificate of completion training program for the field of transportation technicians and other job functions related to the skilled technician work in the Connected and Automated Vehicle and Transportation industry cluster [CAV/CAT].
  - a) Status:
    - i) Established a kick-off meeting and a cadence of regular meetings.
    - ii) Identified team organization, roles, and responsibilities.
    - iii) Created a project work plan.
    - iv) Began surveying and interviewing transportation infrastructure companies for job descriptions, skills and competencies required for field technicians in CAT areas.
    - v) WCC Executive Leadership toured the new American Center for Mobility at Willow Run Airport properties to obtain facility information.
    - vi) Established a contract for office space at ACM for the purpose of offering workforce training in CAV/CAT technologies.
    - vii) WCC President convened meetings with the State of Michigan and Ann Arbor SPARK Economic Development and other community colleges in the Southeast Michigan region to discuss partnerships in offering CAV/CAT workforce training at the ACM.
    - viii) Gathered first input data on the role of the contrasting Transportation Engineer.
    - ix) WCC announced it will open an office at the American Center for Mobility [ACM] by June 30, 2017 to offer workforce training related to Connected and Autonomous vehicles. Wayne County Community College District, and Macomb CC will join in the training effort. Workforce needs include skills training and apprenticeships in CAV/CAT technologies.
    - x) Currently developing the engineering concepts portion of training for use with industry at the ACM.
    - xi) Posted and interviewed candidates for a Corporate Instructional Designer in the WFD area.
  - b) Training and Professional Development Opportunities:
    - i) With the announcement that WCC will open an office at the ACM, the goal is to create training programs which could be customized for employers and help students earn certificates of completion. The implementation process will commence on June 30, 2017.
  - c) Planned activities for the next reporting period:
    - i) Continue work plan activities.

- 2) Develop credit education programs to address the growing demand for talent in STEM-oriented occupations in the emerging Connected and Automated Transportation industry cluster.
  - a) Status:
    - i) In-process of reviewing current articulation agreements in IT technologies with partner 4-year universities in C++ programming and applied data management.
    - ii) Early definition of gaps and potential opportunities for desired articulation agreements.
    - iii) Started meetings with selected 4-year institutions to develop new agreements.
    - iv) Reviewed a dormant Pre-Engineering Program and began defining updates.
    - v) Worked with the WCC Computer Information Systems [CIS] and Arts and Sciences departments to re-activate the Pre-Engineering program. During discussions with the University of Michigan, a new articulation opportunity may be developing into its School of Information.
    - vi) WCC interviewed candidates for an Engineer-in-Residence position, to consult with faculty and guide the development of curricula and experiential activities. A candidate was selected and contracting is in process.
  - b) Training and Professional Development Opportunities:
    - i) A cross-functional meeting has been scheduled July 26 to bring together IT/CIS instructors with Automotive Technology instructors for the purpose of identifying and developing integrated skills sets in courses/curricula meeting industry's needs related to CAV/CAT.
    - ii) WCC is sponsoring two of its students in CAV/CAT related programs to attend the Center for Automotive Research Management Briefing Seminars July 30-August 3. These students will be coached and mentored while attending all automotive and transportation seminars to learn about industry developments on virtually all fronts, and to meet and network with industry representatives and employers.
    - iii) The Advanced Technology Dean, IT Faculty and the ATC Director are planning to attend the Car Management Briefing Seminars, July 30-August 3, with topics ranging from Connected & Automated Vehicles, to Mobility, Design & Innovation, Fuel Economy/Emissions Policies and Manufacturing.
    - iv) The Computer & Information Systems department has scheduled a Lunch & Learn event for September 28 on the topic of "Automotive Cyber Security- Next Challenges and Approaches". The presenter will be the VP of Cybersecurity at Lear Corporation. The audience will be faculty, instructors, students and administrators from the IT, Automotive Services and Workforce Development areas of WCC.
  - c) Planned Activities for the Next Reporting Period:
    - i) Continue work plan activities.

- 3) Foster K-12 STEM career pathways in Connected and Automated Transportation fields and student dual enrollments in related certificate and degree programs.
  - a) Status:
    - i) Established a kick-off meeting with project partners, established roles, responsibilities and resources.
    - ii) Created a project work plan.
    - iii) WCC participated with sixteen WCC staffers to support a Square One Education Network [SOEN] Innovative Vehicle Design Mobility Challenge event at Mcity, May 6, 2017. Approximately sixty high schools competed. WCC staffers also promoted its Advanced Transportation Center of educational programs, especially to high school juniors and seniors.
    - iv) WCC is seeking eligible funding for SOEN to run multiple two-day CAV/V2X Workshops from July through November 2017.
    - v) Commenced planning for the above multiple two-day high school workshops in the fall 2017 for schools in the Greater Ann Arbor Region.
    - vi) Scheduled SOEN non-credit training for youth this summer at Parkridge Community Center, Ypsilanti, MI, an economically disadvantaged community.
    - vii) The WCC Business and Computer Information Systems activity identified plans to host K-12 educational activities as follows:
      - (1) Conduct CAV/CAT boot camps following the C++ certificate program.
      - (2) Conduct a session of the SOEN/WCC "Cars that Communicate" V2X technology Youth Camp, to be offered free of charge to low income or disadvantaged youth from Ypsilanti and Eastern Washtenaw County.
  - b) Training and Professional Development Opportunities:
    - i) Opportunities for training are presently in the planning stages. See above.
  - c) Planned Activities for the Next Reporting Period:
    - i) Continue work plan activities.

## University of Michigan

The University of Michigan outreach activities span a wide range of topics. For this reporting period, the activities described below were the main focus. Additionally, marketing materials were produced such as posters and banners.

- 1) Distinguished Lecture Series: At a minimum of twice per year, invite a distinguished guest to give a presentation on their work in the CCAT area. The presentation will be held live at UMTRI and also broadcast to the consortium organizations (Purdue, UIUC, Akron, CSU, and WCC), as well as any other Region 5 colleagues that are interested.
  - a) Status:

- i) Scheduled inaugural event for October 4, 2017 from 2:00 – 3:00 PM.
    - ii) Confirmed Dr. Chris Hendrickson as the inaugural speaker. Chris is the Hamerschlag University Professor Emeritus, Civil and Environmental Engineering at Carnegie Mellon University.
    - iii) Began making arrangements for Dr. Hendrickson’s visit.
  - b) Training and Professional Development Opportunities:
    - i) Professional development is inherent to the lecture series and will be offered to faculty, staff, students, and other CCAT stakeholders including government and industry.
  - c) Planned activities for the Next Reporting Period:
    - i) Advertise the event.
    - ii) Finalize travel plans for Dr. Hendrickson.
    - iii) Plan hosting activities for Dr. Hendrickson to showcase CCAT.
- 2) CCAT Annual Symposium on Connected and Automated Vehicles and Infrastructure
- a) Status:
    - i) Selected date for 2018 Symposium – March 6-8, 2017
    - ii) Kick-off event planning
  - b) Training and Professional Development Opportunities:
    - i) No formal PDUs are planned at this time
  - c) Planned Activities for the Next Reporting Period:
    - i) Send out save the date flyers for the event
    - ii) Finalize conference format
    - iii) Invite and confirm keynote speaker(s) and panel moderators.
    - iv) Coordinate with other organizations for pre-meeting annual conference
    - v) Finalize tours and demos
- 3) CAV Certification Program: Fifteen credits including 2 new CAT classes plus three electives from existing courses. The certificate program will be introduced in the fall of 2017 and be offered to existing master’s degree students. The long-term goal is to offer this to new college of engineering enrollees.
- a) Status:
    - i) Began developing the CAT Fundamentals course and selected the instructors. This course will be based off an existing executive education class that is offered at UM.
    - ii) Began developing the CAT Professional Practice course and selected the instructor.
  - b) Training and Professional Development Opportunities:
    - i) Certificate from UM
  - c) Planned Activities for the Next Reporting Period:
    - i) Finalize CAT Fundamentals course curriculum.
    - ii) Finalize CAT Professional Practice course curriculum.
- 4) Leadership Development: support student organizations by providing funding and assistance for them to host a guest lecturer in the CAT field. Also provide funding and support to attend CAT-related conferences.

- a) Status:
  - i) Met with the College of Engineering to establish a new student organization MiTSO (Michigan Transportation Student Organization). MiTSO will be an umbrella organization for ITS, ITE, and ASCE. However, only ASCE has established a student chapter at UM.
  - ii) Met with ITS Michigan to begin process of establishing a student chapter at UM.
  - iii) Attended the MiTSO kick-off meeting and discussed the level of support that CCAT is willing and able to provide.
- b) Training and Professional Development Opportunities:
  - i) Once MiTSO has been established, we can begin assisting the students with hosting events. The events will allow them to learn about opportunities in the transportation industry as well as to begin building their professional network.
- c) Planned Activities for the Next Reporting Period:
  - i) Organize first MiTSO event.
  - ii) Establish ITS Michigan student chapter.

In addition to the above activities, the following UM outreach events occurred that helped propagate the connected and automated transportation knowledge base:

- Participated in conferences:
  - TIA panelist for CAV testbeds moderated by Ken Leonard (11/30/16).
  - Congress of Automotive Repairs and Service (CARS) Conference – Q&A session for a live audience moderated by Robert Redding (5/18/17).
- Gave media interviews:
  - Associated Press – interview for article on the Audi system being deployed in Las Vegas (12/6/16).
  - WDET Public Radio – interview on CAV and CCAT (12/15).
  - MLive – interview on the current state of the industry and how the NPRM will impact it (12/19/16).
  - Consumer’s Report – CAV interview and V2X demonstration drive (1/6/17).
  - Consumer’s Report – Podcast with live studio audience at UMTRI (1/7/17).
  - Freelance reporters Jim Motavalli and Brad Berman – CAV interview, tour of Mcity, and V2X demonstration drive (1/11/17).
  - Seattle Times – interview on connected vehicle technology (2/2/17).
  - CBS This Morning – CAV interviews; CV, AV, and CAV demonstration drives at Mcity (3/7/17).
  - Ratchet Wrench - Interview on Connected Vehicle activities and experiences at the University of Michigan and future plans. The focus is on automotive repair and the impact of connected vehicles on automotive repairs and the skills needed for those repairs (4/18/17).
- Met with industry stakeholders:

- Ford – CAV overview for Ford engineering managers, tour of Mcity, V2X demonstration drive, AV demonstration drive (2/23/17, 4/6/17, and 4/10/17).
- Toyota – discussed the importance of CAV technology and gave a V2X demonstration drive (3/1/17).
- Michigan Connected and Automated Working Group – Introduce CCAT and present the status of AACVTE (4/27/17).
- Met with academia and governments:
  - KIST (Korean Institute of Civil Engineering and Building Technology) and Western Michigan University – overview of CCAT and the Ann Arbor Connected Vehicle Test Environment, V2X demonstration drive, and tour of Mcity (3/29/17).
  - Purdue – interview on Connected Vehicle activities and experiences at the University of Michigan and future plans as part of a research project being conducted at Purdue (4/14/17).
  - University of Michigan – participated in Robotics Day by presenting an overview of CCAT and announcing the CAV master’s certificate program (4/11/17).
  - Lawrence Tech University – CAV presentation, AV and V2X demonstration drives (4/17/17).
  - NYC DOT (CV Pilot) – interview on current status of AACVTE with respect to DSRC device specifications, vendor selection, and technical performance (4/6/17).
  - EPA – presented AACVTE and potential benefits of CAV on the environment (4/13/17).
  - University of Michigan – V2X demos for CAV short course enrollees. The enrollees are from industry (5/8/17).
  - Aberdeen Test Labs – presented the CAV activities at the University of Michigan including SPMD, AACVTE, Mcity, and CCAT (5/17/17).

## 1.D Deliverables

The main deliverables for this reporting period were:

- Website ([ccat.umtri.umich.edu](http://ccat.umtri.umich.edu))
- Directory of Key Personnel posted to website
- Data Management Plan
- Research Project Description for “An Investigation of User Responses to Connected and Autonomous Vehicles using Prompted Choice Experiments” entered into RiP.

Deliverables planned for next reporting period are:

- Complete all research project descriptions and enter into RiP and post to the CCAT website.
- Update the website to include planned outreach events.

## 2. Products

In this reporting period, the following products were created:

### University of Michigan

- Henry Liu filed a patent for Simulated Vehicle Traffic for Autonomous Vehicles (EFS ID 29096023). The intellectual property was generated under the project “Development of an Augmented Reality Environment for Connected and Automated Vehicle Testing” with federal funds and will be submitted via iedison in the next reporting period.
- The CCAT website was launched (ccat.umtri.umich.edu).
- Several presentations were given at the twenty-three various outreach events (see outreach status above).

### Washtenaw Community College

- A WCC news release was made at the Detroit Regional Chamber’s Michigan Economic Policy Conference, “*Washtenaw Community College Brings Workforce Development to American Center for Mobility*”, dated May 31, 2017. The release stated Washtenaw Community College is allying a consortium of community colleges to develop training for skilled professionals at the American Center for Mobility (ACM). The college is opening an office on the ACM campus to work with employers on the development of connected and automated vehicles. The office is expected to open in June.
- The Detroit Free Press release by Eric D. Lawrence, May 30, 2017 stated in its headline “*Colleges plan to connect with self-driving test site that was former Willow Run bomber plant*”.
- The Detroit Regional Chamber issued a press release, June 1, 2017, entitled “*Community Colleges’ Talent Pool to Play Large Role in Michigan’s Mobility Future*”.
- MLive issued a press release May 31, 2017, entitled “*Washtenaw, Wayne County colleges to offer connected-vehicle training*”.
- Crain’s Detroit Business reported the WCC announcement- see “*Washtenaw, Wayne community colleges join in training project at American Center for Mobility,*” by Lindsey Van Hulle, May 31, 2017.
- Following the above news release, a presentation was made at the Detroit Regional Chamber Mackinac Policy Conference, “*Creating the Talent Pipeline for the Mobility Workforce,*” June 1, 2017, which included WCC President Rose Bellanca, WCCCD Chancellor & CEO Curtis L. Ivery, Michigan Dept. of Talent & Economic Development Director Roger Curtis; and Ann Arbor SPARK President & CEO Paul Krutko.
- Interviews with WCC President Bellanca following the above announcements occurred with the following news media: WWJ 950 AM, WJR 760 AM, WEMU, MiWeek, MLive and the Detroit Free Press.
- Meeting planned June 14 with the University of Valenciennes, France, to share and discuss each other’s educational programs related to CAV/CAT and Mobility.

### 3. Participants and Other Collaborating Organizations

One of the CCAT goals is to collaborate with other organizations within the CCAT consortium, within Region 5, and nationally. The following tables summarize the collaborations that occurred during this reporting period.

#### University of Michigan

<b>Organization Name</b>	Mcity (formerly the Mobility Transformation Center) at UM
<b>Organization Location</b>	Ann Arbor, MI
<b>Organization Contribution</b>	Funding for additional projects including a pedestrian detection deployment and the transportation control room. Collaboration on joint project selection process.

#### Washtenaw Community College:

<b>Organization Name</b>	Michigan Dept. of Transportation
<b>Organization Location</b>	Lansing, MI
<b>Organization Contribution</b>	Collaborative activities and support on the development of CAV Infrastructure and talent requirements

<b>Organization Name</b>	Center for Automotive Research
<b>Organization Location</b>	Ann Arbor, MI
<b>Organization Contribution</b>	Collaborative research on CAV and Infrastructure developments and talent requirements

<b>Organization Name</b>	Ann Arbor SPARK
<b>Organization Location</b>	Ann Arbor, MI
<b>Organization Contribution</b>	Community and industry collaboration on CAV and Infrastructure developments and talent requirements

<b>Organization Name</b>	MICHauto- The Detroit Regional Chamber
<b>Organization Location</b>	Detroit, MI
<b>Organization Contribution</b>	Collaborative on advocacy, awareness, business attraction and talent requirements for all aspects of the automotive and transportation industries

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<b>Organization Name</b>	Integral Blue
<b>Organization Location</b>	Madison Heights, MI
<b>Organization Contribution</b>	Collaborative research on job skills and descriptions. Reference projects include: MDOT RSU Deployment, MDOT SEMTOC Systems Integration, MDOT Metro Region Wireless Path

<b>Organization Name</b>	Michigan Academy of Greater Mobility Advancement [MAGMA] – part of the Workforce Intelligence Network for SE MI
<b>Organization Location</b>	Southeast Michigan, Michigan
<b>Organization Contribution</b>	As a convener organization, MAGMA brings together automotive manufacturing companies, educational institutions, and the workforce development system to ensure the automotive industry has the engineering and technical talent needed to support connected, autonomous, hybrid, electric, lightweight, alternative fuel, and other advanced vehicle technologies.

<b>Organization Name</b>	Ypsilanti Community Schools
<b>Organization Location</b>	Ypsilanti, MI
<b>Organization Contribution</b>	A partnership with WCC that identifies high school students interested in STEM careers to participate in key college learning activities, and who may be eligible for dual enrollment to earn an Associate’s Degree in their 5 <sup>th</sup> year.

<b>Organization Name</b>	Square One Education Network [SOEN]
<b>Organization Location</b>	Waterford, MI
<b>Organization Contribution</b>	Square One’s “Signature Series” of STEM projects enable high school students to incorporate innovation and engineering into their design of a wide variety of complex vehicles. This family of Innovative Vehicle Design projects provides students with a real-world, authentic learning opportunity, including connected and autonomous technologies.

<b>Organization Name</b>	Washtenaw Technical Middle College
<b>Organization Location</b>	Ann Arbor, MI
<b>Organization Contribution</b>	Students and teachers to participate in project activities

<b>Organization Name</b>	Greater Ann Arbor Prosperity Region Consortium [State of MI organized]
<b>Organization Location</b>	Ann Arbor and surrounding communities, MI
<b>Organization Contribution</b>	Economic and talent development program coordination in the consortium communities

<b>Organization Name</b>	Planet M, an initiative of the State of Michigan
<b>Organization Location</b>	Lansing, MI
<b>Organization Contribution</b>	Planet M, the epicenter for mobility initiatives, sponsored WCC for various vehicle and transportation technology events including the Automobili-D educational exhibits at the January 2017 North American International Auto Show in Detroit.

## 4. Impact

### University of Michigan:

The use of augmented reality for CAV testing will save automobile manufacturers millions of dollars in development and validation costs.

### Washtenaw Community College:

The announcement of WCC opening an office at the American Center for Mobility has big impact upon the project goal to certificates of completion and talent development in CAT sectors. In collaboration with Wayne County Community College District, the colleges will focus attention on developing skills and competencies for new hires and incumbent workers needing skill development in V2V/V2I/V2X communications, advanced vehicle design and manufacturing, cybersecurity, data analytics and supply chain logistics.

Additionally, the announcement of WCC opening an office at the American Center for Mobility for workforce development are expected to precede employer demand for credit education certificates and degree programs. These programs for new hires and incumbent workers will likely focus upon skill development in V2V/V2I/V2X communications, advanced vehicle design and manufacturing, cybersecurity, data analytics and supply chain logistics.

Lastly, K-12 Students and teachers gained awareness of WCC's educational resources during the Square One Education Network [SOEN] Innovative Vehicle Design Mobility Challenge event at Mcity, May 6, 2017. With approximately sixty high schools competing, sixteen WCC staffers promoted its Advanced Transportation Center of educational programs, especially to high school juniors and seniors. It was observed many of the high school project teams had difficulty with their vehicles during the competition. Failures occurred with sensors and other

vehicle parts. WCC will add repair materials/equipment to the workshops and competition event to allow the project teams to incorporate repairs and fixes.

## 5. CHANGES/PROBLEMS

There were no significant program changes or problems that would require prior written approval from OST-R grants official. Below is the summary for this reporting period.

### University of Michigan:

Not all subcontracts have been issued to the partner organizations. Therefore, not all projects have been started.

### Washtenaw Community College:

A workforce development project individual has left WCC and will be replaced. Interviews and assessments are underway. Hiring and acclimation to the project role are expected to possibly delay the year-1 online training development by as much as two months.

The hiring of an Engineer in Residence has been delayed approximately one month from the original work plan. Contracting is presently in-process for a prospective candidate. The impact of this delay will have a limited effect upon the curricula development and professional development activities at this time.

Removed the Amazon/Azure web services from the contract list because we wanted to research a more value added service/equipment that would be able to serve a larger group of students.

The SOEN V2X Workshop for high school project teams was originally scheduled for February 2017. However, funding was not available from known resources and the workshop had to be canceled. We are investigating funding two workshops in 2017 as described below:

- A two day V2X/Cybersecurity workshop. This would be the Raspberry Pi ECU programming specification. Both days would be hands-on and would include materials and about six classroom investigations.
- A two day Connected Vehicle Sensor application workshop. This would be the 3D printed mobile platform specification. Both days would be hands on and would include materials and 6-12 classroom investigations.
- Both workshops above may be scheduled during the period of August to October 2017.
- Added **Equipment/Materials** to assist the above high school project teams develop their connected vehicles for improved sensor signal transmission and receiving without interference from nearby metal components, vehicle dynamic response and distance/range in the school year-end competition at Mcity.