

**Program Progress Performance Report  
for the  
New England University Transportation Center  
Massachusetts Institute of Technology**

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## REPORTING CATEGORIES

### 1. Accomplishments

#### 1A. Research Projects

##### Major goals as stated in New England UTC Prospectus

##### Research Goal

- To conduct research in technology applications and systems integration with related work in policy, planning and human factors that improve transportation safety as well as further our understanding and realization of livable communities to support mobility across the lifespan.
- To support peer-reviewed investigations that address safety and livability by exploring and furthering research, policy, and practice in the application of ubiquitous intelligence, use of big data, and improved human performance

Following is the list of the 48 research projects under this grant, and their current status. Note that five of the research projects are “active” because they are still in the process of finishing up analyzing the data from their surveys. These five projects will be completed—with Final Reports submitted—by December 15, 2019.

Project No.	PI	Project Title	Status
MITR25-1	Abou-Zeid Ben-Akiva	Capturing the Relationship between Social Interaction and Travel Behavior Using Smart Phones	completed
MITR25-2	Caplice Caballero	High-Resolution Urban Freight Modeling in Cambridge, MA	completed
MITR25-3	Coughlin	Assessing Navigability and Livability of Public Transportation Systems	completed
MITR25-4	Ellis Lavalliere	Transportation Workforce Health and Wellbeing	completed
MITR25-5	D'Ambrosio	Understanding the Adoption of and Education about New Auto Technologies among Older Adults	completed

MITR25-6	Frazzoli	Modeling the Impact of One-Way Car Sharing: An integrated data- and optimization-driven approach	completed
MITR25-7	Goentzel	Stochastic Analysis of Logistics Capacity in Disaster Response Networks	completed
MITR25-8	Gonzalez	Coupled Mobility Networks: A Data Driven Approach	completed
MITR25-9	Isaacson	Out and About in New England: Maintaining Active Life styles in Later Life	completed
MITR25-10	Lee	Effectiveness of Various Information Channels on User Training and Learning in Automobiles	completed
MITR25-11	Osorio	Optimal Road Traffic Operations for an Increasingly Autonomous and Connected Vehicle Fleet	completed
MITR25-12	Pentland Shmueli	Incentivizing Safer Driving Using Peer-Pressure	completed
MITR25-13	Reimer Dobres	Assessing the Effect of Typography on In-Vehicle Glance-Like Reading Across the Lifespan	completed
MITR25-14	Salvucci Murga	MALL Transit and Wider Economic Benefit Assessment	completed
MITR25-15	Sussman	Hub Stations As Catalysts for Regional Growth: The Case of New York Penn Station	completed
MITR25-16	Trancik	From Trip Data to the Energy Requirements of Personal Vehicle Travel	completed
MITR25-17	Zegras Pereira	Scenario Discovery for Resilient Urban Systems (or, The Future is "Big Data")	completed

MITR25-18	Zhao	Humanizing Travel: How E-hail Apps Transform Stakeholder Relationships in Taxi Services	completed
HVDR25-19	Glaeser	Transportation Stimulus Spending and Long Term Unemployment	completed
MITR25-47	D'Ambrosio Coughlin	Transit User Centered Empathy & Experience	active
MITR25-48	Coughlin	Shared Ride Service Drivers' Profiles & Perspectives	active
MITR25-49	Zhao	An Urban Agenda for Autonomous Vehicles: Embedding Planning Principles into Technological Deployment	completed
MITR25-50	Patskanick D'Ambrosio Coughlin	Transit Fare Discount Processing Improvements for Disadvantaged Populations	completed
MITR25-51	Raue Coughlin	Perceived Risk of Loss of Driving & Alternative Mobility Planning	active
MITR25-52	Sheffi Winkenbach	Urban Last-Mile Transportation 4.0	completed
MITR25-53	Seppelt Coughlin	Consumer Use & Adoption of Advanced Vehicle Systems: Leveraging Individual Variation in Visual Perception to Optimize Display Design	completed
MITR25-54	Reimer	Exploration of Factors Impacting the Successful Adoption of External Vehicle Interfaces	completed
MITR25-55	Brady Coughlin	Understanding Perceptions of Transportation for Livable Communities	active
MITR25-56	Zegras	Advanced Behavioral Analysis of High Resolution Mobility Data	completed

MITR25-57	Lee	IoT Home Transportation & Trip Substitution Services	active
HVDR25-20	Gomez-Ibanez Fagan	The Experience with Managed Toll Lanes	completed
HVDR25-21	Howitt	Recreating Livable Communities after Catastrophe: Managing the Recovery from Japan's Earthquake, Tsunami, and Nuclear Disaster of 2011	completed
HVDR25-22	Mayne	The Politics of Transport Policy in the Greater Copenhagen Region, Part 2	completed
HVDR25-23	Shoag	The Local Effects of the American Recovery and Reinvestment Act on Economic Activity and Traffic Safety	completed
UMAR25-24	Christofa Knodler	Operational and Emission Analyses of Roundabouts under Varied Vehicle and Pedestrian Demands	completed
UMAR25-25	Fisher Knodler Zafian	Evaluating the Effect of Google Glass on Driver Distraction	completed
UMAR25-26	Gao	Routing Policy Choice Models in Stochastic Time-Dependent Networks: The Stockholm Case Study	completed
UMAR25-27	Gonzales	Route Choice in Congested Grid Networks	completed
UMAR25-28	Knodler Fisher	A Driving Simulator Evaluation of Driver Distraction and Traffic Control Device Comprehension for At-Grade Railroad Crossings	completed
UMAR25-29	Krishnamurty	An Innovative Design to Retrofit Seatbelts in Motorcoaches	completed
UMAR25-30	Ni Wang	Supplementary Vehicle Positioning to Connected Vehicles	completed
UCNR25-31	Atkinson-Palombo Garrick	A Multi-Scalar Model to Identify the Causes of Decreased Vehicle Miles Traveled (VMT) in the United States	completed

UCNR25-32	Garrick Atkinson-Palombo	Factors Contributing to the Decrease in Traffic Fatality Rates for Young People in America	completed
UCNR25-33	Ivan Ravishanker Townsend	Social Network Effects on Attitudes about Pedestrian Street Crossing Behavior	completed
UCNR25-34	Konduri Dalal	Exploration of Human Psychological Factors Underlying Mobile Phone Usage Behaviors while Driving	completed
UCNR25-35	Lownes	Clustering Algorithms for Transit Network Design	completed
UMER25-36	Garder	Deficient Bridges and Safety Information	completed
UMER25-37	Rubin Garder	Automated Vehicles: Economic Incentives for Environmental Benefits and Safety	completed

**Accomplishments under the New England UTC’s research goal**

**Project MITR25-49**

**An Urban Agenda for Autonomous Vehicles Embedding Planning Principles into Technological Deployment**

Autonomous vehicles are poised to dramatically reshape the transportation system. We conducted new survey- and model-based research to assess the potential implications of varying AV-focused planning policies, while providing new materials and conducting significant outreach to local government officials. Our work has received considerable interest from the press and from municipalities themselves. Our first paper was discussed in articles in *CityLab* and several foreign news outlets, demonstrating the value of this research for the public at large.

**Project MITR25-50**

**Transit Fare Discount Processing Improvements for Disadvantaged Populations**

Across Massachusetts, older adults are often faced with important decisions about making changes to their daily modes of transportation as they age. The goal of this project was to develop a better understanding of the transportation experiences and service use among a sample of the “oldest old” adults. This study investigated the attitudes, experiences and beliefs of a panel of adults all over the age of 85 who live local to the metro-Boston, MA area. The primary impact of this research included gaining and documenting an extensive understanding of the current Massachusetts MBTA Senior CharlieCard fare designation process from the applicant’s point of view. Additionally, a focus on effective public engagement and communication with community-based service providers and teams at the MBTA fosters diverse opinions, mutual respect, and a climate promoting social action.

### **Project MITR25-52**

#### **Urban Last-Mile Transportation 4.0**

The purpose of this research project was to evaluate and compare the performance of different operational setups for highly responsive urban logistics services based on a number of economic, social, and environmental metrics. Based on open-source technology, we established a simulation-based optimization framework to design and evaluate flexible urban distribution systems. Using our model implementation, we conducted large-scale, vehicle-level simulations of how effectively and efficiently randomly materializing demand can be served by various designs of highly responsive urban last-mile delivery systems. Our findings suggest that an urban freight policy aimed at reducing congestion, and also emissions, should focus on incentivizing companies to use bicycles as last-mile couriers and improve their operations such that they can consolidate customer orders.

### **Project MITR25-53**

#### **Consumer Use & Adoption of Advanced Vehicle Systems: Leveraging Individual Variation in Visual Perception to Optimize Display Design**

The overall aim of this research was to design safer assistance automation systems that keep the driver informed and involved in the driving task. The recent publications of "*The "out-of-the-loop" concept in automated driving: Proposed definition, measures and implications*" and "*Keeping the driver in the loop: Dynamic feedback to support appropriate use of imperfect vehicle control automation*" together define what it means for a driver to be "in-" versus "out-of-the-loop" as well as the information requirements to support drivers in understanding and more appropriately relying on assistive features [Merat et al., 2019; Seppelt & Lee, 2019]. Analysis of a nationally-deployed survey on driver perceptions of AVs and of interview data collected from a four-week field operational trial, from data initially collected within the AVT project, revealed important information related to naturalistic system use of automated technologies that informs the design of safer, more effective HMLs.

### **Project MITR25-54**

#### **Exploration of Factors Impacting the Successful Adoption of External Vehicle Interfaces**

There is concern that vehicle automation may necessitate the introduction of added displays to indicate vehicle intent in vehicle-to-pedestrian interactions. Displays of various types have been demonstrated to best assess the need for new external vehicle interfaces and how to develop interfaces that enhance communication. This research explored this situation through a set of crowdsourced experiments that considered the use of high resolution static imagery and the ability to perceive a drivers' presence in a car under different lighting conditions and ranges—aimed to deepen our understanding of the relationship between pedestrians and drivers. Results have been discussed with an international working group focused on external vehicle interfaces as a way to enhance the industrial and federal stakeholders understanding of the pedestrian-vehicle interactions that may be required to provide pedestrians with an understanding of an automated vehicles intent. These results aid standardization efforts by informing stakeholders of the various factor involved in the complex interaction that occurs between pedestrians and vehicles.

### **Project MITR25-56**

#### **Advanced Behavioral Analysis of High Resolution Mobility Data**

This project explored the value of integrating theory-based discrete choice models (DCMs) and data-driven neural networks to demonstrate the benefit from the strengths of both. We proposed hybrid structures and strategies to flexibly represent taste heterogeneity and improve predictability while keeping model interpretability. Also, we utilized neural networks' training machinery to speed up and scale up the estimation of Latent Class Choice Models (LCCMs). The neural-embedded choice models proposed in this study can be integrated into trip-based model systems and activity-based model systems. The benefits are flexible specification, reduced bias, and more accurate prediction, Interpretability partially is maintained, and faster estimation is possible. The practical implications are neural-embedded discrete choice models (NEDCMs) can be beneficial to transport modeling and planning, by reducing potential biases and improving model forecast accuracy.

## How the New England UTC's research results have been disseminated

### **Project MITR25-49**

#### **An Urban Agenda for Autonomous Vehicles Embedding Planning Principles into Technological Deployment**

Our first paper was discussed in articles in *CityLab* and several foreign news outlets, demonstrating the value of this research for the public at large.

### **Project MITR25-53**

#### **Consumer Use & Adoption of Advanced Vehicle Systems: Leveraging Individual Variation in Visual Perception to Optimize Display Design**

Two recent publications: "*The "out-of-the-loop" concept in automated driving: Proposed definition, measures and implications*" and "*Keeping the driver in the loop: Dynamic feedback to support appropriate use of imperfect vehicle control automation*" (Merat et al., 2019; Seppelt & Lee, 2019).

## Plans during the next reporting period to accomplish the New England UTC's research goal

Our grant ended on September 30, 2019 and all research activities—except for the five active projects noted above—have ceased.



## **1B. Education Projects**

### **Education & Workforce Goal**

- To introduce transportation to all levels of education: K-12, undergraduate, graduate and continuing education.
- To place graduates into transportation fields.
- To provide current and developing methods, tools and insights to today's transportation workforce to support their capacity to build, operate and manage a safe and efficient transportation system.

Following is the list of the 2 education projects under this grant, and their current status:

<b>Project No.</b>	<b>PI</b>	<b>Project Title</b>	<b>Status</b>
HVDE25-38	Howitt	Teaching Case Study on Korea Ferry Disaster of April 2014	completed
HVDE25-39	Davis Altshuler	Transforming Urban Transport: A Set of Case Studies	completed

### **Accomplishments under the New England UTC's education goal**

Nothing to report.

### **How the New England UTC's education results have been disseminated**

Nothing to report

## **1C. Technology Transfer Projects**

### **Technology Transfer Goal**

- To increase the awareness and level of information concerning transportation issues facing New England.
- To further our well-established technology transfer and outreach activities.
- To engage the public and private transportation sectors throughout the New England Region and the nation.

Following is the list of the 2 technology transfer projects under this grant, and their current status:

<b>Project No.</b>	<b>PI</b>	<b>Project Title</b>	<b>Status</b>
MITT25-43	Coughlin	MIT Centralized Technology Transfer Initiatives	completed
UMAT25-44	Collura	UMass Centralized Technology Transfer Initiatives	completed

### **Accomplishments under the New England UTC's technology transfer goal**

#### **Project UMAT25-44 UMass Centralized Technology Transfer Initiatives**

The focus of this initiative is on workforce development and technology transfer.

In April 2019, three UMass students traveled to the Northeastern District Traffic Bowl held at New York University to compete and present their research. The three-student team won the competition.

In April 2019, one UMass student presented her research at the NEITS Annual Interchange and was awarded the New England ITS Joseph Sussman Award.

Four UMass students attended the Northeastern District ITE Meeting in New Haven, CT in May 2019 to network, present their research, and attend technical sessions. At this meeting, UMassITE was awarded the Student Chapter of the Year Award by the District; graduate student member, Alyssa Ryan, was awarded 1st Place in the Student Poster Competition; and graduate student member, Francis Tainter, was awarded 1st Place in the Student Paper Competition for the District.

Also, on May 14, 2019, two UMass students attended the University Transportation Centers Spotlight Conference in Washington DC. This one-day conference highlighted UTC program-supported and other transportation research activities for Congress and other stakeholders. UMass students presented to members of the Senate and Congress the current UTC research work being done. The conference was co-hosted by the Council of University Transportation Centers and the Research, Education, and Training Reauthorization Coalition.

In June 2019, six UMass students participated in the ASCE International Conference on Transportation and Development in Alexandria, VA. At this conference, students networked, presented their research, and attended technical sessions.

In July 2019, three UMass students participated in the ITE Annual Meeting in Austin, TX. One student presented her research there, and all three competed in the Traffic Bowl. Student Alyssa Ryan was awarded Second Place in the HSIS Research Paper Competition

In September 2019, six UMass students attended the Massachusetts/New England Joint ITE meeting in Waltham, MA. One of UMass's undergraduate members, Thomas Hannon, was awarded the Undergraduate Thomas Desjardins Scholarship, and one of UMass's graduate members, Alyssa Ryan, was awarded the Graduate Thomas Desjardins Scholarship.

In April 2019 UMass faculty, staff and students organized and participated in the 2019 MassDOT Innovation Conference, a two day conference which attracted a total of 1,293 attendees. Sessions included, among others, the following: "New Shared Mobility: Electric Scooters, Electric Assist Bicycles, and What's Next"; "Connected Vehicle Technology and the Road to a Connected Corridor"; "How Teamwork & Technology Drove the Success of Hingham's Route 3A Road Diet Pilot Program"; "Drones Part 1 - UAS Systems and Use-Cases: A New Paradigm for Transportation and Incident Response"; "New England Community Transportation Roundtable"; "Testing Automated Driving Systems on Public Ways"; "In the Zone - Work Zone Safety"; "Creating a Complete Street on a Gateway Bridge"; "Implementing a GIS-based Safety System"; "Advancements in Curb Management and Bus Rapid Transit in Massachusetts"; "Drones Part 2 - Developing & Deploying Advanced UAS Applications: The Case for Collaboration Among Government, Industry and Academia"; "Use of Adaptive Traffic Control Signals in Massachusetts"; "South Massachusetts Avenue Corridor Safety Improvements"; "An Ongoing Study in Municipal Transportation Best Practices".

Also of note, UMass students, faculty, and staff participated in the following UMass/Amherst Transportation Engineering Program seminars: "Travel Demand Modeling at an MPO: Insight into the Education, Skills, and Tools Needed to Build and Use the Models" (speaker Scott Peterson, Manager of Planning at CTPS); "Toward A National Policy in Climate Change and Transportation from the Bottom Up: Examples from around the U.S." (speaker Michael D. Meyer, Ph.D., P.E., F.ASCE, Senior Advisor, WSP USA, Inc.); "Major Programs & Initiatives of the MBTA" (speaker Jeffrey D. Gonneville, Deputy General Manager, Massachusetts Bay Transportation Authority); "Self-organization in traffic flow: Applications in modeling and mitigation of traffic jams" (speaker Kshitij Jerath, Assistant Professor, University of Massachusetts Lowell); "From Physical Properties of Transportation Flows to Demand Estimation: An Optimization Approach" (speaker Julia Yan, PhD candidate at MIT Operations Research Center); "Winners and losers from congestion pricing with a mixed-traffic bus alternative" (speaker Lewis Lehe, Assistant Professor, University of Illinois Urbana-Champaign).

In July 2019, two UMass faculty attended the 23rd International Symposium on Transportation and Traffic Theory (ISTTT23), held in Lausanne, Switzerland. They did a poster presentation: "A continuous model for coordinated pricing of mixed access modes to transit."

## 2. Products

### Journal publications

AlAdawy, D., Glazer, M., Terwilliger, J., Schmidt, H., Domeyer, J., Mehler, B., Reimer, B. & Fridman, L. (2019). Eye Contact Between Pedestrians and Drivers. Proceedings of the 10th International Driving Symposium on Human Factors in Driver Assessment, Training, and Vehicle Design.

Schmidt, H., Terwilliger, J., AlAdawy, D. & Fridman, L. (2019). Hacking Nonverbal Communication Between Pedestrians and Vehicles in Virtual Reality. Proceedings of the 10th International Driving Symposium on Human Factors in Driver Assessment, Training, and Vehicle Design.

Terwilliger, J., Glazer, M., Schmidt, H., Domeyer, J., Toyoda, H., Mehler, B., Reimer, B. & Fridman, L. (2019). Dynamics of Pedestrian Crossing Decisions Based on Vehicle Trajectories in Large-Scale Simulated and Real-World Data. Proceedings of the 10th International Driving Symposium on Human Factors in Driver Assessment, Training, and Vehicle Design.

Y. Freemark, A.W. Hudson and J. Zhao, "Are cities prepared for autonomous vehicles? Planning for technological change by U.S. local governments," *Journal of the American Planning Association*, spring 2019.

Y. Freemark, A.W. Hudson, and J. Zhao, "Policies for Autonomy: How American Cities Envision Regulating Automated Vehicles," to *Transportation Research Part A*. This paper is currently under review.

### Books, dissertations, or one-time publication

Nothing to report

### Other publications, conference papers and presentations

Nothing to report

### Websites or other Internet sites

Nothing to report

### Media

Nothing to report

### **Technologies or techniques**

Nothing to report

### **Inventions, patent applications, and licenses**

Nothing to report

### **Other products**

Nothing to report

## **3. Participants & Other Collaborating Organizations**

### **Organizations that have been involved as partners**

Massachusetts Bay Transportation Authority (MBTA) – Boston, MA: Collaborative research

Prof. Francisco Camara Pereira. Professor, Technical University of Denmark (DTU)

Prof. Moshe Ben-Akiva. Professor, CEE, MIT

The University of Wisconsin

Toyota's Collaborative Safety Research Center

Transamerica

University of Wisconsin-Madison - Professor John D. Lee. - Collaborative Research

Waltham Council on Aging – Waltham, MA: Collaborative research

### **Other collaborators or contacts that have been involved**

Qin Gao, Tsinghua University, discussions to brainstorm ideas for study design and analysis

University of Leeds - Professor Natasha Merat - Collaborative Research

## **4. Impact**

### **The impact on the development of the principal disciplines of the program**

Nothing to report

### **The impact on other disciplines**

Nothing to report

### **The impact on the development of transportation workforce development**

See the details under the section “Accomplishments Under the New England UTC’s Technology Transfer Goal” for Project UMAT25-44: UMass Centralized Technology Transfer Initiatives, whose focus is on workforce development and technology transfer.

### **The impact on physical, institutional, and information resources at your university or other partner institutions**

Nothing to report

### **The impact on technology transfer**

See the details under the section “Accomplishments Under the New England UTC’s Technology Transfer Goal” for Project UMAT25-44: UMass Centralized Technology Transfer Initiatives, whose focus is on workforce development and technology transfer.

### **The impact on society beyond science and technology**

Nothing to report

## **5. CHANGES/PROBLEMS**

Nothing to report.

### **Additional information regarding Products and Impacts**

Nothing to report

### **Outputs**

Nothing to report.

### **Outcomes**

Nothing to report.

### **Impacts**

Nothing to report.