Program Progress Performance Report for University Transportation Centers

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1. ACCOMPLISHMENTS

What are the major goals of the program?

The goals of the Center for Transportation, Environment, and Community Health (CTECH) are to pursue research and education innovations to support sustainable mobility of people and goods, while preserving the environment and improving community health. It leverages behavioral and economic sciences, information technology, and environmental and transportation sciences and technologies to address critical issues falling under the FAST Act's priority area of Preserving the Environment: greenhouse gas reduction, use of alternative fuels and energy technologies, environmentally responsible planning, and impacts of freight movement.

To address these challenges, the Center organizes its research activities through six thrusts: 1) Behavior, Active Transportation, and Community Health, which studies the links between travel behavior, active transportation, the built environment, and health; 2) New Transportation Technologies and Business Models, which explores how mobility-on-demand services can be used to improve environmental sustainability and human health; 3) Green Multimodal Transportation Systems, which leverages new mobility technologies to promote sustainable and health-enhancing modal integration; 4) Freight Transportation and Community Health, which explores new vehicle technologies and operation paradigms to reduce human exposure to truck exhaust; 5) Data-Driven Transportation-Health Informatics, which leverages Smart City and IoT (Internet-of-Things) technologies to develop community-based and personalized transportation-health indices for promoting heathy mobility choices; and 6) Energy, Technology and Policy Pathways, which studies the impact of different combinations of energy, technology and policy pathways on the environment and community health. The consortium, consisting of Cornell University (Cornell), University of California, Davis (UCD), University of South Florida (USF), and The University of Texas at El Paso (UTEP), has assembled a team of renowned researchers to collaboratively advance these research activities and goals.

The Center leverages existing strengths of partner universities to create an innovative, multidisciplinary education program capable of training a workforce that will meet the complex challenges at the intersection of transportation, environment, and community health. Beyond the multidisciplinary curriculum designed in parallel with its research, the Center is developing programs to attract motivated undergraduates and high school students to transportation, particularly from underrepresented groups. Through multi-level, multidisciplinary and institutional collaborations, CTECH is advancing transportation sustainability in its broader human and environmental contexts.

What was accomplished under these goals?

Under the major program goals described in the previous section, CTECH completed the following during the reporting period from April 1, 2018 to September 30, 2018.

Administrative:

1) Wrote and adopted a Technology Transfer Plan.
2) Completed our second call for proposals for CTECH New Research Initiative Funds (NRIF) for projects to be carried out in year three. Ten projects were funded with $633,200 in award funds (~$1 million with 50% match).
3) Solicited applications for our second CTECH Ph.D. Dissertation and selected two awardees, Mayra Chavez form UTEP and Hanjiro Ambrose from UC Davis. Their Ph.D. dissertations are on *Assessing Children's Spatiotemporal Exposures to Transportation Pollutants in Near-Road Communities* and *Life Cycle Modelling of Technologies and Strategies for Pollution Abatement: A Study of Heavy Duty Vehicle Systems*, respectively.
4) In conjunction with our host institution, UC Davis, planned our first Annual Meeting and Poster session to be held on November 9, 2018, followed on November 10, 2018 by our first joint meeting of our Executive and Technical Advisory Board members.

Research:

Across the four partner institutions, progress continues on CTECH research projects and publications as summarized below.

Table 1: Research projects.

University	Ongoing Projects	Status
Cornell	Active Transportation, Environment, and Health	Active
Cornell	Aerodynamic Equilibrium and Stability in Ventilation and Air Quality Control of Complex Urban Tunnels	Active
Cornell	The air quality and health impacts of projected long-haul truck and rail freight transportation in the United States in 2050	Active
Cornell	Examining Individual Health and Healthcare Utilization Patterns at the Intersection of Transportation, Environment, and Communities	Active
Cornell	Active transportation and the emotion-stress-health link: virtual reality for assessing perceptual responses by pedestrians and bicyclists to the built environment	Active
Cornell/USF	Demand-Driven Operational Design for Shared Mobility with Ride-pooling Options	Active
Cornell	URBANO: A computational tool-kit for integrated urban design incorporating active transportation, pollution, and outdoor comfort models to facilitate the design of healthy and sustainable urban habitats	Active
UCD	Estimating Activity and Health Impacts of First and Last Mile Transit Access Programs for Work and Shopping Trips Using Shared Mobility Services in a Metropolitan Area	Active
UCD	Optimal driving of autonomous vehicle platoons on arterial streets to reduce fuel consumption	Active
UCD	Routing Traffic for Community Health: The Case with Safety-Conscious Travelers	Active
UCD	Tracking Shoreline Conditions to Protect Infrastructure	Active
UCD	Active Transportation and Community Health Impacts of Automated Vehicle Scenarios: An Integration of the San Francisco Bay Area Activity Based Travel Demand Model and the Integrated Transport and Health Impacts Model	
UTEP	Assessing Children's Spatiotemporal Exposures to Transportation Pollutants in Near-Road Communities	Active
UTEP	Smart Sensors to Reduce Pollutant Emissions in Transportation, Phase I and Phase II	Active
UTEP	Vulnerable User Road Safety Enhancements for Transportation Management	Active
UTEP	Exploring Social Connectivity and Transportation Needs of the Seniors through a Mobile Smartphone Application	Active
USF	Air pollution and equity impacts of the proposed Tampa Bay Next program from a Health in all Policies perspective	Active
USF	Development and Evaluation of Porous Pavement Surface Mixtures with Biobased Epoxy Asphalt Binder	Active
USF	Implementation of a Community-Based Public Health Buddy Program for Transportation-Disadvantaged Older Adults	Active

Table 2: Publications and related presentations.

University	White Papers/Research Papers	Status
Cornell	Analyzing willingness to improve the resilience of New York City's transportation system	Accepted
Cornell	Optimal charging station location problem in bus networks based on the minimum energy consumption strategy	Under review
Cornell	The effects of control technologies, fleet turnover, and electrification on transportation in Houston and its associated air quality, health endpoints, and benefits changes in 2040	In submission
Cornell	Traffic stability under provision of real-time en-route air pollution information	Under review
Cornell	The air quality and health impacts of projected long-haul trucks and rail freight transportation in the United States in 2050	Under review
Cornell	The Marginal Cost of Traffic Congestion and Road Pricing: Evidence from a Natural Experiment in Beijing	Under review
Cornell	The Batched Set Cover Problem	In submission
Cornell	URBANO: A new tool to promote mobility-aware urban design, active transportation modeling	Submitted

	and access analysis for amenities and public transport	
Cornell	Transportation Policies and Equilibrium Sorting: Evidence from Beijing	In progress
Cornell	Predicting Health Outcomes Using Spatial and Environmental Data (PHOCUS): Application on Hospital Readmission Among Heart Failure Patients	In progress
USF	A statistical analysis of bikesharing use and its potential as an auto-trip substitute	In submission
USF	Shared Automated Vehicles: A Statistical Analysis of Consumer Use Likelihoods and Concerns	Submitted
USF	Evaluating Environmental and Economic Effects of Different Pavement Rehabilitation Strategies	In progress
USF	Development of a community based buddy program for college students	In progress
USF	Agent-based modeling to estimate exposures to urban air pollution from transportation: exposure disparities and impacts of high-resolution data	Under review
USF	Equity assessment for economic, environmental, and public health outcomes of transportation: From conventional to emerging technologies, in "Pushing the Frontier: Data Driven Transportation Networks in an Era of Rapid Change	Under review
USF	A GIS-based framework creating green stormwater infrastructure inventory relevant to surface transportation planning	In submission
USF	Equity assessment for economic, environmental, and public health outcomes of transportation: From conventional to emerging technologies	Submitted
USF	Exploring the equity performance of bike-sharing systems with disaggregated data: A story of South Tampa	In progress
USF	Risk-Averse Network Design with Behavioral Conditional Value-at-Risk for Hazardous Materials Transportation	Submitted
UCD	Transit demand estimation based on multi-source data	In progress
UCD	Simulation-Optimization Framework to Evaluate a Sustainable First Mile Transit Access Program Using Shared Mobility	Under review
UCD	Automated Vehicle Scenarios: Simulation Of System-Level Travel Effects In The San Francisco Bay Area , Automated Vehicle Scenarios: Simulation of System-Level Travel Effects in the San Francisco Bay Area	Under review
UCD	Competition among Automated Taxis, Transit, and Conventional Passenger Vehicles: Traffic Effects in the San Francisco Bay Area	Under review
UCD	Evaluating the Environmental Impacts of Online Shopping: A Behavioral Analysis Using the American Time Use Survey (Atus) Data	Under review
UCD	Tracking risk to coastal infrastructure from eroding shorelines	In progress
UCD	Ridesharing on a Many-to-One Network with a Common Parking Location	In progress
UCD	The Morning Commute Problem of Heterogeneous Ridesharing Travelers	In progress
UCD	An analysis of the effect of ridesharing incentives on fuel consumption in the morning commute	
UTEP	A Metric for Transportation, Environment and Community Health	Under review
UTEP	Development of Demand and Pricing Models for University Campus Parking	Under review

Engagement:

Engagement activities during the reporting period are summarized in Tables 3-6 below.

CTECH students at UTEP conducted outreach sessions on June 26 and July 14 to a total of 50 grade 9-10 students. The high school students were at UTEP to participate in the week long ExciTES summer program that aims to introduce them to different engineering disciplines (https://www.utep.edu/engineering/academic-programs/k12-outreach/excites.html). In each of 1.5-hour interactive sessions, participants were introduced to the following topics: *What is transportation engineering? What are the various modes of transportation? The four functional classifications of roads. Different intersections and interchanges. Different types of traffic signs. Traffic signals: cycle length, phases and movements. Freeway dynamic message signs and incident management. Transportation engineering professional communities. Companies/organizations that hire transportation engineers.*

CTECH was proud to host the 2018 "Smart and Healthy Cities" activity as part of the Cornell College of Engineering Diversity Program's CURIE Academy. 48 dynamic junior and senior female high school students participated in this one-week summer residential program intended to advance women in engineering and its related disciplines. These students listened to lectures on how urban infrastructure provides critical services for the health, economic well-being, and security of modern communities, and represents one of the defining characteristics of the modern world.

A student from the CTECH 2017 CATALYST Academy was invited back to the summer 2018 CTECH Research Experience for Undergraduate Program. Under the direction of Dr. Esther Chiew and Professor Linda Nozick, she successfully completed a research project entitled *Understanding Consumer Decisions on Alternative Fuel Vehicles Using Discrete Choice Models*, learned new tools, and wrote and presented a final report. This program helps acclimate soon-to-be undergraduates to a college environment, expose the research side of academia, provide tools for future academic success, and to spark an interest in research and the pursuit of an advanced degree. This student applied, was accepted, and matriculated into the Cornell Engineering program in Fall 2018.

Table 3: Meetings and presentations.

Date	Title	Speaker(s) or Participant	Event /Organization	Location	Stakeholder Group	Attend/ URMs
4/1/18	An integrated Life Cycle Assessment (LCA) - Life Cycle Cost Analysis (LCCA) Framework for Pavement Maintenance and Rehabilitation	Chunfu Xin, USF	Institute of Transportation Engineers (ITE) USF Student Chapter	Tampa, Florida	Academic	40
4/7/18-4/8/18	Transportation Policies and Equilibrium Sorting: Evidence from Beijing	Shanjun Li, Cornell	Beijing University	Beijing, China	Academic	~50
4/9/18	Transportation Policies and Equilibrium Sorting: Evidence from Beijing	Shanjun Li, Cornell	Beihang University	Beijing, China	Academic	~20
4/12/18	Transportation Policies and Equilibrium Sorting: Evidence from Beijing	Shanjun Li, Cornell	Massachusetts Institute of Technology	Cambridge, Massachusetts	Academic	~20
4/25/18	System Challenges and Innovation in Urban Infrastructure for Healthy Living in Smart Cities	Oliver Gao, Cornell	Panel discussion in the annual Advisory Board meeting of the Cornell Program of Infrastructure Policy	New York, New York	Industrial	~100
4/26/18	Transportation Policies and Equilibrium Sorting: Evidence from Beijing	Shanjun Li, Cornell	Duke University	Durham, North Carolina	Academic	~20
4/26/18	Improving urban mobility with transit centric on-demand services	Samitha Samaranayake, Cornell	Massachusetts Institute of Technology Transit Lab Seminar	Cambridge, Massachusetts	Academic	~30
4/26/18	Cornell-Unibo Center for Vehicle Intelligence launching ceremony	Oliver Gao, Cornell	University of Bologna (Unibo), Motorvehicle University of Emilia-Romagna (MUNER), and Cornell University	New York, New York	Academic	6
5/2/18	One Health: Approach & Goals	Alexander Travis, Cornell	First Indian One Health Summit	Delhi, India	Academic, Government, Industrial,	

					Public	
5/2/18	One Health Agenda: Implementation Approaches and Challenges	Alexander Travis, Cornell	First Indian One Health Summit	Delhi, India	Academic, Government, Industrial, Public	
5/5/18	Sustainable Mobility Project - Bus Shelter System Design/Mobility Redesign	Siretta Simoncini, Cornell	Cornell University Sustainable Design Expo	Ithaca, New York	Academic, Public	~100
5/7/18	Bus Shelter System Design	Siretta Simoncini, Cornell	Cornell University Innovation Award Competition	Ithaca, New York	Academic	~20
5/16/18	U.S. Infrastructure Projects Forum: Projects Meet Money, Policy, Innovation, and Risk – Infraday East	Oliver Gao, Cornell	Infraday, LLC	New York, New York	Industrial	~150
5/29/18	Interview with Oliver Gao: GAO Engagement on Air Quality Monitoring Networks	Oliver Gao, Cornell	Government Accountability Office (GAO)	Washington, DC	Federal	4
5/29/18	Smart Cities – Ideas and Best Practices that will bring American Communities into the 21st Century	Oliver Gao, Cornell	Smart Cities Caucus Sustainability Roundtable	Washington, DC	Federal	15
6/7/18	LEED-ND and SmartCode	Kelvin Cheu, UTEP	Special lecture to students from University of Piura, Peru and UTEP	El Paso, Texas	Academic, K-12	32
6/11/18	Improving urban mobility with transit centric on-demand services	Samitha Samaranayake, Cornell	NSF Institute for Pure and Applied Mathematics, Reunion Workshop on New Directions in Mathematical Approaches for Traffic Flow Management	Lake Arrowhead, California	Academic	~25
6/20/18	Future of Transportation Panelist	Michael Zhang, UCD	Transportation Symposium in honor of Prof Carlos Daganzo/ ITS Berkeley	Berkeley, California	Academic	50
6/21/18	City Intelligence for Intelligent Living From Transportation to Air Pollution & Public Health	Oliver Gao, Cornell	Chinese University of Hong Kong Chinese Academy of Science University, Shenzhen	Shenzhen, China	Academic	25
6/25/18	City Intelligence for Intelligent Living From Transportation to Air Pollution & Public Health	Oliver Gao, Cornell	Chinese Academy of Science University	Beijing, China	Academic	20
6/26/18	City Intelligence for Intelligent Living From Transportation to Air Pollution & Public Health	Oliver Gao, Cornell	Xiamen University	Xiamen, China	Academic	50
6/26/18	Impacts of Transit-Oriented Compact-Growth on Air Pollutant Concentrations and Exposures in the Tampa Region	Sashikanth Gurram, USF	7th Transportation Research Board Conference on Innovations in Travel	Atlanta, Georgia		

			Modeling			
6/29/18	City Intelligence for Intelligent Living From Transportation to Air Pollution & Public Health	Oliver Gao, Cornell	Ecology Research Center, Chinese Academy of Science	Beijing, China	Academic	10
7/3/18	Traffic Flow Research in the Era of Autonomous Vehicles	Michael Zhang, UCD	Shandong University	Jinan, Shandong, China	Academic	35
7/4/18	Transportation Policies and Equilibrium Sorting: Evidence from Beijing	Shanjun Li, Cornell	Jinan University	Jinan, China	Academic	~30
7/6/18 – 7/7/18	Towards Faster, Greener and Safer Transportation – Autonomous, Electric and Shared Transportation Systems	Xiaopeng Li, USF	Research Institute of Ministry of Transport	Beijing, China	Academic, Industrial, Federal, State/Local, Public	30
7/7/18	Empirical Analysis on how Emerging Automated Vehicles and Shared Automated Vehicles affect Future Travel Behavior	Yu Zhang, USF	COTA International Conference for Transportation Professionals (CICTP 2019)	Beijing, China	Academic, Industrial, Federal, State/Local, Public	85
712/18	Sustainability assessment of green stormwater infrastructure	Xiaofan Xu, USF	Jilin University	Changchun, Jilin, China	Academic	30
7/15/18	Traffic Flow Research in the Era of Autonomous Vehicles	Michael Zhang, UCD	Zhejiang University	Hangzhou, China	Academic	20
8/7/18	Traffic Flow Modeling, including the Case of Connected/Automated Vehicles	Michael Zhang, UCD	TRB Mid-Year Meeting/Traffic Flow Theory and Characteristics Committee	Woods Hole, Massachusetts	Academic	50
8/14/18	Challenges for the adoption of sustainable transportation (Keynote)	Ricardo Daziano, Cornell	Energy Center, University of Chile	Santiago, Chili	Academic	~100
8/24/18	Improving urban mobility with transit centric on-demand service	Samitha Samaranayake, Cornell	The Alan Turing Institute, Workshop on Optimizing flow within mobility systems with AI	London, United Kingdom	Academic	~50
8/29/18	Panelist	Caroline Rodier, UCD	2018 FHWA Emerging Trends Workshop	Washington, DC	Academic, Industrial, Federal, State/Local, Non-Profit	75
9/7/18	Progress and Challenges Coupling to ITHIM , Progress and Challenges Coupling to ITHIM - Presentation	Caroline Rodier, UCD	Human Health and Coupling to ITHIM at the National Socio-Environmental Synthesis Center	Annapolis, Maryland	Academic, Federal, State/Local, Non-Profit	30
9/11/18	Integrating Multiple Methods for Tracking Shoreline Change Resulting from Sea Level Rise	Fraser Shilling, UCD	Infra-Eco Network Europe 2018 Conference	Amsterdam, Netherlands	Academic	
9/11/18	National Conference on Health Communication, Marketing and Media	Siwon Jang, USF	Centers for Disease Control and Prevention (CDC), the National Public Health	Atlanta, Georgia	Federal	

			Information Coalition and the Society for Health Communication			
9/12/18	Trajectories of Health: Insights from Electronic Health Records and Beyond	Yiye Zhang, Weill Cornell Medicine, Cornell	LinkedIn	New York, New York	Industrial	400
9/17/18	Empirical Analysis on how Emerging Automated Vehicles and Shared Automated Vehicles affect Future Travel Behavior	Yu Zhang, USF	International Conference for Transportation Innovation	Alberta, Canada	Academic, Industrial, Federal, State/Local	60

Table 4: Events/Activities.

Date	Event Name	Description	Organizer	Location	Stakeholders	Participants/ URMs
4/11/18	Webinar – Oliver Gao	From Transportation to Air Pollution and Public-Health – Are We Doing the Right Thing, and Doing it Right?	OST-R UTC Program	Washington, DC	Academic, State/Local, Industrial, Public	
4/19/18	ITE Student Chapter Event	Simulation competition	ITE Student Chapter, UTEP	El Paso, Texas	Academic	8
4/19/18	Colin Huwyler, CEO, Optimus Technologies	Diesel retrofit technologies	CTECH	Ithaca, New York	Industrial, Academic	25
5/19/18	2018 C-STEM Center RoboPlay Challenge "Manufacturing and Automation"	Competition caps a year of K-12 students working on robots to learn algebra, mathematics, and programming	Zhang Research Group, UCD	Davis, California	K-12	120 school teams
5/29/18	Smart Cities and Healthy Communities	Opportunity to engage potential stakeholders who are interesting in Smart and Healthy Communities (e.g., U.S. military bases)	Cornell University and Army Strategic Integration Pentagon	Washington, DC	Federal	4
6/20/18	ITHIM Development Project	Kick-Off Meeting	California Air Resources Board	Sacramento, California	Academic, State/Local	30
7/15/18 - 7/21/18	CURIE Academy	One-week residential program for high school girls who excel in math and science; provides an opportunity for them to explore engineering.	CTECH, School of Civil and Environmental Engineering, and Cornell Engineering Diversity Programs	Ithaca, New York	K-12	48/11
7/25/18	ITHIM Technical User Group	Meeting	UCD	Davis, California	Academic, State/Local	30
8/24/18	Status of Aviation Industry in Florida - Lisa Waters, CEO, Florida Airport Council	How aviation blends into the multimodal transportation system and what environmental issues and challenges the industry and government	CTECH	Tampa, Florida	Academic, Industrial, Non-Profit	37

		agency are facing				

Table 5: Meetings.

Date	Purpose and Description	Location
5/18	Tompkins Consolidated Area Transit (TCAT), Town of Lansing, Tompkins County District 10 Legislator – to present feedback on Lansing re-routing proposal	Ithaca, NY
5/18/18	Valley Transit Agency – met with Santa Clara Valley Transit Agency to discuss possible collaboration	Davis, CA
5/29/18	Army Strategic Integration Pentagon – to discuss Smart Cities and Healthy Communities	Washington, DC
6/18 - /18	Multiple visits to senior centers to initiate Healthy Buddy program outreach and schedule interview with local seniors	Tampa, FL
6/20/18	Municipal Transportation Council of Guangzhu City – visit to discuss intelligent and sustainable transportation systems	Guangzhou, China
6/20/18	Vice President, Biguiyuan – met about Smart City and sustainable infrastructure	Fuoshan, China
7/18/18 – 719/18	Safe Mobility for Florida Coalition – meeting to introduce Healthy Buddy Program and receive feedback	Tallahassee, FL
8/6/18	Chief Scientist in Intelligent Transportation, Didi – met to discuss possible collaboration	Beijing, China
8/22/18	Koch Foundation Representative – meeting to discuss possible collaboration	Ithaca, NY
8/31/18	Hillsborough County Senior Center – meeting with General Manager, Frances Brea to introduce the Healthy Buddy Program; Mrs. Brea introduced the program to six other senior centers in Hillsborough for recruitment of research participants	Hillsborough County, FL
9/18	TCAT – to follow up with past tasks and to plan new tasks for fall semester	Ithaca, NY
9/10/18	USF Physical Plant Director – to discuss the status of bike sharing at USF	Tampa, FL
9/12/18	Cornell University Corporate and Foundation Relations Representative – met to discuss possible opportunities with foundations	Ithaca, NY
9/12/18	Florida Department of Transportation – met to discuss potential collaborations on air quality and health equity impacts of their transportation projects in Tampa	Tampa, FL
9/17/18	Tampa International Airport Management operation and IT departments - to discuss the impact of automated vehicles to airport landside terminal operations. Dr. Zhang made a presentation on this topic, mainly presenting a modeling framework that her team developed for evaluating the potential impacts of AV with different market penetration rates and how to assess different airport charging measures. During the meeting, Dr. Zhang also described the CTECH on-going project about reducing air pollutant at airports and discussed with the directors on how information technologies could link the airport and other transportation modes for better network flow monitoring and airport management.	Tampa, FL
9/21/18	City of Tampa Transportation and Stormwater Service Director, Mrs. Jean Duncan – to discuss forthcoming scooter sharing	Tampa, FL
9/28/18	Arup – conference call to discuss potential collaboration	Ithaca, NY
10/12/18	Conduent – met with Renee Autumn Ray, AICP, PMP to discuss possible collaboration	Atlanta, GA
Recurring	Dalio Institute of Cardiovascular Disease – provides clinical expertise regarding cardiovascular health and is collaborating on proposals, research, and publications	New York, NY
Recurring	Englander Precision Medicine Institute –provides expertise on phenotype and genotype associations on mental health and is collaborating on proposals, research, and publications	New York, NY

Table 6: Media and Online Engagement Activities.

Media and Online Engagement	
Web Page	Expanded website (http://ctech.cee.cornell.edu/). Research project related website (www.urbano.io). Developed a site for seniors to access local transportation and health information, with ability to log in and access a customized information page at https://www.hbuddy.org/.
Print Media	*Cornell Chronicle* article "Students' bus stop sign design becomes roadside reality" by Blaine Friedlander, 3/29/18.

	Tompkins Weekly article "Cornell students help design new TCAT bus stop signs" by Jamie Swinnerton, 4/16/18. *Ithaca Times* article "About those new signs at the bus stop" by Nick Reynolds, 4/25/18. *Autonomous Vehicle International* interviewed Michael Zhang, UCD, for a feature on V2X (vehicle to infrastructure) in its inaugural issue, May 2018.
Videos	CGTN America interview with Yu Zhang, USF on bike sharing, 4/18/18. The second two project related videos (USF and UCD) are completed and on the Center's website.
Webinar	CTECH attempted a webinar, however the invited speaker left his position and so we need to revisit after this setback.
Online Engagement	Three active social media accounts (Facebook, LinkedIn and Twitter) that facilitate the dissemination of research results, news, events, and other important updates; and engage in discussion with policymakers and practitioners who are active on these social media platforms.

Education:

Participation and efforts to influence and enhance the educational programs of consortium universities in the transportation field with respect to environment and community health are detailed below.

Table 7: Curricula enhancements, how and number of students impacted.

Course Name	Description of Contribution	Institution	Students Served (#)
Introduction to Transportation Engineering	Instructor, Dr. Francis Vanek, incorporates environment and health dimensions in this introduction course of transportation systems.	Cornell	63
Transportation Systems Design	Instructor, Dr. Francis Vanek, incorporates environment and health impacts in the design of transportation systems.	Cornell	15
Systems Engineering Design Project	CTECH faculty researcher, Sirietta Simoncini, was an advisor for Sustainable Mobility Projects.	Cornell	SP 38/FA 33
Transportation Energy Systems Module	Enhances both the transportation and energy course curriculums (a 1-credit module on transportation energy taught by CTECH co-PI, Ricardo Daziano).	Cornell	24
Public Health Foundations I	Discussions of 1) impacts in terms of Disability Adjusted Life Years of transportation due to air pollution and other factors and 2) of the inequitable impacts of air pollution on public health using examples of cook stoves and industry.	Cornell	32
Project Management	Transportation graduate students were TAs for these classes.	Cornell	FA105/SP 144
Introduction to Social Marketing	The Health Buddy Program was introduced to the students in this course for their course project.	USF	~15
Sustainable Engineering Design	New course that covers principles and practices related to sustainability topics by following a problem-based quantitative approach to address societal needs for the development and preservation of livable communities. The course content focuses on environmental, social, economic, and management challenges and the application of global sustainability principles into engineering solutions. Concepts and applications of green engineering, life cycle assessment and other methods and tools for sustainability analysis are discussed to provide sustainable engineering solutions. Emphasis is placed on the importance to communicate short, medium, and long-term consequences of engineering solutions to decision-makers and society from a sustainability perspective.	UTEP	7

Advanced Materials	Sensors in transportation were introduced.	UTEP	26
Dynamic Programming and Multi-stage Decision Processes	Added a case study option for students' final project in the context of transit operations.	UCD	17
Transportation Demand Modeling	Updated course content to include findings from CTECH research projects..	UCD	17
Transportation Planning	Updated course content to include findings from CTECH research projects.	UCD	5
Sustainable Transportation Systems	Developed curriculum for first track in transportation as part of the UC Davis COSMOS Program for high school students.	UCD	22

In June 2018, UTEP hosted 15 undergraduate students from University of Piura, Peru for 10 days for the study abroad program, Global & Sustainable Engineering. They attended classes with 15 UTEP students, went on field trips (e.g., transit company) and did a team project with UTEP students. Then, UTEP students traveled to Peru for similar activities on Piura's campus.

Two UTEP undergraduate students, Fernie Briones and Emiliano Ruiz, completed their 12-week summer internship in the transportation laboratory on campus. This program is designed to expose students to CTECH activities so as to cultivate their interest in the related professional or research career. They were selected for their excellent GPAs and potential interest in CTECH research and were mentored by graduate and Ph.D. students to perform various research tasks. Both of them were involved in 1) a senior citizen survey to gather feedback on a smartphone application for transportation/navigation for the seniors; 2) transportation talks to high school students who participated in UTEP's engineering summer camps; 3) assisted in using tube counters and video recording to do traffic volume survey and vehicle classification; and 4) internet searches to collect parking information from more than 100 universities. The internships culminated with final presentations to faculty and research students. Both expressed their realizations that (i) transportation, environment and community health were multidisciplinary and involved teamwork, and (ii) research in transportation, environment and community health, unlike other traditional disciplines, must involve interaction with community groups.

At UCD, co-PI, Michael Zhang, mentored High School student, Kyle Gray, from February to June, actively involving him in research group activities.

How have the results been disseminated?
Completed research activities (Table 12) have been, or are in the process of being, summarized in final reports submitted/to be submitted to TRID. Engagement activities listed above provided a platform to disseminate research from consortium members. Also, news items are posted on the website at http://ctech.cee.cornell.edu/news/.

What do you plan to do during the next reporting period to accomplish the goals?
We plan to continue to move the Center forward during the next reporting period as summarized below.

Administrative:
1) Advance the development of a tool to efficiently collect relevant data from the CTECH community for the semi-annual PPPR.
2) Facilitate an internal call for the year 4 NRIF project proposals and make award decisions. This year the process will incorporate new questions into the requirements that are intended to drive academic researchers in the Center to not only think about, but to commit to engaging stakeholders in the implementation and deployment of project outcomes. It is also expected to acclimate them to the expectation of impact, focusing them and their efforts towards real world applications.
3) Internal call for Ph.D. Dissertation Awards, a competitive process with one possible for each of the four partner institutions.

Research:

Researchers at each of the consortium universities will continue work on active projects and publications (see Tables 1 and 2). Research projects will involve graduate students, providing them with hands-on opportunities to engage in interdisciplinary and cutting-edge research. The Executive Committee members will monitor ongoing projects at each of their respective institutions to ensure they are progressing on schedule with products and results delivered.

Engagement:

Table 8: Upcoming Presentations.

Date	Title	Speaker(s)	Event/Organization	Type	Location
10/19/18	Introduction to traffic operations: capacity, control and LOS	Michael Zhang, UCD	Transportation Technology and Policy Seminar / ITS Davis	Academic	Davis, California
10/19/18	Development of a Community-Based Public Health Buddy Program for Transportation Disadvantaged Older Adult	Siwon Jang, USF	University of Alabama Transportation Disparities Research Forum	Academic	Tuscaloosa, Alabama
10/23/18	Cornell Environmental Systems Lab Research Overview	Timur Dogan, Cornell	Solemma Symposium	Industrial	New York, New York
10/24/18	Traffic routing and control in a Connected and Autonomous Vehicle environment	Michael Zhang, UCD	3 Revolutions Workshop /ITS Davis	Industrial	Davis, California
10/26/18	Transportation Policies and Equilibrium Sorting: Evidence from Beijing	Shanjun Li, Cornell	Beijing Normal University	Academic	Beijing, China
10/27/18-10/28/18	Building Sustainable Cities: Equilibrium Modeling of Transportation Policies and the Housing Market	Shanjun Li, Cornell	9th China Energy Economics and Management Conference	Academic	ChangSha, China
11/2/18	Scenario analysis of green infrastructure implementation at watershed scale	Xiaofan Xu and Dylan Schreiber, USF	AEESP Distinguished Lecture	Academic	Tampa, Florida
11/4/18	Integrating on-demand services with mass-transit	Samitha Samaranayake, Cornell	INFORMS Annual Meeting	Academic	Phoenix, Arizona
11/6/18	Online Demand-driven Car Sharing Rebalancing	Xiaopeng Li, USF	INFORMS Annual Meeting	Academic	Phoenix, Arizona
11/4/18-11/7/18	A Scalable Non-myopic Atomic Game for Smart Parking Mechanism	Hamid R. Sayarshad, Shahram Sattar, Oliver Gao, Cornell	INFORMS Annual Meeting	Academic	Phoenix, Arizona
11/4/18-11/7/18	Optimal Resource Allocation Policies in Nonprofit Organizations	Faisal M M Alkhannan Alkaabneh, Siddhartha Banerjee, Oliver Gao, Cornell	INFORMS Annual Meeting	Academic	Phoenix, Arizona
11/9/18	Potential impacts from autonomous vehicles and	Miguel Jaller,	CTECH Annual	Academic	Davis,

	transit access programs using shared mobility services in the San Francisco Bay Area	UCD	Meeting		California
11/9/18	Active Transportation	Ricardo Daziano, Cornell	CTECH Annual Meeting	Academic	Davis, California
11/9/18	Safety	Carlos Chang, UTEP	CTECH Annual Meeting	Academic	Davis, California
11/9/18	Impacts of urban and transportation design on exposures to traffic-related air pollution and exposure equity	Amy Stuart, USF	CTECH Annual Meeting	Academic	Davis, California
11/9/18	Impacts of urban and transportation design on exposures to traffic-related air pollution and exposure equity	Chintalapalli Ramana, UTEP	CTECH Annual Meeting	Academic	Davis, California
11/9/18	Tracking shoreline conditions to protect infrastructure	Fraser Shilling, UCD	CTECH Annual Meeting	Academic	Davis, California
11/9/18	Examining Individual Health and Healthcare Utilization Trend through the Lens of Transportation, Environment, and Communities	Yiye Zhang, Weill Cornell Medicine, Cornell	CTECH Annual Meeting	Academic	Davis, California
11/9/18	Development of a Comprehensive Metric for Transportation, Environment, and Community Health	Esmaeil Balal, UTEP	CTECH Annual Meeting	Academic	Davis, California
11/9/18	Transportation Policies and Equilibrium Sorting: Evidence from Beijing	Shanjun Li, Cornell	CTECH Annual Meeting	Academic	Davis, California
11/9/18	Understanding Adoption Patterns of Shared Mobility and Its Interaction with Health Perception	Natalia Barbour, USF	CTECH Annual Meeting	Academic	Davis, California
11/16/18	Planetary Health	Alexander Travis, Cornell	2nd Annual Public Health Symposium	State/Local	Ithaca, New York
11/18/18	How to mitigate environmental impact of aviation operations?	Yu Zhang, USF	World Bank Green Airport Workshop	Academic, Non-Profit, State/Local	Shangrao, Jiangxi Province, China
11/26/18	Future mobility in urban transition— Systems engineering and data analytics linking urban transport innovation, air pollution, and health	Oliver Gao, Cornell	Urban Transitions 2018	Industrial	Barcelona, Spain
11/28/18	Transportation Policies and Equilibrium Sorting: Evidence from Beijing	Shanjun Li, Cornell	Boston University	Academic	Boston, Massachusetts
11/30/18	Transportation Policies and Equilibrium Sorting: Evidence from Beijing	Shanjun Li, Cornell	University of Montreal	Academic	Montreal, Canada

1/7/19	Bi-objective Optimization of Integrated Design of Dynamic Wireless Charging Facility and On-Board Battery Size for Electric Bus Systems	Tingting Zhao, USF	TRB Annual Meeting 2019	Academic, Industrial, Federal, State/Local	Washington, DC
1/7/19	Electric Vehicle Sharing Based "Energy Sponge" Service Interfacing Transportation and Power Systems	Dongfang Zhao, USF	TRB Annual Meeting 2019	Academic, Industrial, Federal, State/Local	Washington, DC
1/7/19	A statistical analysis of consumers' perceptions towards automated vehicles and their intended adoption	Nikhil Menon, USF	TRB Annual Meeting 2019	Academic, Industrial, Federal, State/Local	Washington, DC
1/7/19	Aircraft Carbon Dioxide Emission and Spatial Characteristics of A Regional Multi-Airport System	Yu Zhang, USF	TRB Annual Meeting 2019	Academic, Industrial, Federal, State/Local	Washington, DC
1/7/19	Impacts of Automated Vehicles to Airport Planning, Design, and Operation	Yuan Wang, USF	TRB Annual Meeting 2019	Academic, Industrial, Federal, State/Local	Washington, DC
1/13/19	Modeling the Effects of Asphalt Overlay Design Factors on Long-term Pavement Roughness Progression	Chunfu Xin, USF	TRB Annual Meeting 2019	Academic, Industrial, Federal, State/Local	Washington, DC
1/13/19-1/17/19	Optimizing dynamic switching between fixed and flexible transit services with an idle-vehicle relocation strategy and reductions in emissions	Hamid Sayarshad, Oliver Gao, Cornell	TRB Annual Meeting 2019	Academic, Industrial, Federal, State/Local	Washington, DC
1/13/19-1/17/19	Simulation-Optimization Framework to Evaluate a Sustainable First Mile Transit Access Program Using Shared Mobility	Miguel Jaller, UCD	TRB Annual Meeting 2019	Academic, Industrial, Federal, State/Local	Washington, DC
1/13/19-1/17/19	Automated Vehicle Scenarios: Simulation Of System-Level Travel Effects In The San Francisco Bay Area , Automated Vehicle Scenarios: Simulation of System-Level Travel Effects in the San Francisco Bay Area	Caroline Rodier, UCD	TRB Annual Meeting 2019	Academic, Industrial, Federal, State/Local	Washington, DC
1/13/19-1/17/19	Competition among Automated Taxis, Transit, and Conventional Passenger Vehicles: Traffic Effects in the San Francisco Bay Area	Caroline Rodier, UCD	TRB Annual Meeting 2019	Academic, Industrial, Federal, State/Local	Washington, DC
1/13/19-1/17/19	Evaluating the Environmental Impacts of Online Shopping: A Behavioral Analysis Using the American Time Use Survey	Miguel Jaller, UCD	TRB Annual Meeting 2019	Academic, Industrial, Federal, State/Local	Washington, DC

	(Atus) Data				
2/25/19	Transit demand estimation based on multiple transit data sources	Ran Sun, UCD	California Department of Transportation	State/Local, Academic	San Diego, California
Spring 2019	Using Clinical History and Built Environment Information to Predict 30-day Hospital Readmission	Yiye Zhang, Weill Cornell Medicine, Cornell	WCM Healthcare Policy and Research Seminar	Academic	New York, New York
7/29/19 – 8/2/19	Network demand Estimation by integrating hard data with soft information	Yueyue Fan, UCD	The XV International Conference on Stochastic Programming	Academic, Industrial	Trondheim, Norway

Table 9: Upcoming Events/Activities.

Date	Event Name	Description	Organizer	Location
10/25/18	Association of Collegiate Schools of Planning (ACSP) 2018 Conference	Talk: How Car Donation Programs Change the Lives of Poor Families, Professor Nicholas Klein, Cornell,	ACSP	Buffalo, New York
10/29/18	Cornell Program for Infrastructure Policy (CPIP) Board Meeting	Speakers from academia and industry	CPIP	Ithaca, New York
11/1/18	WTS Special Seminar	Speaker Cassandra Borchers, Chief Development Officer of the Pinellas Suncoast Transit Authority (PSTA) in St. Petersburg, Florida	CTECH	Tampa, Florida
11/8/18	Cornell Energy Systems Institute (CESI) Advisory Board Meeting	CTECH Lead-PI, Oliver Gao, is an Associate Director of CESI and will do a talk for the Advisory Board	CESI	Ithaca, New York
11/9/18	CTECH Annual Meeting and Poster Session	First cross institutional meeting of CTECH researchers to engage and foster collaborative engagement	CTECH	Davis, California
11/10/18	CTECH Advisory Board Meetings	CTECH Executive and Technical Advisory Board meetings	CTECH	Davis, California
2/14/18	ITE Student Leadership Summit	Event intended to get students and young professionals in Transportation Engineering ready for excellence in the workplace of tomorrow in ways not usually done in a classroom setting	ITE USF Student Chapter, CTECH	Tampa, Florida
2/16/18	USF Engineering Expo	Seeks to educate K-12 students on the importance of STEM fields in their lives. It is a free and unique opportunity (open to the public) to meet and talk with Tampa Bay's local engineers and engineering student organizations at USF. Expo features interactive, educational shows, and hands-on exhibits that help encourage more students to pursue fields in science and mathematics. There is also an opportunity to fulfill Sunshine State Standards and even finish a Scout Badge Achievement.	CTECH Student Council, WTS USF Student Chapter, ITE Student Chapter	Tampa, Florida

Table 10: Upcoming Meetings.

Date	Purpose and Description	Location

TBD	Wegmans Supply Chain Management – meet with Scott Andrews to discuss CTECH mission and initiatives and potential collaboration opportunities	Ithaca, NY
TBD	City of University of Hong Kong, Provost – meet to explore collaboration opportunities in CTECH research areas	Ithaca, NY
TBD	Vice Chancellor of Universidad Politecnica de Madrid and Julio Lumbreras, Asunción Gómez-Pérez - – meet to explore collaboration opportunities in CTECH research areas	Ithaca, NY
10/18	Tompkins Consolidated Area Transit (TCAT), Town of Lansing, Tompkins County District 10 Legislator, and Village Solar Apartments – to discuss/explore possible location of first bus shelter implementation	Ithaca, NY
10/31/18	Environmental Defense Fund – Zoom call with representative	Ithaca, NY
11/18	TCAT – to plan new tasks for spring semester	Ithaca, NY
11/15/18	Hillsborough County MPO – to discuss how automated vehicles can be incorporated into long-range planning	Tampa, FL
12/18	TCAT, Town of Lansing, and Tompkins County District 10 Legislator – fall semester review of tasks developed	Ithaca, NY

Table 11: Planned Media and Online Engagement Activities.

Media and Online Engagement	
Web Page	We will continue to keep the CTECH website current and include content submitted by all four partner institutions.
Videos	CTECH plans to continue to develop short project videos for engagement with our community and the general public. CURIE Academy videos in progress.
Webinar	CTECH is working on starting a CTECH webinar series.
Online Engagement	Cornell will continue to manage and track CTECH's three social media accounts and have recently engaged the new Student Council leaders to provide material for these communication tools. USF plans to use social media to advertise the Healthy Buddy Program.

Education:

CTECH faculty will work on influencing course curriculums to strengthen the educational programs of consortium universities for preparing next-generation transportation professionals, while inspiring, advising and supporting students in pursuing transportation engineering or related careers. In addition, they will continue and expand workforce development efforts geared to practice professionals, educating current practitioners to be responsive to rapid changes in the transportation field with respect to environment and community health.

Co-curricular activities such as industry mentorship programs and seminar series in conjunction with active student chapters of professional organizations provide students with a well-rounded educational experience.

USF will continue with its industry mentorship program and we continue to invite industry partners to the other three institutions to mentor graduate student research by offering comments and suggestions from a practitioner's point of view, and by providing data or other information. Students benefit from working closely with both a major advisor and a transportation industry mentor. Volunteers from local transportation industry companies and government agencies are encouraged to engage in this joint educational opportunity.

Oliver Gao, CTECH Director, has been actively involved in enhancing Cornell course curriculums related to our themes. For example, as a faculty advisory board member of the new Cornell Master of Public Health (MPH) professional degree program (directed by CTECH co-PI, Alex Travis), they have worked

to incorporate the topics of transportation, built environment and community health. He also gives a guest lecture linking transportation to health. As a core faculty member of the Cornell Institute for Public Affairs (CIPA), Oliver is the CIPA concentration faculty in Science, Technology, and Infrastructure Policy (STIP), advising STIP students in their course selection and study program to help them better understand the opportunities in their concentration relevant to CTECH focus areas. He gave a roundtable seminar talk to approximately 15 CIPA fellows on transportation systems innovation towards sustainable community development, and participated the CIPA STIP concentration meeting (20+ students) to talk about CTECH research and education.

2. PRODUCTS

Products from CTECH members during the reporting period are listed below.

Table 12: Research projects.

University	Completed Projects	Status
Cornell	Redesigning Mass Transit Systems to better integrate with Mobility-on-Demand Systems	Completed
Cornell	The Economic and Health Impacts of Subway Construction: Evidence from Beijing	Completed
Cornell	Mobility-Aware Integrated Urban Design	Completed
Cornell	Designing Cross-subsidy Mechanisms for Sustainable Multi-modal Transportation Systems	Completed
UCD	A Study of the Integrated Parking and Ridesharing Pricing/Incentives and their Social and Environmental Impacts in Metropolitan Areas	Completed
UCD	Evaluating the Efficiency and Health Impacts of Next-Generation Transit System Design with Integration of Shared Mobility Services	Completed
USF	Health Perception on Adoption and Acceptance of Shared Mobility: From Now to Future	Completed
USF	Improving Quality of Life for Transportation-Disadvantaged Older Adults through Community-Based Healthy Buddy Program	Completed
USF	Measuring Impact of Emerging Transportation Technologies on Community Equity in Economy, Environment, and Public Health	Completed
USF	Pavement Rehabilitation Policy for Reduced Life-Cycle Cost and Environmental Impact Based on Multiple Pavement Performance Measures	Completed
USF	Reducing Airport Pollution and Consequent Health Impacts to Local Community	Completed
USF	Spatial Sustainability Assessment of Green Stormwater Infrastructure for Surface Transportation Planning, Phase II	Completed
UTEP	Characterization of University Parking Systems	Completed

- Journal publications
    1. Tan, Z., Gao, H.O. (2018). Hybrid model predictive control based dynamic pricing of managed lanes with multiple accesses, Transportation Research Part B: Methodological, Volume 112, Pages 113-131, https://doi.org/10.1016/j.trb.2018.03.008.
    2. Tan, Z., Gao, H.O. (2018). Ventilation Control in Bifurcate Tunnels with Distributed Vents, 2018 Annual American Control Conference (ACC), 27-29 June 2018, Pages 559-564, https://doi.org/10.23919/ACC.2018.8431467.
    3. Menon, N., Barbour, N., Zhang, Y., Pinjari, A.R., Mannering, F. (2018). Shared autonomous vehicles and their potential impacts on household vehicle ownership: An exploratory empirical assessment, International Journal of Sustainable Transportation, https://doi.org/10.1080/15568318.2018.1443178.
    4. Hoque, M.M., Lu, Q., Xin, C. (2018). Effect of Highway Lane Management Policy of Heavy Vehicles on the Construction Cost of Flexible Pavement, Journal of Transportation Engineering, Part A: Systems, Issue 11, Volume 144, Pages 04018072-1-04018072-9, https://doi.org/10.1061/JTEPBS.0000194.
    5. Dogan, T., Samaranayake, S., Saraf, N. (2018). Urbano: A new tool to promote mobility-aware urban design, active transportation modeling and access analysis for amenities and public transport, 2018 SimAUD Conference (Symposium on Simulation//For Architecture + Urban Design), 4-7 June 2018.
    6. Kaster, P., Dogan, T. (2018). Optimization of meshing methodologies for annual urban CFD simulations, 2018 eSIM Canada 2018, 9-10 May 2018.

7. Ancker, J.S., Kim, M-H., Zhang, Y., Zhang, Y., Pathak, J. (2018). The potential value of social determinants of health in predicting health outcomes, Journal of the American Medical Informatics Association, Volume 25, Issue 8, Pages 1109-1110, https://doi.org/10.1093/jamia/ocy061.
8. Schinfeld, J., Sharara, F., Morris, R., Gianpiero, P.D., Rosenwaks, Z., Seaman, E., Hirshberg, S., Cook, J., Cardona, C., Ostermeier, G.C., Travis, A.J. (2018). Cap-Score™ prospectively predicts probability of pregnancy, Molecular Reproduction & Development, Volume 85, Issue 8-9, Pages 654-664, https://doi.org/10.1002/mrd.23057.
9. Dumas, S.E., Lewis, D., Travis, A.J. (2018). Small-scale egg production centres increase children's egg consumption in rural Zambia, Maternal & Child Nutrition, Volume 14, Issue S3, https://doi.org/10.1111/mcn.12662.
10. Asano, A., Roman, H.B., Hirschberger, L.L., Ushiyama, A., Hinchman, M.M., Stipanuk, M.H., Travis, A.J. (2018). Cysteine dioxygenase is essential for mouse sperm osmoadaptation and male fertility, FEBS, Volume 285, Issue 10, Pages, 1827-1839, https://doi.org/10.1111/febs.14449.

3. PARTICIPANTS & COLLABORATING ORGANIZATIONS

There are a variety of ways for external entities to engage with CTECH to advance the development and deployment of research and technologies. Those, and a complete list of CTECH affiliates, is at http://ctech.cee.cornell.edu/consortium-opportunities/. New relationships developed during this reporting period include those listed in Table 13.

Table 13: New Partner and Collaborating Organizations.

Organization	Location	Contribution to CTECH
City of Ithaca	Ithaca, NY	Collaborative research
City of Temple Terrace	Temple Terrace, FL	Collaborative research
Cornell-Unibo Center for Vehicle Intelligence	New York, NY	Co-PI of Cornell-Unibo Center is CTECH Lead-PI, Oliver Gao
Dalio Institute of Cardiovascular Disease	New York, NY	Collaborative research
Englander Precision Medicine Institute	New York, NY	Collaborative research
Florida Safe Mobility for Florida Coalition	Tallahassee, FL	Collaborative Effort
Hillsborough County Public Works		Collaborative research
Hillsborough County Senior Centers	Tampa, FL	Research participants
Ithaca Tompkins County Transportation Council (ITCTC)	Ithaca, NY	Collaborative research
Kohn Pederson Fox	New York, NY	Collaborative research
NYMTC (The New York Metropolitan Transportation Council)	New York, NY	Collaborative research
Optimus Technologies	Pittsburgh, PA	Technology application
Rensselaer Polytechnic Institute	Troy, NY	Collaborative NYSERDA proposal
Texas Transportation Institute	College Station, TX	Collaborative NYSERDA proposal
Tompkins County District 10 Legislature	Ithaca, NY	Collaborative research
Town of Lansing	Lansing, NY	Collaborative research
United States Geological Survey	Vallejo, CA	Collaborative research

4. IMPACT

Transportation that sacrifices environmental quality and public health is simply untenable. Successful solutions call for innovative cross-disciplinary research and education, and integrated technologies and approaches that meet goals in mobility alongside goals in environmental and health protection. Focused on FAST Act's priority area of Preserving the Environment, CTECH will use its fundamental research

activities as the driving force to create downstream innovations, practices, and to spur an education program for workforce development. Even in its initial stage, CTECH is already showing its impact on the development of the principal discipline(s) as a unique platform for synergistic and multidisciplinary research and education in the nexus of Transportation, Environment, and Community Health, defining and advancing clear broad impacts to meet global challenges.

What is the impact on the development of the principal discipline(s) of the program?
CTECH is an interdisciplinary consortium involving faculty from engineering, urban planning, environmental science, and social science. Our research program, as organized by interlocking thrusts through interactive structures, promotes cross-fertilizations of ideas inside and outside of the transportation research discipline. For example, CTECH's focus incorporating environment and health dimensions into the disciplinary study of transportation systems has helped advance the multi-objective optimization of transportation design not only to achieve the traditional efficiency goal, but also emission reduction and public health protection objectives in transportation systems design (e.g., Pareto optimality).

What is the impact on other disciplines?
Research and education thrust one on "Behavior, Active Transportation, the Built Environment, and Health" links travel behavior, active transportation and the built environment to community health. Primary goals are to: (a) identify the multiple factors that motivate travelers to choose transportation modes that promote healthy lifestyles; and (b) characterize the benefits of active transportation toward good health. One current project investigates the factors that explain demand for active transportation, including non-instrumental attributes and non-standard observed attributes, and extended decision rules. Data and methods developed in such studies are expected to also have significant implications for economic choice models, city and regional planning, cognitive science, and social psychology. For instance, CTECH researcher Ricardo Daziano's recent study reveals that not only are autonomous features highly desirable, but consumers are willing to pay a premium for them – almost $5,000 in addition to the price of a car with standard features (https://www.sciencedirect.com/science/article/pii/S0968090X17300682).

What is the impact on the development of transportation workforce development?
CTECH's mission is to pursue research and innovation to support sustainable mobility of people and goods while preserving the environment and improving community health. While traditional training and development of the transportation workforce helps prepare professionals well to cope with traditional transportation problems, the exposure and training of the transportation workforce on the aspects of environment and community health has been lacking. Through the research, education, and engagement activities reported, we are enabling an innovative, multidisciplinary education program capable of training a workforce that will meet the complex challenges at the intersection of transportation, environment, and community health.

Our education and workforce building effort trains students and professionals on the findings and insights of the research, as well as the tools used, lessons learned, and best practices. CTECH encourages, inspires and supports students to pursue transportation engineering or related careers through a comprehensive education program. For example, graduates from transportation-related programs at CTECH consortium universities join industrial, governmental, and academic sectors with their comprehensive systems expertise to make environment and health considerations an integral part of their future work. In addition, through the CTECH summer courses (e.g., courses at UTEP) and diversity programs (e.g., CURIE Academy at Cornell on smart and healthy cities) for URM and/or female high-school students, we are attracting upcoming generations to the future workforce in CTECH areas.

What is the impact on physical, institutional, and information resources at the university or other

partner institutions?
The Center has drawn increased awareness of, and has created physical, institutional, and information resources/opportunities for, a transportation, environment, and community health systems approach to add value across different levels to all partner institutions and collaborators. At Cornell, for instance, we are becoming a major force driving research, education, and engagement for sustainable means of campus transportation to improve campus environment, lessen environmental degradation, and keep the campus free of exhaust fumes, congestion, and energy waste. Using universities as living labs for carbon neutrality and community health is also gaining interest among students at other CTECH institutions.

What is the impact on technology transfer?
The unique aspect of the work conducted by CTECH researchers is that they focus on informing and changing policy, i.e., legislation, regulations, programs, ordinances, and protocols, at the nexus of transportation, environment and community health. The development of technologies to license or commercialize is also encouraged. The main products from our research activities are in the forms of insights, new knowledge, new tools, and new models that are instrumental to policy development and analysis. Examples of such impacts from this reporting period include a) a report on Green-house-gas emission estimation for the NYC metropolitan area prepared for New York Metropolitan Transportation Council (NYMTC); b) a database containing longitudinal information on 1.8 million patients who have been treated at Weill Cornell Medicine and NewYork-Presbyterian Hospital; c) Algorithms, codes, software that can be used by practitioners in sustainable community design; d) a model developed for integrating transit swap card readings with other transit data to infer global transit demand on the whole transit network; e) Geo-database of landscape elevations adjacent to SR 37 that can be compared to data from 2007 to study erosion/change in landscape elevation; f) survey data collected as part of the Healthy Buddy project on transportation services for seniors in Hillsborough County; and g) a project highlight on the air quality and health impacts of projected freight transportation submitted for a USDOT report to Congress.

What is the impact on society beyond science and technology?
The integrative research and education of CTECH, as evidenced by outcomes reported, is expected to create a continuous stream of knowledge and information to support systems-wide decisions in transportation-environment-health management. For example, new air quality regulations are expected to cost over $6.5 billion per year and potentially save $120 billion in health-related expenses. Ultimately, our work will contribute to improved community health and sustainable transportation through the development of more scientifically sound and operationally feasible/cost-effective strategies, and through the education of qualified professionals that can become leaders in creating innovative solutions for harmonized built and natural environments. Given that transportation and environmental problems are tenacious and globally pervasive, CTECH's study framework and methodologies could be applied to other countries via international collaborations.

5. CHANGES/PROBLEMS

None to report.

6. SPECIAL REPORTING REQUIREMENTS

Data Management Plan: http://ctech.cee.cornell.edu/data-management-and-sharing-plan/
Website: http://ctech.cee.cornell.edu/
Directory of Key Personnel: http://ctech.cee.cornell.edu/people/
Financial and Annual Share Reports: The SF425 requirements will be met by separate report.
Research Project Descriptions: http://ctech.cee.cornell.edu/projects/
CTECH Specific Metrics: In attached addendum.

CTECH Addendum

Reporting Period End Date: September 30, 2018

CTECH specific performance indicators, not included in the standardized PPPR (UTC-wide), are provided in this addendum.

1) Overarching goals of the Center include the development of a metric for community health that incorporates mobility and health indicators; mobility on-demand models including environmental sustainability indicators; large-scale models to promote environmental sustainability, community health, and environmental justice. A summary of progress on these initiatives during the reporting period is below.

For example, one second-year CTECH project studies the air quality and health impacts of projected long-haul truck and rail freight transportation in the United States in 2050. By examining multiple emission scenarios based on varying policy assumptions, we systematically model the impacts of future freight emissions on $PM_{2.5}$ concentrations, and the associated change in health outcomes (e.g., premature mortality, morbidities) and economic benefits. **Outputs from the project include** an integrated modeling system (WRF-SMOKE-CMAQ-BenMAP) that was established to incorporate the Weather Research and Forecasting (WRF) model, the Sparse Matrix Operator Kernel Emissions (SMOKE) system, the USEPA Community Multi-scale Air Quality (CMAQ) model and Environmental Benefits Mapping and Analysis Program (BenMAP) model. By considering fleet turnover, climate policy, and technology evolution, this study examined the air quality and public health impacts of projected freight emissions in 2050 over the continental United States. It quantified the impacts of changes in diesel fine particulate matter ($PM_{2.5}$) emissions on air quality, health, and economic benefits. With projected business-as-usual socioeconomic growth and fleet turnover in freight, **outcomes from the project indicate that** simulated $PM_{2.5}$ concentrations have widespread reductions, between 1-1.5 $\mu g\ m^{-3}$. This translates into health benefits of 10.3 (95% CI: 6.9 – 13.6) thousand prevented premature deaths, corresponding to $107 (95% CI: $10 – $291) billion of health cost savings annually. The carbon pricing climate policy can obtain ~6% more health benefits nationally, it also affects the health outcomes regionally due to a demand transition from truck to rail. Further technology improvements to eliminate high-emitting conditions in the truck fleet provide substantial additional benefits. These results support that a combination of continuous adoption of stringent emission standards and improvements in vehicle technology and fuels are necessary, as well as rewarding, to meet the sustainable freight and community health goals. States and metropolitan areas with high population density can take more immediate actions such as the elimination of super-emitters to improve air quality and health benefits.

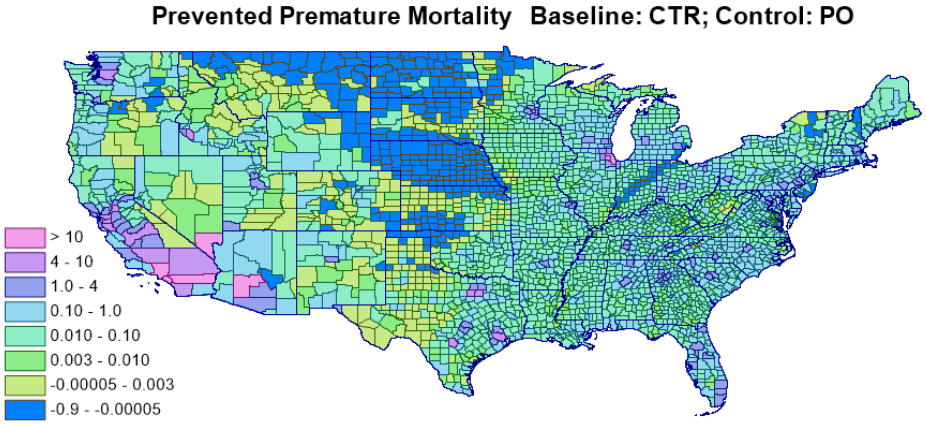

Figure1. Prevented premature mortality due to the changes in $PM_{2.5}$ concentrations between the PO case and CTR case (PO minus CTR) at the county-level.

Another CTECH project characterizes university parking system as a part of the solution towards carbon-neutral campuses. Most universities are constantly challenged by the parking congestion problem. As one of the initial steps towards finding the solutions, this research set out to: (1) understand the parking demand and management strategies at four different university campuses; (2) identify innovative solutions to manage parking demand and supply on university campuses; and (3) propose a framework to analyze the relationship between parking management on a university campus with the environment and community health. To meet the first objective, the parking demand and supply managements at four selected universities, namely Cornell University (Cornell), The University of Texas at El Paso (UTEP), University of California at Davis (UCD), and University of South Florida (USF) were reviewed, analyzed and compared. For the second objective, this report surveyed the parking management practices in more than 300 universities and summarized innovative implementations of zoning, permit sales, pricing, access control, visitor payment, data collection, guidance, enforcement and multimodal integration. For the third objective, **a major outcome from the project** is an integrative framework based on the VISSIM microscopic traffic simulation followed by emission estimation using the CMEM emission estimation model has been proposed. A case study was performed, using UTEP campus as an example, to illustrate the application of the proposed framework. **Outputs** from the VISSIM-CMEM framework estimated that the vehicle headed to UTEP parking lots between from 8:00 a.m. to 9:00 a.m. contributed 248,707 kg of CO_2.

CTECH researchers Juan Carlos Martínez Mori and Samitha Samaranayake have carried out innovative fundamental research on developing models and theories for redesigning mass transit systems to better integrate with Mobility-on Demand (MOD) systems that have significant environment and health implications for communities. In the study they introduce the batched set cover problem, which is a generalization of the online set cover problem. In this problem, the elements of the ground set that need to be covered arrive in batches. The main technical contribution is a tight lower bound on the competitive ratio of any algorithm given an adversary that is required to produce batches of VC-dimension at least z. This restriction on the adversary is motivated by the fact that, in some real world applications, decisions are made after collecting batches of data of high VC dimension. In particular, ridesharing systems rely on the batch assignment of trip requests to vehicles, and some related problems such as that of optimal congregation points for passenger pickups and dropoffs can be modeled as a batched set cover problem with VC-dimension typically greater than one. The researchers note that while any online algorithm may be used to solve the batched set cover problem by artificially sequencing the elements in a batch, this procedure may neglect the rich information encoded in the complex interactions between the elements of a batch and the sets that contain them. Therefore, they propose a minor modification to an online algorithm to obtain an algorithm that attempts to exploit such information. With the importance of efficient transit systems in improving community livability, this study contributes to the development of large-scale models to promote environmental sustainability, community health, and environmental justice.

In addition, CTECH researchers Xiaopeng Li, Yu Zhang, and Amy L. Stuart have been conducting a cross-disciplinary study measuring the impact of emerging transportation technologies on community equity in economy, environment and public health. This CTECH project aims to develop understanding of, and quantify, skewed distributions of benefits from emerging transportation technologies and services across different demographic groups in a metropolitan area. We will propose new equity measures in economy, environment and public health that can be integrated with multi-model transportation systems that include emerging technologies. A chronological comparison study will be conducted to analyze the impact of the emerging technologies on these equity measures. A case study in the Hillsborough County, Florida will be conducted to test and validate these measures, while their transferability to other metropolitan areas across the nation will be also investigated.

Last but not least, CTECH researcher Michael Zhang led a CTECH project developing new models and algorithms to route traffic for community health: the case with safety conscious travelers. This project

studies the traffic routing and equilibrium with traffic safety rather than travel time or fuel use as the main factor that affects travelers' routing choice. The safety (i.e., accident risk) is described as a random variable that depends on traffic conditions and location specific characteristics for each road. **Outputs from the project include** network equilibrium models to be developed for two distinct scenarios, namely, each traveler minimizes his or her own accident risk (user-optimal) and travelers cooperated to minimize the total accident risk in the network (system-optimal). System performance, such as total travel cost, total risk of accidents, equity of safety among all travelers, will be evaluated for both scenarios.

2) General indicators of progress:

Table 1: Members serving on boards, as editors, on national committees during the reporting period.

Commitment Date Range	Role	CTECH Member	Organization
11/2017-11/2018	Cluster Chair for National Meeting 2018 in Phoenix, Arizona	Samitha Samarayanake, Cornell	INFORMS TSL
1/2016-12/2018	Editor-in-Chief	R. (Kelvin) Cheu, UTEP	International Journal of Transportation Science & Technology
2/2107 – 1/2020	Member	R. (Kelvin) Cheu, UTEP	TRB Committee on Artificial Intelligence and Advanced Computing Applications
2006-present	Member, Editorial Advisory Board	R. (Kelvin) Cheu, UTEP	Journal of Intelligent Transportation Systems
2018-2021	Member	Ricardo Daziano, Cornell	TRB ADB40 Committee (Transportation Demand Forecasting)
2018-2021	Elected Regular Board Member	Ricardo Daziano, Cornell	International Association for Travel Behaviour Research (IATBR)
2018-2021	Member, North American Chapter	Ricardo Daziano, Cornell	International Steering Committee for Travel Survey Conferences (ISCTSC)
2017-2018	Guest Editor	Ricardo Daziano, Cornell	Journal of Choice Modeling for a special issue on estimation of complex models
1998-present	Member	Michael Zhang, UCD	TRB AHB45 Committee (Traffic Flow Theory and Characteristics)
2015-present	Member	Michael Zhang, UCD	International Advisory Committee International Symposium of Transportation and Traffic Theory
2003-present	Associate Editor	Michael Zhang, UCD	Transportation Research, Part B
2000-present	Area Editor	Michael Zhang, UCD	Networks and Spatial Economics (NETS)
2013-present	Associate Editor	Michael Zhang, UCD	Transportmetrica A: Transport Science
2016-present	Associate Editor	Michael Zhang, UCD	Transportation Science
2017-2020	Member	Miguel Jaller, UCD	TRB ABJ40 Committee (Travel Survey Methods)

2017-2019	Chair	Miguel Jaller, UCD	TRB ABJ40(2) Subcommittee (Freight Surveys)
2014-present	Member	Miguel Jaller, UCD	TRB AT025 Committee (Urban Freight Transportation)
2011-2017	Chair	Caroline Rodier, UCD	TRB Emerging and Innovative Public Transport and Technologies
2017-2018	Executive Member	Yueyue Fan, UCD	TRB Network Modeling Committee
4/2018-4/2021	Chair	Yu Zhang, USF	Transportation Research Board Standing Committee on Airfield and Airspace Capacity (AV060)
3/2018-present	Editorial Board	Yu Zhang, USF	International Journal of Sustainable Transportation
7/2014-present	Editorial Board	Yu Zhang, USF	Transportation Research Part C: Emerging Technologies
10/2016-present	Editorial Board	Yu Zhang, USF	International Journal of Transportation Science & Technology
1/2017-1/2018	President	Yu Zhang, USF	Chinese Overseas Transportation Association (COTA)
1/2018-1/2020	Immediate Past President	Yu Zhang, USF	Chinese Overseas Transportation Association (COTA)
10/2017-9/2019	Vice-Chair	Changhyun Kwon, USF	Urban Transportation Planning and Modeling SIG of the INFORMS Transportation Science and Logistics Society
4/2015-4/2021	Member	Changhyun Kwon, USF	Transportation Research Board Standing Committee Transportation Network Modeling Committee (ADB30)
6/2013-present	Member	Amy Stuart, USF	Lectures Committee, Association of Environmental Engineering and Science Professors
2/2018-present	Task Force Member	Qiong Zhang, USF	American Academy of Environmental Engineers and Scientists (AAEES)
2/2018-present	Task Force Member	Qiong Zhang, USF	Association of Environmental Engineering and Science Professors (AEESP)
10/2016-present	Member	Qing Lu, USF	EMI Mechanics of Pavements Committee, American Society of Civil Engineers (ASCE)
1/2017-present	Editorial Board	Qing Lu, USF	Transportation Research Part D
4/2015-present	Member	Qing Lu, USF	Transportation Research Board Standing Committee on Pavement Surface Properties and Vehicle Interaction (AFD90)
4/2014-present	Member	Xiaopeng Li, USF	Transportation Research Board Standing Committee on Transportation Network Modeling Committee (ADB30)
4/2014-present	Member	Xiaopeng Li, USF	Transportation Research Board Standing Committee on Traffic Flow Theory and Characteristics (AHB45)
4/2016-4/2019	Chair	Robert Bertini, USF	Transportation Research Board (TRB) Operations Section (AHB00)
1/2017-12/2019	Member	Robert Bertini, USF	Board of Governors of the IEEE Intelligent Transportation Systems Society
2013-present	Founding Editor and Editor-in-Chief	Fred Mannering, USF	Analytic Methods in Accident Research
2013-present	Editorial Advisory Board	Fred Mannering, USF	Accident Analysis and Prevention

2013-present	Editorial Advisory Board	Fred Mannering, USF	Transportation Research Part C: Emerging Technologies

Table 2: Supported students that have been hired into their first, post-undergraduate or graduate, employment positions during the reporting period.

Student Name	**Degree Conferred**	**First Post-degree Employer**
Zhen Tan	Ph.D.	Assistant Professor, Nottingham University Business School, China
Nikhil Saraf	B.S.	Transition to Cornell Ph.D. Program
Patrick Kastner	Ph.D.	Seeking employment, likely in industrial sector

Table 3: Supported students that attended conferences.

Student Name	**Conference**	**Location**	**Institution**
Zhen Tan	2018 Annual American Control Conference (ACC)	Milwaukee, Wisconsin	Cornell
Zhiqiang Wu	Institute of Industrial and System Engineering Annual Conference	Orlando, Florida	USF
Tingting Zhao	Institute of Industrial and System Engineering Annual Conference	Orlando, Florida	USF