



UTC Semi-Annual Progress Report

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Center Director Name, Title, and Contact Information

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North Carolina Agricultural and Technical State University
1601 E. Market Street, Greensboro, NC 27411

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Dr. Maranda McBride, Director, Center for Advanced Transportation Mobility



NORTH CAROLINA AGRICULTURAL
AND TECHNICAL STATE UNIVERSITY



VirginiaTech
TRANSPORTATION
INSTITUTE

EMBRY-RIDDLE
Aeronautical University



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DISTRICT OF
COLUMBIA
1851

1. ACCOMPLISHMENTS:

What are the major goals of the program?

The Center for Advanced Transportation Mobility (CATM) will employ multidisciplinary approaches and processes to design, develop, and implement innovative solutions to the transportation needs of vulnerable populations. CATM will utilize the knowledge, skills, and expertise of its affiliates and partners to identify the needs of individuals who are often underrepresented in the design process due to specific physical and/or mental conditions or their socio/economic status. These collaborations will be leveraged to develop and implement comprehensive research, education, workforce development, and technology transfer programs that improve access to transportation for vulnerable users.

CATM endeavors to enhance the transportation industry by achieving the following goals:

- 1) Develop innovative assistive technologies to enable safe and efficient mobility for individuals with special needs (Research).
- 2) Develop forward-looking optimization tools to effectively manage transportation system disruptions (Research).
- 3) Promote equity by increasing access to transportation educational and workforce development opportunities for underserved populations (Education, Outreach, and Workforce Development).
- 4) Disseminate knowledge about the transportation industry to a broad range of stakeholders using multiple technology transfer methods (Technology Transfer).

The overall goal of the center is to develop and implement research, education, outreach, workforce development, and technology transfer programs to address the need for improved mobility across multiple modes of transportation – primarily highway, rail, and air. In an effort to accomplish this goal, several activities took place during this reporting period. Table 1 provides a list of these activities and their statuses as of March 31, 2020.

Table 1: Progress of period 5 activities

Research	Status	% Complete
Complete year 1 projects	Behind schedule	90%
Complete year 2 projects	Complete	100%
Continue making progress on Year 3 projects	On schedule	70%
Conduct year 4 research proposal solicitation, review, and award process	Complete	100%
Initiate year 4 projects	Behind schedule	50%
Participate in kick off meeting for NCDOT Centers of Excellence	Complete	100%
Conduct annual visit to member institutions to obtain research status reports – Year 4	Behind schedule	50%
Education, Outreach, and Workforce Development Activities		
Prepare for and take students to 2020 TRB conference	Complete	100%
Develop and hold 2020 Transportation Awareness Day	Postponed	90%
Prepare to take students to 2020 Southeastern Region UTC conference	Postponed	90%
Develop and conduct Spring 2020 student-to-student K-12 initiative workshops	Partially completed	33%
Distribute applications for 2020-21 CATM Transportation Scholarship program	Complete	100%
Select 2020-21 CATM Transportation Scholarship program awardees	Forthcoming	0%
Prepare for and hold 28 th Summer High School Transportation Institute	Forthcoming	50%

Recruit and select participants for 2020 Summer High School Transportation Institute (STI)	On schedule	50%
Develop transportation case for case competition	Behind schedule	25%
Technology Transfer Activities		
Schedule research webinars	Complete	100%
Create and distribute Winter 2019 newsletter	Complete	100%
Plan and hold the 3 rd Annual CATM Symposium	Complete	100%
Create and distribute Spring 2020 newsletter	On schedule	90%
Assist with the 2020 Southeastern Region UTC Conference planning	Postponed	70%
Plan and hold the 4 th Annual CATM Symposium	Forthcoming	0%
US DOT Reporting Activities		
Complete and submit PPPR#5	Complete	100%
Complete and submit SF425 for Q10 and Q11	Complete	100%
Complete and submit 2020 performance indicator report	Forthcoming	0%
Complete and submit recipient share report #4	Forthcoming	0%
Review year 3 final reports for completed research projects	On schedule	50%
Upload year 3 final reports to TRID database	On schedule	50%
Update records in RiP database	On schedule	50%
Complete and submit PPPR#6	On schedule	80%
Complete and submit SF425 for Q12 and Q13	Forthcoming	0%

What was accomplished under these goals?

During the reporting period, a variety of accomplishments were made in the areas of research, education/workforce development, and technology transfer. A summary of the activities and the associated accomplishments are described below.

Research

Table 2 provides a running list of the year 1, 2, and 3 projects that were active at the beginning of the reporting period along with their current statuses, the primary research priority areas that are addressed by each project, and the link to the project abstracts. This is followed by a summary of the key accomplishments associated with each project.

Table 2: Funded projects active during reporting period

Project Title	Status/Award Year	Research Priority Area(s)	Project Link
Automated Last Mile Connectivity for Vulnerable Road Users	Continuing/Y1	IM, RC, PS	https://www.ncat.edu/cobe/transportation-institute/catm/1-last-mile-abstract.pdf
Development, Design, and Calibration of the Vulnerable Road User Mobility Assistance Platform	Continuing/Y1	IM, PS	https://www.ncat.edu/cobe/transportation-institute/catm/catm_documents/3-vrumap-abstract.pdf
Analysis of the Non-Driving Mobility Needs of People with Disabilities	Completed/Y2	IM, PS	https://www.ncat.edu/cobe/transportation-institute/catm/catm_documents/6-mobilityneedsabstract.pdf
Multiscale Model for Hurricane Evacuation and Fuel Shortage	Continuing/Y3	IM, RC, TS	https://www.ncat.edu/cobe/transportation-institute/catm1/files/10-multiscalemodelabstract1.pdf

Multi-agent Reinforcement Learning-based Pedestrian Dynamics Models for Emergency Evacuation	Continuing/Y3	IM, RC	https://www.ncat.edu/cobe/transportation-institute/catm1/files/11-multiagentabstract1.pdf
DRONETIM: Dynamic Routing Of uNmanned-aerial and Emergency Team Incident Management	Continuing/Y3	IM, RC, PS	https://www.ncat.edu/cobe/transportation-institute/catm1/files/12-dronetimabstract1.pdf
VRU-Personalized, Optimum, and Dynamic (POD) Routing	Continuing /Y3	IM	https://www.ncat.edu/cobe/transportation-institute/catm1/files/13-vrupersonalizedabstract1.pdf
Real-Time Recommendations for Traffic Control in an Intelligent Transportation System During an Emergency Evacuation	Continuing/Y3	IM, RC	https://www.ncat.edu/cobe/transportation-institute/catm1/files/14-realtimeabstract1.pdf
Discrete Dynamics and Epidemiological Multi-Physics Models for Transportation Applications	New/Y4	IM, RC	https://www.ncat.edu/cobe/transportation-institute/files/23-discretedynamicsabstract-1.pdf
Multi-scale and Collaborative Disaster Evacuation Planning Framework	New/Y4	IM, RC	https://www.ncat.edu/cobe/transportation-institute/files/22-multiscalecollaborativeabstract-1.pdf
Detecting Early-Stage Dementia Using Naturalistic Driving	New/Y4	IM, PS	https://www.ncat.edu/cobe/transportation-institute/files/21-dementiaabstract-1.pdf
Evaluation of Web-Based Driving Feedback for Teens and their Parents	New/Y4	IM, PS	https://www.ncat.edu/cobe/transportation-institute/files/20-drivingfeedbackabstract-4.pdf
Epidemiological Models for Transportation Applications: Secondary Crashes	New/Y4	IM, PS	https://www.ncat.edu/cobe/transportation-institute/files/17-epidemiologicalmodelsabstract.pdf
Real-Time Recommendations for Traffic Control in an Intelligent Transportation System During an Emergency Evacuation – Part 2	New/Y4	IM, RC	https://www.ncat.edu/cobe/transportation-institute/files/16-realtime2abstract.pdf
Vulnerable Road Users demand-responsive Transit Optimization with healthcare Privatization (VRUTOP)	New/Y4	IM	https://www.ncat.edu/cobe/transportation-institute/files/19-vrutopabstract.pdf
Acoustic Situation Awareness and Its Effects on Pedestrian Safety within a Virtual Environment	New/Y4	IM, PS	https://www.ncat.edu/cobe/transportation-institute/files/18-acousticssituationalawarenessabstract.pdf

IM = Improving mobility of people and goods; RC = Reducing congestion; PS = Promoting safety; ID = Improving durability and extending the life of transportation infrastructure; PE = Preserving the environment; TS = Preserving the existing transportation system

Automated Last Mile Connectivity for Vulnerable Road Users (Last Mile)

The Last Mile team worked with VTTI’s IRB to evaluate the safety of putting elderly populations in the EasyMile shuttle to experience rides during focus groups. After reviewing reports of public incidents where similar shuttles experienced high deceleration emergency stops unexpectedly,

VTTI decided that it was not appropriate to have elderly participants ride in the vehicle, even with shuttle operator supervision. The team worked with the IRB to submit a revised protocol for a participant focus group study. However, Virginia Tech's IRB also suspended participant research involving human contact during the reporting period because of concerns related to COVID-19. The team will work to acquire IRB approval and be prepared for data collection whenever Virginia Tech's IRB determines it is safe to move forward. In the meantime, the team has developed a list of best practices and lessons learned from the project's efforts. This includes the shuttle acquisition, route and environment preparation, shuttle and environment maintenance, operator training and scheduling, operation policies, and operations and outreach data collection recommendations. The list will be developed into a webinar and publication to improve the resources stakeholders have for future shuttle adoptions.

Development, Design, and Calibration of the Vulnerable Road User Mobility Assistance Platform (VRU-MAP)

The VRU-MAP team has continued progressing on front- and back-end app development, including crowdsourcing, augmented reality implementation, interface (iOS and Android) development, server upgrading, and module integration. Research opportunities have been provided for a number of undergraduate and graduate students. Development of machine vision detection of traffic signals and signs using Mask RCNN and Mask SSD has also continued.

Analysis of the Non-Driving Mobility Needs of People with Disabilities (Disability Survey)

The disability survey was administered to 160 individuals during the previous year; however, analysis and reporting were completed during this reporting period. The survey focused on mobility needs of individuals with differing physical, intellectual, perceptual, or mental disabilities. Findings highlight the highly varying individualized needs and the comorbidity of disabilities. The final report is posted on the CATM website (https://www.ncat.edu/cobe/transportation-institute/catm/catm-finalreport_disabilitysurvey_final-1.pdf).

Multiscale Model for Hurricane Evacuation and Fuel Shortage (Multiscale Model)

During the reporting period, the Multiscale Model team developed a correlation between traffic data and fuel shortage data. In addition, they developed a predictive model for the hurricane fuel shortage.

Multi-agent Reinforcement Learning-based Pedestrian Dynamics Models for Emergency Evacuation (Multi-agent)

The team Multi-agent team worked on modeling pedestrian dynamics in airport evacuation scenarios during this reporting period. Pedestrian dynamics were used as an input and the best pedestrian path decisions were determined based on evacuation performance measures. Team members at ERAU worked on finalizing the airport evacuation models created as part of the previously funded Emergency project and NCAT team members will use their results as inputs to compute the optimal decision for this project.

DRONETIM: Dynamic Routing Of uNmanned-aerial and Emergency Team Incident Management (DRONETIM)

The team developed a cooperative vehicle system consisting of an UAV and an ERV and multi-objective allocation of ERVs that are busy handling previous emergencies. The team also wrote

and received funding for three grant proposals to extend the work being performed for the DRONETIM project. The funding agencies and topics of these grant proposals are listed below:

- VDOT: UAV application in traffic operation
- NSF Robust Intelligence Program: Information Theoretic Path Planning
- NASA JPL: UAV Information Gain during Hurricane

VRU-Personalized, Optimum, and Dynamic Routing (VRU-POD)

During this reporting period, the team developed adaptive route planners for travelers with disabilities considering multimodal transportation options. As an extension of the VRUPOD project, a grant proposal was developed in collaboration with researchers from North Carolina State University. The proposal, which related to the impact of Medicare on VRUs, was submitted and funded by the NCDOT.

Real-Time Recommendations for Traffic Control in an Intelligent Transportation System During an Emergency Evacuation (Real-Time)

Several tasks were accomplished by the team during this reporting period. First, they analyzed the change in outgoing and incoming airport connections before, during, and after Hurricane Matthew; identified the airports and airlines mostly affected by Hurricane Matthew using visualization; and investigated the performance of different airlines network structures under a disruption. They proposed a method to estimate the number of affected passengers for each airline and are currently working on a theoretical approach based on network theory concepts to identify disruptor airports and disrupted airports in airport networks. Second, significant factors and potential actions in the current North Carolina intelligent transportation systems that can benefit an emergency evacuation were identified and the evacuation traffic data in southeastern North Carolina during Hurricane Florence were collected and analyzed to discover space-time traffic patterns during that storm. Third, a network disruption analysis was conducted by examining the connectivity and topology of the North Carolina road transportation network of Charlotte. The study aims to identify the road segments critical to the efficiency of the transportation network with respect to daily disruptions. The weighted edge betweenness centrality (BC) indicator was used to identify topologically vulnerable road segments and intersections to Charlotte's transportation network and a hierarchical cluster analysis of 2018 average annual daily traffic (AADT) data was conducted to identify roads critical to traffic. Fourth, a Lens Model (LM) was developed to characterize the decision behavior during an emergency evacuation based on multiple cues. The LM parameters were estimated by analyzing historical data and simulated data using five Supervised Machine Learning (SML) algorithms and a judgment model for emergency has been created to gain insight into the decision behavior of the various entities involved when the environment presents multiple cues.

New Projects

Eight additional projects were awarded during this reporting period. The subcontracts to establish these projects were initiated in March or April 2020 so no significant progress was made on them during the current reporting period.

Research Assistants

There was a total of 25 students working as research assistants on projects within CATM during the reporting period. Table 3 provides a breakdown of these students by classification and gender.

Table 3: Demographics of student research assistants

Classification	Male	Female	Total
Undergraduate	3	4	7
Master's	5	0	5
Doctoral	7	6	13
Total	15	10	25

Along with the research projects currently being funded through the UTC grant, Table 4 lists additional transportation research grants that were awarded through the center during the reporting period and the agencies that are funding them.

Table 4: Transportation research grants awarded

Project Title	Lead Institution	Funding Agency
NC Transportation Center of Excellence in Advanced Technology Safety and Policy	University of North Carolina – Chapel Hill	NC Department of Transportation
University Transportation Center of Excellence – Mobility and Congestion	North Carolina State University	NC Department of Transportation

Education

On October 21, 2019, a CATM scholar workshop was held. A representative from NC A&T's Office of Career Services presented a workshop on Professionalism and Business Etiquette. Five CATM scholars participated this workshop. Considering the students will be attending professional conferences and workshops and moving into internship and professional roles, techniques were presented to assist them in building networking and etiquette skills for use in professional settings. Simulated office related situations were presented and students used role play to demonstrate their understanding of the appropriate professional etiquette. These skills will be helpful for their professional and personal development. This workshop is expected to be offered annually to students participating in CATM activities.

On November 4, 2019, seven CATM Transportation scholars attended the 3rd Annual CATM Symposium hosted by Embry-Riddle Aeronautical University in Daytona Beach, FL. The students networked with other students, faculty, and researchers from the three-member consortium. They also had the opportunity to attend poster presentations during which they learned more about the on-going transportation research being conducted by CATM's affiliate researchers.

The Dwight D. Eisenhower Transportation Fellowship Program awardees were announced on November 15, 2019. Kiana Williams, Joseph Smith, and Tyler Huggins from NC A&T were awarded fellowships under this program and initiated work on their transportation research projects with the help of their mentors. The major components of this fellowship are scholarly research projects, tuition funding, monthly stipends, and travel funds to attend the TRB Annual Meeting. All three students attended the TRB 2020 Annual Meeting which took place in Washington, DC in January.

Mr. Eulois Clecky, an NC A&T transportation program alumnus who currently serves as the Executive Director of Public Works for the City and County of Denver, Colorado was the guest speaker at the William A. Deese College of Business and Economics (Deese COBE) Closing Bell Speaker Series on November 21, 2019. CATM scholars, Joseph Smith and Jacob Smith, served as presenters in this program providing the welcoming remarks and introduction of the speaker (Figure 1). The Closing Bell program provides opportunities for alumni and professionals in the various majors represented in the Deese COBE to engage the student body in discussions related to their scholarly and professional experiences.



Figure 1: CATM scholars Jacob Smith (left) and Joseph Smith (right) with the Executive Director of Public Works for the City and County of Denver, Colorado, Mr. Eulois Clecky (center) during the NC A&T Closing Bell.

In January 2020, three DDETFP Scholars and 3 CATM Scholars attended the 99th TRB Annual Meeting in Washington, DC (Figure 2). Joseph Smith, DDETFP Fellow, was chosen to present his research as a poster presentation at the TRB meeting. This meeting served as an opportunity for the students to learn about scholarly transportation research,

network with transportation professionals from around the world, and learn about leading-edge transportation technologies.



Figure 2: CATM student scholars and DDETFP fellows at the 2020 TRB Meeting in Washington, DC. From the left – Marvin Edge, Tyler Huggins, Kiana Williams, Tyreak Carr, Joseph Smith, and Amanda Gray.

This year the Aggies' Autonomous Auto (A³) team continued their competition in the Autodrive Challenge sponsored by GM and SME. The team focused on urban environment driving scenarios that require teams to optimize perception and sensing algorithms to navigate a fictitious rider sharing scenario through the Transportation Research Center's SMART Center. The autonomous car developed by the A³ team was enabled to handle both static and dynamic objects, traffic control lights and signs, as well as various lane line scenarios. The team integrated HERE mapping into their Year 3 dynamic challenges, focusing the social

responsibility report on writing accessibility standards for a growing mobility industry, and refining the concept design to highlight innovative additions. There were approximately 40 students working on various elements of this challenge during this reporting period.

Four CATM scholars had arranged to attend the 7th Annual UTC Conference for the Southeastern Region which was scheduled to take place March 26-27, 2020. However, due to the COVID-19 Pandemic, this conference was postponed until Fall 2020.

Workforce Development and Outreach

During this reporting period, NC A&T's CATM scholars and Supply Chain Management majors participated in the Student-to-Student (S2S) Initiative through which they visit local high schools to share their experiences as supply chain majors, NC A&T Summer High School Transportation Institute participants, and CATM program activity participants. On March 10, 2020 Marvin Edge, Amanda Gray, and Quadir Donaldson visited Dudley High School in Greensboro, NC (Figure 3). They spoke to 15 honor's business students during a regularly scheduled class. On March 11, 2020, Kiana Williams and Aliyah McRae visited another business class consisting of 12 students also at Dudley High School. Students from both sessions expressed interest in learning more about the supply chain management major and supply chain management as a career. Two more S2S sessions were scheduled to



Figure 3: CATM scholars Quadir Donaldson, Marvin Edge, and Amanda Gray talk to a Dudley High School business management class about the transportation/supply chain curriculum at NC A&T on March 10, 2020.

take place at Dudley High School in April and two sessions at Western Guilford High School were in the process of being scheduling for April when the stay-at-home orders issued by the governor of North Carolina went into effect.

Over 3,000 North Carolina middle school students registered for the 2nd Annual Transportation Awareness Day event which was to be held at NC A&T's BB&T Stadium on March 31, 2020. Organizations that had confirmed their participation included the NCDOT Highway Unit, Tesla, Volvo, Fed Ex, Greensboro Transit Authority, NCDOT Photogrammetry Unit, NC A&T and UNC-G Joint School of Nanoscience and Nanoengineering, UNC-Chapel Hill Highway Safety Research Center, Piedmont Triad Regional Council - NC Clean Transportation Initiatives, NC A&T Electrical and Computer Engineering - Aggie Autodrive Vehicle, NC A&T Civil Engineering - Transportation Planning, Triad Aviation Academy, North Carolina Transportation Engineering - Vehicle/Wind Tunnel Experiment, Cisco - Careers in Supply Chain Management, and NC A&T's Supply Chain Management Department. The public school systems where the registered students attend included Alamance County, Chatham County, Cumberland County, Davidson County, Forsyth County, Gaston County, Guilford County, Halifax County, Rockingham County, Union County, and Vance County. Unfortunately, due to the stay-at-home orders, this event was cancelled; however, plans are currently in process to schedule it again for either September 2020 or March 2021.

Technology Transfer

The Last Mile team presented preliminary versions of its best practices and lessons learned to a number of stakeholders in Virginia who were considering operating EasyMile shuttles. This included the cities of Fairfax and Virginia Beach, Dominion Energy, and first responders at the state and local level. The presentation was very well received and became the basis for what VTTI is turning into a webinar and publication. VTTI is planning to advertise the webinar to a wide range of stakeholders in transit or conduct separate webinars for different kinds of stakeholders in order to provide as much education as possible.

The VRU-MAP team participated in and submitted to several conferences, including the 3rd Annual CATM symposium, HFES 2020, IDEAS 2020, and IISE 2020.

The Multiscale team presented its research at the INFORMS conference and 3rd Annual CATM Symposium. A journal paper based on the results of this project was published in Plos One. Another journal paper for ASCE National Hazard Review is currently being prepared.

Scenarios from the DRONETIM and VRUPOD projects were used as practical examples for classes during this reporting period. In Fall 2019, the scenarios were used in a modeling and simulation class and, in Spring 2020, scenarios were used in an optimization class and a transportation class. The main objective of using aspects of these projects in the courses is to demonstrate to approximately 40 masters and doctoral students how dynamic programming methods can be integrated into the transportation field. In addition, the DRONETIM and VRUPOD research teams engaged in an initial discussion with NCDOT public transportation division which resulted in additional technology transfer opportunities.

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

A number of students have been funded through the grant during the reporting period. These students are provided educational and experiential benefits through CATM. Experience with the UTC projects have directly contributed to career obtainment and growth for several graduates. For several of the research projects, students learned how to formulate problems, collect and prepare data, and validate their formulations through simulation. Students also play a major role in preparing papers for conferences and journals. Some students also learned how to write proposals for state and federal governments. These experiences helped the students develop some of the skills they will need to demonstrate in the near future particularly when they interview for academic or research careers related to transportation. The training obtained through the research activities has been effective and will be strengthened as the students continue their engagement with CATM programs. In addition, students engaged in the Autodrive competition had the opportunity to attend several workshops organized by the industrial sponsors.

Have the results been disseminated?

CATM held its third annual symposium in November 2019. During this event, researchers from each of the research projects gave a presentation on their project. Students also presented posters that demonstrated their activities associated with each project (Figure 4 and Figure 5).

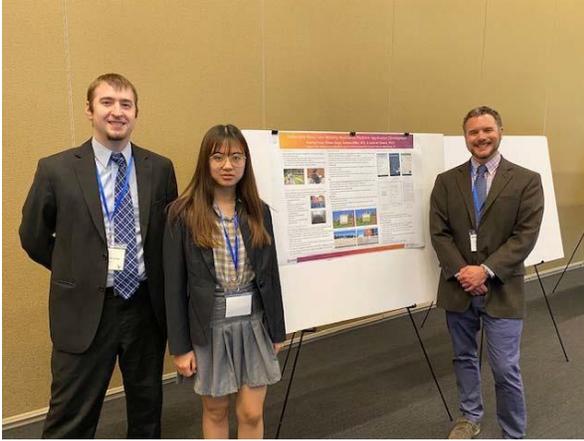


Figure 4: Andrew Miller, Shirley Feng, and Justin Owens present a research poster at the 2019 CATM Symposium.

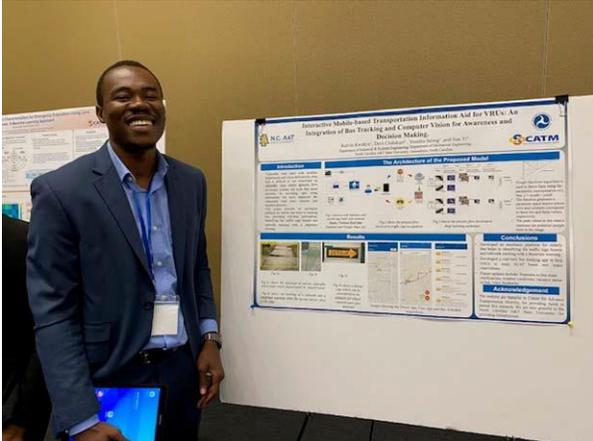


Figure 5: Kelvin Kwakye, a student in NC A&T's Department of Industrial & Systems Engineering, presents a research poster at the 2019 CATM Symposium.

The CATM winter newsletter was distributed to CATM stakeholders and posted on the CATM website during this reporting period. The newsletter included articles on the various activities that took place from April through August 2019, such as the STI program, ERAU STEM workshop, and NCDOT Research and Innovation Summit. The newsletter also included spotlight articles on the Last Mile and Travelers' Rationality projects.

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

Below is a list of the primary tasks for the next reporting period. Some of these activities are contingent upon the operating status of the consortium members due to the COVID-19 pandemic.

- Distribute the Spring 2020 newsletter
- Continue research project specific activities
- Hold two research webinars
- Review and post final reports for completed projects
- Hold NC A&T's 28th Summer High School Transportation Institute
- Review applications and select awardees for the 2020-21 DDETFP and 2020-21 CATM Scholars
- Initiate and complete proposal review process for Year 5 internal grant competition
- Hold the Second Annual Transportation Awareness Day
- Organize the 4th Annual CATM Symposium
- Help plan and participate in the 2020 UTC Conference for the Southeastern Region

2. PARTICIPANTS & COLLABORATING ORGANIZATIONS:

Organizations that have been involved as partners

Table 5 provides a list of the individuals who were involved in center activities as partners during the reporting period and their associated organizations. This list does not include the center staff at NC A&T nor the various students involved in CATM activities.

Table 5: List of partners

Organization Name	Organization Location	Partner's Contribution to the Project	Name (First and Last)	Partner University
Dept. of Industrial and Systems Engineering	Greensboro, NC	Collaborative Research	Xiuli Qu, Ph.D.; Lauren Davis, Ph.D.; & Younho Seong, Ph.D.	NC A&T
Dept. of Computational Science and Engineering	Greensboro, NC	Collaborative Research	Hyoshin (John) Park, Ph.D.	NC A&T
Dept. of Electrical and Computer Engineering	Greensboro, NC	Collaborative Research	Ali Karimodini, Ph.D. & Abdollah Homaifar, Ph.D.	NC A&T
Dept. of Mechanical Engineering	Greensboro, NC	Collaborative Research	Sun Yi, Ph.D.	NC A&T
Dept. of Computer Science	Greensboro, NC	Collaborative Research	Xiaohong Yuan, Ph.D.	NC A&T
Virginia Tech Transportation Institute	Blacksburg, VA	Facilities	Jon Antin, Ph.D.	Virginia Tech
Virginia Tech Transportation Institute	Blacksburg, VA	Collaborative Research	Andrew Alden, Ph.D.; Kevin Grove, Ph.D.; Justin Owens; & Andrew Miller	Virginia Tech
Dept. of Human Development	Blacksburg, VA	Collaborative Research	Carolyn Shivers	Virginia Tech
Dept. of Graduate Studies, College of Aviation	Daytona Beach, FL	Collaborative Research	Dahai Liu, Ph.D.; Jennifer Thropp, Ph.D.; & Scott Winter, Ph.D.	ERAU
Aerospace Engineering	Daytona Beach, FL	Collaborative Research	Namilae Sirish, Ph.D.	ERAU
North Carolina DOT	Raleigh, NC	Financial Support	Neil Mastin, Curtis Bradley, Ph.D.	
Florida DOT	Tallahassee, FL	In-Kind Support	Larry Ringers, Joey Gordon	
Florida Division of Emergency Management	Tallahassee, FL	In-Kind Support	Andrew Sussman	
North Carolina DOT	Raleigh, NC	In-Kind Support	Ted Baker	

Other collaborators or contacts involved

Maranda McBride and Hyoshin Park are working with researchers at NC State University and UNC-Chapel Hill on two separate NCDOT Transportation Centers of Excellence grants which were awarded in Fall 2019.

Hyoshin Park worked with Kai Monast, Public Transportation Manager of the Institute for Transportation Research and Education (ITRE) at NC State University. Mr. Monast provided Dr. Park with the assistance needed to connect with the appropriate people at the NCDOT for

application of VRUPOD results to North Carolina. Additionally, as an extension of DRONETIM, a collaboration with VTTI resulted in a grant from VDOT.

Drs. Joseph Huscroft and Lauren Davis continued their service as Dwight D. Eisenhower Transportation Fellowship faculty research mentors for the NC A&T Eisenhower Fellows.

3. OUTPUTS:

The subsections below outline some of the outputs that have resulted from the research projects listed in Table 2 as well as the education, workforce development, and technology transfer activities.

Publications, conference papers, and presentations

Journals

- Folsom, L., Ono, M., Otsu, K., and Park, H. Scalable information-theoretic path planning for a rover-helicopter team in uncertain environments, *International Journal of Advanced Robotic Systems*, under review. Acknowledgement of federal support: yes.
- Islam, S., Namilae, S., Prazenica, R., and Liu, D. (2020). Fuel shortages during hurricanes: Epidemiological modeling and optimal control. *PloS one*, 15(4), e0229957, published. Acknowledgement of federal support: yes.
- Islam, S., Parr, S., Prazenica, R., Liu, D., and Namilae, S. (2020). Predictive Model for Fuel shortages during hurricanes, in preparation.
- Pugh, N., and Park, H. High-order Markov model for prediction of secondary crash likelihood considering incident duration. *IEEE Access*, under review. Acknowledgement of federal support: yes.
- Shirzad, K., Darko, J., Folsom, L., Pugh, N., Park, H., Owens, J., and Miller, A., Adaptive personalized routing for vulnerable road users, *Computer-aided Civil and Infrastructure Engineering*, under review. Acknowledgement of federal support: yes.

Books and Non-Periodical, One-Time Publications

- Islam, S. (2019). *Fuel Shortages During Hurricanes: Epidemiological Modeling and Optimal Control*, MS Thesis, Advisor: Sirish Namilae. Acknowledgement of federal support: yes.

Other Publications, Conferences, and Presentations

- Alabi, M., Seong, Y., and Yi, S. Decision-making model for emergency evacuation based on the lens model using machine learning and Monte-Carlo simulation for incomplete information environment. Submitted to the 2020 HFES Annual Conference, October 5 - 9, 2020, Chicago, Illinois, USA. Acknowledgement of federal support: yes.
- Darko, J., Acquaah, Y., Folsom, L., Park, H., and Alden, A. DRONETIM: Dynamic Routing of Unmanned-aerial and Emergency Team Incident Management. The 99th Annual Meeting of Transportation Research Board (TRB 2020), # 20-02283, Washington, DC, January 12-16, 2020, presented. Acknowledgement of federal support: yes.
- Darko, J., Folsom, L., and Park, H., DRONETIM: Dynamic Routing of Unmanned-aerial and Emergency Team Incident Management. *IEEE Forum on Integrated and Sustainable Transportation Systems (ISTS)*, The Netherlands, 2020, accepted. Acknowledgement of federal support: yes.
- Darko, J., Park, H. Vulnerable road user navigation considering perception on the transit uncertainty. Paper submitted to the 2nd Triennial Transportation Science and Logistics Society Conference (TSL2020), Arlington, VA, May 27-29, 2020, accepted. Acknowledgement of federal support: yes.

- Darko, J. Park, H. and Chow, J. VRUPOD: Vulnerable Road User Personalized Optimum and Dynamic routing. Paper submitted to the 8th international Symposium on Transport Network Reliability (INSTR2020), Stockholm, June 24-26, 2020, accepted. Acknowledgement of federal support: yes.
- Islam, S., Parr, S., Prazenica, R., Liu, D, and Namilae, S. An epidemiological modeling approach to fuel shortages during hurricane evacuations. INFORMS Conference, Seattle, WA. October 20-23, 2019, presented. Acknowledgement of federal support: yes.
- McRae, T. CATM education and workforce development update. Talk presented at 3rd Annual CATM Symposium, Daytona Beach, FL, November 4, 2019. Acknowledgement of federal support: yes.
- Mhatre, S. and Qu, X. Traffic pattern discovery during recent hurricane evacuations in North Carolina and Florida: A case study. Accepted as an oral presentation at the 7th Annual UTC Conference for the Southeastern Region, Boca Raton, FL (postponed). Acknowledgement of federal support: yes
- Meda, H., Davis, L.B., and Vogiatzis, C. Analysis of Hurricane Matthew 2016 data to estimate airline passengers disruption. Proceedings of the 2019 IEEE International Conference on Big Data (IEEE BigData 2019), Los Angeles, California, December 10-13, 2019. Acknowledgement of federal support: yes.
- Miller, A., and Owens, J.M. Vulnerable road user mobility assistance platform update. Talk presented at 3rd Annual CATM Symposium, Daytona Beach, FL, November 4, 2019. Acknowledgement of federal support: yes.
- Namilae, S. Multiscale model for hurricane evacuation and fuel shortage. Talk presented at UTC CATM Annual Symposium. Acknowledgement of federal support: yes.
- Namilae, S. Epidemiological Models in Transportation. Seminar presentation at the University of West Florida. Acknowledgement of federal support: yes.
- Ono, M., Rothrock, B., Otsu, K., and Park, H. MAARS: Machine learning-based Analytics for Rover Systems. Proceedings of the International IEEE 2020 Aerospace Conference, Big Sky, MT, March 7-14, 2020, presented. Acknowledgement of federal support: yes.
- Owens, J., Miller, A., and Shivers, C. (2019). VRU Disability Survey. Talk presented at the 3rd annual CATM Symposium, Daytona Beach, FL, November 4, 2019. Acknowledgement of federal support: yes.
- Park, H. Adaptive personalized routing for vulnerable road users. Talk presented at the 3rd Annual CATM Symposium, Daytona Beach, FL, November 4, 2019. Acknowledgement of federal support: yes.
- Park, H. DRONETIM: Dynamic Routing of Unmanned-aerial and Emergency Team Incident Management. Talk presented at the 3rd Annual CATM Symposium, Daytona Beach, FL, November 4, 2019. Acknowledgement of federal support: yes.
- Pugh, N., Derjany, P., Park, H., Namalie, S., and Liu, D. Deep adaptive learning for safe and efficient navigation of pedestrian dynamics – airport evacuation. Proceedings of the 99th Annual Meeting of Transportation Research Board (TRB 2020), # 20-02081, Washington, DC, January 12-16, 2020, presented. Acknowledgement of federal support: yes.
- Pugh, N., Park, H. High-order Markov model for prediction of secondary crash likelihood considering incident duration. Proceedings of the 99th Annual Meeting of Transportation Research Board (TRB 2020), # 20-02092, Washington, DC, January 12-16, 2020, presented. Acknowledgement of federal support: yes.
- Richmond, D. and Qu, X. Transportation network resilience in Charlotte, North Carolina for day-to-day disruptions. Full paper submitted to the 2020 IISE (Institute of Industrial and Systems Engineers) Annual Research Conference, New Orleans, LA, October 31-November 3, 2020, accepted. Acknowledgement of federal support: yes.

- Shirzad, K., Darko, J., Folsom, L., Pugh, N., Park, H., Owens, J., and Miller, A. Adaptive personalized routing for vulnerable road users. TRB2020 Annual Meeting Road Safety Subcommittee Meeting, presented. Acknowledgement of federal support: yes.

Websites or other internet material

- CATM Website: <https://www.ncat.edu/cobe/transportation-institute/catm/index.php>
- CATM Winter 2019 Newsletter: <https://www.ncat.edu/cobe/transportation-institute/files/pdfs/fall2019newsletterada.pdf>
- CATM Facebook Page: <https://www.facebook.com/NCATCATM/>
- STI Facebook Page: <https://www.facebook.com/groups/627756624232070/>
- Webpages where STI program information is provided: <https://www.ncat.edu/cobe/transportation-institute/summer-high-school-transportation-institute.php>
- Website for Dr. Hyohsin (John) Park's research: <https://johnpark.club/2019/10/14/park-lab-ncat-newsletter/>
- A³ Autodrive Team Website: www.A3.ncat.edu

Technologies or techniques

- The A³ autodrive team has developed an autonomous car capable of driving in urban environment.
- The Multiscale Model team developed a predictive model for hurricane fuel shortage.
- The Last Mile project has resulted in a series of best practices that have been identified for a number of activities related to automated shuttles. These best practices are currently in a draft stage but VTTI will work to refine them for presentation in webinars and publications.

Inventions, patent applications, and/or licenses

- Dr. Hyoshin Park's patent titled: "Transportation Infrastructure Location and Redeployment" was filed on January 22, 2019 and approved during this reporting period.

Other products

Publications

- "Automated Last Mile Connectivity for Vulnerable Road Users." FAST Act UTC project information highlighted in a Report to Congress.

Data

- Database of individual mobility needs from surveys for use in analyses.

4. OUTCOMES:

The results of the activities during this reporting period are increasing understanding and awareness of transportation issues in the following ways:

- Last Mile project: The knowledge VTTI has obtained through this project presents an opportunity to improve the safety, speed, and effectiveness of future deployments.
- VRU-MAP project: The research conducted has demonstrated an increased need within the industry to focus on individualized requirements of people with disabilities. A dearth of information has been collected on how collectively people with varying disabilities utilize public transportation, navigate the environment, and utilize other resources for point-to-point navigation.
- Disability Survey project: Through presentations given at a variety of conferences the team has increased awareness of the transportation needs facing people with disabilities along with

potential methods for addressing these needs. Work with students at multiple levels has increased their understanding of these issues along with the broader needs of the transportation community. This knowledge will carry with them beyond their education into the workforce and community.

- Multiscale Model project: Novel social media data sources to address fuel shortage during hurricanes as well as modeling techniques from other domains (epidemic modeling, control theory) to address this problem have resulted from this project.
- DRONETIM project: This project has raised awareness on how emergency responders can maximize the information provided to them during an emergency event.
- VRU-POD project: This research presents an adaptive and personalized routing model that enables individuals with disabilities to define their route preferences as a part of a mobility assistant program. The proactive approach based on anticipated user need accommodates vulnerable road users' personalized optimum dynamic routing rather than a reactive approach passively awaiting input. Most of currently available trip planners target the general public's use of simpler route planning prioritized based on static road characteristics. These static normative approach is only satisfactory when conditions of intermediate nodes in the network are consistent, a constant rate of change occurs per each change of the link condition, and the same fixed routes are valid every day regardless of the user preference.
- Real-Time project: This project prepares students working on them as well as presentation audiences with a better understanding of Intelligent Transportation Systems (ITS) and the impact of hurricanes on transportation systems.
- Autodrive project: The project has engaged a significant number of undergraduate and graduate students from different disciplines. Further, the developed self-driving car has been demonstrated to many K-12 students visiting the campus or other similar outreach activities.

The activities that took place during the reporting period are expected to affect the passage of new policies, regulation, rulemaking, or legislation in the following ways:

- Multi-agent project: Since a route with overcapacity would delay the evacuation performance, decision-making tools such as the ones developed for this project are needed to optimally distribute passengers.
- DRONETIM project: Real-time aerial views using unmanned aerial vehicles are expected to overcome limitations of ground-based operations that do not simultaneously capture network-wide information.
- VRU-POD project: In this research, an adaptive dynamic wayfinding technique navigates vulnerable road users with personalized preferences and time-varying parameters. A reinforcement learning algorithm is used to compute the optimal policy. The resulting improved VRU service will increase VRU demand and help local agencies see the benefit of prioritizing investments designed to serve the VRU population.

The research activities during the reporting period have led (or will lead) to increases in the body of knowledge in the following ways:

- Last Mile project: The research will demonstrate and document how outreach and experience with automated technology can impact user attitudes and acceptance. The research will also document how VRUs prefer to utilize an autonomous shuttle.
- VRU-MAP project: The work on this project has improved the literature regarding mobility of individuals with various disabilities, especially those with intellectual or other cognitive disabilities, which is generally a subpopulation that is untouched by research regarding mobility issues. The project also identifies some key challenges of other individuals with comorbid disabilities.
- Multiscale Model project: Activities from this project have led to the development of a compartmental stochastic epidemic spread model for fuel shortages at the city and state level. A policy analysis was conducted using a predictive model for future hurricanes. The model used traffic data from past hurricanes (e.g. Irma and Florence) combined with a Monte Carlo fuel

consumption model to estimate fuel usage. A self-excitation point process model was used to delineate and estimate baseline and contagious fuel consumption (e.g. fuel hoarding, the effect of nearby refueling stations emptying).

- Multi-agent project: Developing an optimal passenger path planning route while considering the dynamic and uncertain environment as well as passenger behavior is not trivial. While previous evacuation planning studies have focused on either simulation of realistic human behaviors or simple route planning, the best route decisions with several intermediate decision-points and real-time changing environments have not been considered until now.
- DRONETIM project: One of the primary contributions of this project is the development of a cooperative vehicle system consisting of an UAV and ERV and multi-objective allocation of ERV's that are currently responding to earlier emergencies.
- VRU-POD project: Prior work in this area has focused on wayfinding with static parameters related to the sidewalk for people with disabilities. However, wayfinding with static parameters might be impractical in real world situations. Routing with static parameters is only applicable when the same fixed route is used and the same route conditions exist every day. This project provides a VRUPOD model incorporating dynamic parameters in wayfinding for VRUs.
- Real-Time project: During this reporting period, the Lens model was developed to characterize the decision behavior during an emergency evacuation based on multiple cues.
- Autodrive project: The developed technologies by the team have led to a self-driving car that can handle challenges in urban driving environments such as pedestrian detection, vehicle detection, and traffic sign detection.

The following projects are expected to result in improved processes, technologies, techniques and skills in addressing transportation issues:

- Last Mile project: During this reporting period, the research has uncovered various challenges that exist when implementing an autonomous shuttle. Dissemination of the challenges encountered can be used to develop methods that will improve adoption of these vehicles in the real world.
- VRU-MAP project: The work on this project will be incorporated into the VRU-POD project which seeks to produce a more comprehensive prototype mobile app technology for VRUs.
- Multiscale Model project: Modeling techniques from other domains such as epidemic modeling and control theory are being used to address the problem of fuel shortages during hurricanes.
- Multi-agent project: This CATM work develops an optimal navigation model for evacuation path planning to minimize the total evacuation time composed of arrivals at intermediate decision points while considering the influence on other passengers based on the social-force model.
- DRONETIM project: To enrich the coordination of multiple UAVs and ERVs, the constraint satisfaction problem is further extended to a distributed constraint optimization problem.
- VRU-POD project: Through crowdsourcing, which already existing through cellphones, navigation resiliency in response to unexpected circumstances on the sidewalk was greatly improved.

The following activities are expected to result in the enlargement of the pool of trained transportation professionals:

- Last Mile project: Several VTTI staff members received training related to the operation, maintenance, and route mapping functions for the EasyMile shuttle vehicle.
- Research projects: Many students from a diverse array of academic disciplines have participated in the various research projects that were active this reporting period. Several of these students have carried their transportation research experience and training into the workplace.
- Education and Workforce Development activities: The activities that took place during this reporting period have exposed several undergraduate students to various aspects of transportation. This exposure has resulted in piquing the interest of students who otherwise had not considered a career in transportation. These students are expected to seek out transportation-related positions as they engage in internship and permanent job seeking activities.

The following research projects have led or will lead to the adoption of new technologies, techniques or practices:

- Last Mile project: Best practices in training and outreach on automated vehicles are in the process of being developed as a result of this study.
- Multiscale Model project: This project will lead to the adoption of modeling techniques from other domains, such as epidemic modeling and control theory, to address transportation problems.
- DRONETIM project: This study automates the allocation of UAVs and ERVs while satisfying constraints between these vehicles using a constraint satisfaction problem (CSP) framework.
- VRU-POD project: This project will result in a new GPS technology and shared information source.

Table 6 contains the center-specific performance measures for outcomes, the target per year, and the current status of each goal.

Table 6: CATM Outcome Performance Measures

Outcome #	Goals	Research Performance Measures	Target per year	Current Status
Outcome #1 (technology focused)	Adoption of new technologies to help vulnerable road users identify suitable transportation services	Number of technology transfer activities that offer implementation or deployment guidance	2	0
Outcome #2 (technology focused)	Enhanced decision-making techniques that improve the efficiency and effectiveness of emergency evacuation processes	Number of decision-making technology training courses or webinars developed and delivered	2	3
Outcome #3	Automated vehicle design guidelines based on an increased understanding and awareness of human perceptions of and interactions with automated vehicles	Number of human factors guideline documents published	2	0
Outcome #4	Dissemination of research results through presentations, publications, conference papers, and technical reports	Number of presentations and workshops given	6	40
		Number of peer-reviewed journal papers published	2	10
		Number of newsletter articles, conference papers, and technical reports published	10	22

5. IMPACTS:

What is the impact on the effectiveness of the transportation system?

- DRONETIM project: To safely avoid the conflict with other agents and ultimately make evacuation time shorter, an adaptive routing strategy per individual passenger is required. While the previously developed social force model trained by real-world data provides a realistic simulation of pedestrian behaviors under emergent situations, a dynamic routing model will be developed in this study to suggest the best options to evacuate faster.
- VRU-POD project: The proactive approach based on anticipated user needs accommodates VRUs' personalized optimum dynamic routing rather than a reactive approach of passively awaiting input. Most of the currently available trip planners target the general public's use of simpler route planning prioritized based on static road characteristics.

What is the impact on the adoption of new practices, or instances where research outcomes have led to the initiation of a start-up company?

- VRU-MAP project: This project may indirectly impact the mobility of people with disabilities through the incorporation of results into the VRU-POD app.
- Multi-agent project: By integrating two models, further optimization of mobility in emergency evacuation situations was achieved. The alternative path planning model was able to incorporate the social force model's density map and assign highly congested areas to negative reward states. The negative reward states were used to avoid congested areas and pathways and advise pedestrians to follow the alternate path.
- VRU-POD project: The government can integrate the outcome of this project with the public transit system, especially with the use of automated vehicles.
- Real-Time project: The team will identify the factors affecting drivers' choice of evacuation routes, and the factors and actions of the current North Carolina ITSs that can benefit a hurricane evacuation. The contributing factors will support the North Carolina government in organizing an effective emergency evacuation.

What is the impact on the body of scientific knowledge?

- VRU-MAP project: This project incorporates aspects of human factors, psychology, and information science. Both the process and implementation of the product will impact all of these domains.
- Multiscale Model project: The following are contributions of this project achieved this reporting period – 1) Compartmental stochastic epidemic spread model for fuel shortages at a city and state level. 2) Traffic data from past hurricanes (e.g. Irma and Florence) combined with a Monte Carlo fuel consumption model to estimate fuel usage. 3) Self-excitation point process model to delineate and estimate baseline and contagious fuel consumption. 4) Agent-based discrete event simulation model for detailed analysis at the scale of a few intersections. 5) Policy analysis using a predictive model for future hurricanes based on the above outcomes.
- Multi-agent project: The current decision framework can incorporate uncertain information. The belief is that applying this modeling technique will reduce the total overall evacuation time of pedestrians in an emergency airport situation. The findings of this project will lead to a multidisciplinary computational framework for understanding and modeling the human decision-making process and resulting actions in emergency evacuations.
- DRONETIM project: The use of Desktop Communications Protocol (DCOP) for collaborative assignment of UAVs and ERVs can improve how incidents are managed on roadways.
- VRU-POD project: Through VRU personalization, optimization, and simulation, the VRUPOD incorporated multimodal information into the optimal route search policies.
- Real-Time project: The factors identified for drivers' choice of evacuation routes will be used to develop driver behavior models under emergency. The factors for rescheduling airline

passengers will be used in developing the model of airline passengers rescheduling. The factors and actions of the North Carolina ITSs for a hurricane evacuation will be used to develop a simulation testbed for the North Carolina government agencies to evaluate traffic control plans/policies during a hurricane evacuation.

What is the impact on transportation workforce development?

- VRU-MAP project: The experiences we provide the students working on this project will serve them through their post-graduate careers and help bring transportation-related considerations into the public sphere.
- Multiscale Models project: Graduate students who were trained on this project are now in the workforce. Research on using new methods from other domains and social media data sources for transportation applications have been published based on this project for use by transportation researchers and practitioners.
- Multi-Agent and DRONETIM projects: Students learned how to formulate problems, prepare data, and validate model formulation through the simulation. While students played a major role preparing papers accepted for conferences and under review by a journal, they also learned to write a proposal for state and federal governments using their strengths.
- VRU-POD project: Funding for this project has been used to support several graduate students and practical applications of the research have been introduced for various class activities.
- Real-Time project: Six students, including two female undergraduate students, have been involved in the project. Working on this project prepares them with a better understanding of ITSs and the impact of weather events on transportation systems.
- Education and Workforce Development activities: The work of the CATM transportation scholars through the Student-to-Student Initiative has increased awareness and interest in the supply chain major and the desire for a career in supply chain management. This initiative also brings awareness of NC A&T's Summer High School Transportation Institute, through which students can learn more about the breadth of transportation careers available and transportation research activities taking place.

Table 7 contains the center-specific performance measures for impacts, the target per year, and the status of each goal.

Table 7: CATM Impact Performance Measures

Impact #	Goals	Research Performance Measures	Target per year	Current Status
Impact #1 (technology focused)	Increase in the number of vulnerable road users able to acquire transportation services that fit their special needs	Number of instances of vulnerable road user technology adoption or commercialization	2	1 created/ 0 adopted
Impact #2 (technology focused)	More effective and efficient emergency transportation management processes	Number of instances optimization models or technologies are utilized or commercialized	3	6 created/ 0 adopted
Impact #3	Increase the body of knowledge for human factors in automated vehicles	Number of instances of research changing behavior, practices, decision making, policies (including regulatory policies), or social actions	2	0

6. CHANGES/PROBLEMS:

VTTI's initial deployment of the EasyMile has found that it is not appropriate to place vulnerable populations in the vehicle during operation, even with an operator present. This led VTTI to change the focus group protocols to accommodate viewing but not riding.

Progress for several projects are likely to be delayed due to the COVID-19 pandemic stay-at-home orders issued by the various states. Travel plans to present research results at regional and national conferences have also been disrupted due to the COVID-19 pandemic. Because researchers and students were sent home in March and many will not be permitted to return for part, if not all, of summer, some research activities are delayed for at least a couple of months. For instance, Virginia Tech's IRB has already suspended all participant research involving human contact due to COVID-19. VTTI will acquire IRB approval for the focus groups but will wait to collect data until Virginia Tech's IRB determines it is safe. In the meantime, VTTI will focus on developing outreach and technology transfer materials for its best practices and lessons learned, including webinars and publications.

Given the pandemic, the VRU-MAP research team members are working from home, including students. This has reduced face-to-face time and made some interactions more challenging, for example collaborating side-by-side to solve project problems and determine steps to approach next project steps. However, the team is working diligently to mitigate project slowdowns related to stay-at-home orders.

Delays in hiring students have resulted in requests for no-cost extensions for several research projects. These extensions are necessary to ensure adequate staffing levels are acquired and all research tasks are allocated sufficient time to be completed.

The 2nd Annual Transportation Awareness Day was cancelled due to the COVID-19. There were over 3,000 North Carolina middle school students registered for that event. Due to the expected close proximity of attendees and the request for social distancing, the event was cancelled. The current plan is to change the date to a later time when the distancing restrictions have been lifted.

7. SPECIAL REPORTING REQUIREMENTS

Nothing to report for this period.