

SEMI-ANNUAL PROGRESS REPORT

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Table of Contents

I.	Accomplishments	3
A.	Goals and Objectives	3
B.	Accomplishments of Goals and Objectives	3
1.	Center Administration	3
2.	Research	3
3.	Education	5
C.	Training and Professional Development	5
D.	Dissemination and Outreach	6
1.	Conferences, Symposia, and Workshops	6
2.	Industry and Public Agency Outreach	8
3.	Media Coverage and Public Understanding.....	9
E.	Plans for Next Reporting Period	9
II.	Participants and Collaborating Organizations	10
A.	Partner Organizations	10
B.	Other Collaborators or Contacts	11
1.	Collaborations within the Consortium	11
2.	Collaborations outside the Consortium	12
3.	International Collaborations.....	12
III.	Outputs	13
A.	Publications, Conference Papers, and Presentations	13
1.	List of Journal Publications	13
2.	List of Conference Papers.....	14
3.	List of Presentations	15
B.	Policy Papers	15
C.	Websites and other Internet Sites	15
D.	New Methodologies, Technologies or Techniques	16
E.	Inventions, Patents, and Licenses	16
F.	Other Products	16
IV.	Outcomes	17
A.	Increased Understanding and Awareness of Transportation Issues	17
B.	New Policies, Regulation, Rulemaking, or Legislation	17
C.	Increases in the Body of Knowledge	17
D.	Improved Processes, Technologies, Techniques and Skills in Addressing Transportation Issues	18
E.	Enlargement of the Pool of Trained Transportation Professionals	18
F.	Adoption of New Technologies, Techniques, or Practices	19
V.	Impacts	19
A.	Effectiveness of the Transportation System	19
B.	Technology Transfer – New Practices or Companies	19
C.	Increase in the Body of Scientific Knowledge	19
D.	Transportation Workforce Development	19
VI.	Changes/Problems	20

I. Accomplishments

A. Goals and Objectives

Reducing Congestion is the main research area of the Connected Communities for Smart Mobility towards Accessible and Resilient Transportation for Equitably Reducing Congestion (C2SMARTER) Center. C2SMARTER's goal will be to solve two key problems related to urban congestion: (1) untangling the broad system-of-systems interdependencies facing congested urban systems that not only include multiple modes, but many interrelated sectors, and (2) understanding the system-wide impacts of congestion, in particular those that exacerbate inequities on different population segments. We propose to develop new technologies, operational policies, and strategies towards ensuring system-level congestion reduction for all users. C2SMARTER will focus on all three topic areas under reducing congestion framing our three research thrusts on demand management technologies, system-operational control, and data-driven analyses. This integrative approach is also present in the proposed education, training, workforce development, and technology transfer initiatives. Deploying community-oriented technology transfer will further ensure that tools and technologies developed under this grant reach those who need them the most.

B. Accomplishments of Goals and Objectives

1. Center Administration

C2SMARTER's 1st year projects are underway and project webpages and internal tracking systems have been set up. The Center's Year 2 budget request was submitted to U.S. DOT.

2. Research

The following updates are on ongoing projects during this reporting period:

Multi-Modal Tripchain Planner for Disadvantaged Travelers to Incentivize Transit Usage – The team completed the literature review. A preliminary trip planner prototype was designed in PyDash, which combines transit, bike, and walking modes. The team is now working on integrating the on-demand transit options within the trip planner. Further, an agent-based mixed logit model was built to reflect the traveler's choice to use microtransit vs. other modes. A microtransit simulator of project partner Arlington, TX, was also developed based on the work of a previous project.

An AI-reinforced Traffic Digital Twin for Testing Emergency Vehicle Intervention – The team collaborated closely with agency partner FDNY to review sixteen intervention strategies, of which three were prioritized based on model feasibility, innovation, expected benefit, and agency prioritization: 1) Optimizing ambulance cross-street locations, 2) Assessing the impact of road obstacles or closures (e.g., double parking) on emergency vehicle responses, and 3) Potential utilization of bus lanes during emergency responses. For the development of the Traffic Digital Twin, the team successfully established a microscopic simulation framework for the study area in Harlem while integrating various road facilities like bus lanes, stops, parking zones, and bike lanes, ensuring the simulation's realism and relevance.

Sensor Enabled Calibration of VR-Integrated Co-Simulation Platforms – The team has completed their development of VR workers in a simulated environment; the workers can walk with their own feet, grab cones to create a mobile roadway work zone, and move with controller joysticks. A similar environment with VR drivers as the subjects is also underway; the next development will cover the integration between drivers and workers, which will enhance the understanding of work zone design and safety.

Development of a Vision-Based Landside Traffic Management System at Airports – The team discussed video data samples and access with the project partner Port Authority of NY&NJ as well as held a broader

kick-off meeting which included professionals from multiple divisions within PANYNJ, including those focused on JFK airport redevelopment operations. Various potential enhancements that could be implemented through the vision-based solution for current operations were identified.

Development of Guidelines for Implementing the Flipped Left Diamond Interchange Design – The research team developed their VISSIM simulation model for the Flipped Left Diamond Interchange (FLDI) design and tested it under various traffic conditions. The team will continue analyzing the results of the traffic simulation while also investigating any design or implementation issues of the FLDI design.

Impact of WIM-based Direct Enforcement on the Service Life of Bridges – The team has been collaborating with NYCDOT to amend the NIST Handbook 44 to introduce the standard for direct overweight enforcement. The new Section 2.26 of the handbook was selected as a voting item during the National Conference on Weights and Measures (NCWM) interim meeting in January 2024. The team completed a calibration test with New York City and State in accordance with the proposed amendment in the handbook, and ensured that the NYS Department of Agriculture and Markets, which certifies the scales used in the WIM process, validated the site for use in direct overweight enforcement.

Equitable Flood Impact Analysis Integrating GeoAI and Digital Twin Modeling – The team completed the literature review, which was largely focused on the usage of GeoAI as well as a review of Digital Twin methods. The team has also produced geospatial analysis of flooding datasets and conducted preliminary equity analysis of flooding impacts in two counties in North Carolina. The ongoing analysis investigates the overlay of various geospatial layers including flood risk zones and transportation infrastructure to identify potential evacuation methods for residents.

Building Intersection Digital Twins via GPU-Accelerated Human Regularized Reinforcement Learning – The research team successfully completed its goal of building GPU-accelerated driving simulators. These simulators are capable of training human models of driving behavior while also enabling more efficient analysis of proposed congestion reduction schemes. The research team trained models of human driving that are state-of-the-art in terms of their ability to drive long distances without a collision.

Multimodal Multi-scale Urban Traffic Control in Connected and Automated Cities – The UW research team has been working with the University of Michigan’s MCity to test the multiscale signal-vehicle coupled control (SVCC) method both in simulation and with real world CAVs. This process has included refining the team’s SVCC methods and software to fit the MCity testing environment, and preliminary simulation testing has been conducted using the MCity network.

Enhancing Transit Access and Safety Through Equitable Micromobility Solution – The team conducted an internet search and survey of all state DOTs, the Metropolitan Planning Organization (MPO) websites, and attended several public agency meetings. They determined that underserved communities are analyzed by Traffic Analysis Zones (TAZ), census tracts, or census blocks; further, the common indicators of underserved communities are race, ethnicity, income, age, disability, English proficiency, education level, and car-ownership. The team is analyzing data availability of the above indicators in the El Paso region to analyze and identify two underserved communities which will be used to analyze transit services access.

Multi-Horizon Urban EV Charging Infrastructure Planning – Team members have collected data on parking spaces in New York City as well as on EV chargers, EV charging demand, and EV prices in the area. The team has also processed the relevant behavioral data from project partner Replica. The team developed models that track, both in time and space, the distribution of vehicles with a given level of charge, as well as the availability of parking spaces (both for non-EV and EV owners).

Control of CAVs for Congestion Reduction in Mixed Traffic: A Learning-Based Approach – The team completed a literature review, which indicated that physics-informed machine learning methods could suit the study’s aspiration to improve traffic efficiency with a learning-based approach. Among these methods, physically-informed neural network (PINN), a deep learning framework, has been most widely used in previous studies of a similar nature.

A Knowledge Capture and Deployment Tracking Platform for UTC Research – As part of the project’s source collection and database mining task, the team outlined a comprehensive protocol, identifying ITS-related projects from the U.S. DOT UTC program. To build a repository of training documents, the team also wrote a Python script that downloaded every item from the TRID database tagged as a UTC report and uploaded since January 2019. The team began selecting evaluation metrics and categories for indexing, with a special emphasis on new Measures of Effectiveness (MOEs), tech transfer methods, and equity considerations in deployments. An automated knowledge synthesis process which leverages large language models (LLMs) is in the developmental phase; the chosen approach aims to merge AI-driven insights with manual validation to ensure the relevance and accuracy of synthesized knowledge. A preliminary design for an initial chatbot embedding the LLMs as well as PDF readers was built.

Transit Accessibility Showcase - The Transit Accessibility Showcase, hosted at NYU on January 23, 2024, featured a presentation of report findings and panel discussion with representatives from the Metropolitan Transportation Authority (MTA), the city’s disability community, and New York City government. Attendees from government, industry, and the public engaged in a thoughtful discussion about needs and plans for accessibility. The project met its objectives of bringing light to the progress and challenges of making transit accessible in New York, and recommending paths forward.

Charting Equitable Outcomes for Highway Communities/ Smart Technology & Smart Development – The project team hosted a symposium titled BQE 2053: Towards a Decarbonized Sustainable Multi-Modal Transportation Network, which brought together planners, architects, public officials, community leaders, youth, and engineers to discuss the history of the Brooklyn Queens Expressway (BQE) and situate it in the context of highway construction throughout the U.S. The team continues to work on documenting the community voices that will help shape the future of the BQE; this documentation will culminate in an online repository of oral histories of the communities living near the expressway.

3. Education

K-12 STEAM Club Drone Tech in Rural, Tribal Communities – Between 5 and 8 students at Ocosta High School have regularly participated in drone technology training and applications; they attended Saturday activities an average of once every 2-3 weeks in the Autumn 2023 Quarter and once a month in Winter 2024 Quarter. Activities were designed and led by two UW masters students in urban planning, under the guidance of PI Abramson.

Undergraduate researchers who completed City Tech’s Emerging Scholars Program (ESP) were paired with NYU faculty under the **Tech Transfer with Undergrad Research & Workforce Development** cross-institutional mentorship initiative. In March of 2024, a C2SMARTER Research Social was held at NYU with approximately 30 attendees from both NYU and City Tech. Student researchers that completed the Fall 2023 ESP program presented their research posters at the event.

C. Training and Professional Development

- The **Emerging Leaders in Transportation** program was held on February 13-18, 2024, successfully bringing together 36 early-career professionals for a transformative experience. Participants engaged in insightful panels and discussions, fostering innovation and creative thinking, and developed plans to incorporate innovative tools and practices within their organizations. Participants enhanced their

leadership skills through interactive workshops and interactions with industry experts, and built a strong professional network within the industry, which will benefit them throughout their careers.

- The [C2SMARTER Student Learning Hub](#), open to all students attending C2SMARTER Consortium Universities, has offered free courses on applicable skills for students since its launch in 2020. The classes are primarily taught by doctoral students at Consortium schools, providing teaching and curriculum development experience. The following classes were offered during this period:
 - **October 13, 2023:** Introduction to Neural Networks (NNs): How and When to Use Recurrent NNs and Convolution NNs
 - **October 20, 2023:** Contextualizing Cloud-based Geospatial Analytics Techniques
 - **October 27, 2023:** Solving Large-Scale Optimization Problems: A Practical Guide to High-Performance Computing (HPC) and Using C++ APIs for CPLEX
 - **November 8, 2023:** From Classroom to Career: How Students Can Harness Experiential Learning for Future Success with Carnegie Mellon’s Prof. Gabriela Gongora-Svartzman.
 - **November 10, 2023:** Essentials of Data Acquisition for Transportation Analysis
 - **March 8, 2024:** Fueling Innovation: An Industry View on CV Data and its Applications with Chris Wichman of AirSage.
- C2SMARTER Center continues to support consortium institution Institute of Transportation Engineers / Intelligent Transportation Society Student Chapters. NYU ITE hosted several events:
 - **October 3, 2023:** Transportation Jeopardy
 - **October 14, 2023:** TransportationCamp NYC 2023
 - **December 1, 2023:** Holiday Train Show
 - **December 15, 2023:** End of Semester Celebration
 - **February 19, 2024:** New York City: The Game
 - **March 11, 2024:** Women in Transportation Panel
- On November 9, 2023, the ASCE and CMAA Civil Engineering Career Fair was held at NYU. Companies who attended included HNTB, Port Authority of New York and New Jersey, and Amtrak.
- On March 1, 2023, NYU Tandon hosted a Virtual Career Fair with a number of employers interested in Civil and Urban Engineering students.
- Center Director Dr. Kaan Ozbay and NYU Knowledge Capture team’s Co-PI Dr. Bian organized the Understand Digital Twins for Transportation Systems workshop at TRB 2024, invited 10 speakers across academic, industry and agency to discuss digital twins in transportation systems.
- In partnership with ITE Met Section, C2SMARTER celebrated National STEM Day on November 8, 2023, by hosting students from Bard High School Early College, Bronx, NY.

D. Dissemination and Outreach

1. Conferences, Symposia, and Workshops

- The Transportation Research Board (TRB) 2024 Annual Meeting was held in Washington D.C. over January 7 - 11, 2024. The conference accepted over [40 papers](#) from professors within the C2SMARTER Consortium, covering a plethora of transportation research interests. Highlighted sessions included:
 - Professor Joseph Chow participated in a panel moderated by fellow NYU Professor Daniel Vignon; they discussed scientific outreach and communication for young academics. The panel was organized by the Young Member Coordinating Council of TRB.
 - Dr. Jingqin Gao presented in the ITS Standing Committee to transfer knowledge on an NCHRP project on using cooperative automated data for reducing congestion and improving safety.
 - Dr. Kaan Ozbay hosted the Understand Digital Twins for Transportation Systems workshop.

- INFORMS (The Institute for Operations Research and the Management Sciences) annual meeting, in October 2023, was attended by NYU students who covered/presented:
 - Bingqing Liu chaired a session titled "Modeling Smart Mobility Markets with Multi-players: Matching, Pricing, and Design"
 - Hai (Marshall) Yang presented collaborative work with Purdue researchers on "A Continuous Approximation Model for Urban Electric Robotic Deliveries with Maintenance Costs"
 - Eren Kaval presented "Data-driven Quantification of the Resilience of Enforcement Policies on Transp. Systems: A Comparative Study of Two Major Winter Storms in Buffalo, NY"
 - Zilin Bian presented "A-TEAM Case Study- Applications Traffic Accident Detection and Prediction"
 - Ruixuan Zhang presented "Anomaly Detection and String Stability Analysis in Connected Automated Vehicular Platoons"
- NYU Prof. Chow presented at IPAM 2024: Mathematical Foundations for Equity in Transportation, California, January 26, 2024.
- City Tech's Dr. Janet Liou-Mark Honors and Undergraduate Research Poster Presentation and award ceremony was held on December 6-7, 2023. This event hosts over 150 undergraduate researchers to present their posters, giving students experience in presenting a research poster.
- NYU/City Tech Research Social was held on March 5, 2024. This event engaged both faculty and students from both City Tech and NYU in open discussion of active research.
- Vision Zero Youth Day was cohosted by C2SMARTER and The Vision Zero Youth Council, a youth-led organization that advocates for safe and sustainable mobility and the prioritization of youth representation and involvement in decision-making spaces, on February 9, 2024.
- "Building an Accessible Transit System in New York" was hosted by C2SMARTER and NYU's Rudin Center for Transportation to discuss findings from the report of the same name on January 23, 2024.
- C2SMARTER co-hosted the inaugural NYC Intelligent Transportation System Workshop, whose topic was Network Designs in the Era of Digital Mobility, on January 16, 2024.
- Prof. Pandey's NCA&T team presented at the 2024 Workshop on the Mathematical Foundations for Equity in Transportation Systems, Institute of Pure and Applied Mathematics, January 22-26, 2024.
- NYU PhD Candidate Haggai Davis presented virtually to the University of New Orleans class TR 6010 on freight mobility on September 29, 2023; he also presented to the Rotary Club of Baton Rouge on technology for freight on March 20, 2024, in Baton Rouge, LA.
- On behalf of NYU's Control of CAV for Congestion Reduction project, a paper was presented at the 62nd IEEE Conference on Decision and Control, December 13-15, 2023, Singapore.
- Work from NYU Prof. Vinitzky and the Building Intersection Digital Twins project has been presented at the Conference on Information Sciences and Systems which was held at Princeton, NJ on March 15, 2024 and the GRASP SFI Seminar, held at UPenn on March 20, 2024.
- NYU PI Sarah Kaufman moderated a panel discussion on "Moving People and Goods Without Fossil Fuels" at Cornell's Urban Tech Summit on November 14, 2023.
- NYU Prof. Kaan Ozbay presented at the "Private Sector Disaster Preparation" workshop co-organized by the International Transporters' Association of Turkey, Ozyegin University and NYU in January 2024.
- The Rutgers team attended several workshops in service of the WIM-based Enforcement project:
 - American Concrete Institute (ACI) Spring Convention on March 24–28, 2024.
 - The 16th International Symposium on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structure (FRPRCS) on March 23–24, 2024.
 - International Workshop on Fiber Reinforcement Concrete: from Design to Structural Application on September 18-20, 2023.
 - Regional and National Weights and Measures Meetings:
 - CWMA Interim Meeting on September 11–14, 2023, Dubuque, IA

- WWMA Interim Meeting on September 17–21, 2023, Sparks, NV
- NEWMA Interim Meeting on October 17–19, 2023, Norwich, CT
- SWMA Interim Meeting on October 8–11, 2023, Annapolis, MD
- NCWM Interim Meeting on January 7–10, 2024, New Orleans, LA
- C2SMARTER’S Student Learning Hub hosted an Industry Roundtable on November 13, 2023, with Dollaride’s Su Sanni, Numina’s Tara Pham, and Strata’s Navjodh Singh to discuss their experiences as technology start up founders.
- NYU PI Sarah Kaufman chaired a workshop in January, 2024, regarding the C2SMARTER funded report “Building an Accessible Transit System in New York.”
- UW’s PI Abramson and his students presented a poster at Cascadia CoPes Hazards Research Hub’s Navigating Coastal Hazards Workshop in Astoria, OR, March 11-12, 2024.
- UW’s PI Abramson also presented at the University of Washington Industrial & Systems Engineering Graduate Seminar on April 9, 2024.
- TSU hosted several workshops featuring industry professionals, three of whom are TSU alumni, over the course of this period:
 - Project Logistics Career Talk: Itoro Ibanga, Project Logistics Specialist, Air Liquide, October 31, 2023
 - ITS Technologies in Traffic Signal Control and Traffic Management: Peijia Tang, Senior Traffic Engineer, CUBIC, November 30, 2023
 - Blueprint for Success: Navigating the Path to Professional Excellence: Enamul Karim Fayek, Team Lead - Traffic, HNTB, February 1, 2024
 - Engineering in the City of Houston: Richard Smith, Managing Engineer, City of Houston, February 29, 2024
- C2SMARTER also hosted the following seminars/webinars during this period:
 - Project Mjolnir: Designing an Open-Source Adaptive Mountain Bike by Prof. Noel Joyce
 - Advancing Sustainable Transportation: Policy Analysis and Operation Design for Electrified Ride-Sourcing Systems by Prof. Zhibin Chen.
 - Leveraging Passively-collected Mobility Data in Generating Spatially-heterogeneous Synthetic Population by Prof. Prateek Bansal.
 - Three seminars concluding with a panel discussion as part of the Center’s Women in Transportation Series to celebrate Women’s History Month:
 - Elaine Du, AKRF, October 17, 2023.
 - Prof. Lavanya Marla, UIUC, February 14, 2024.
 - Prof. Ilgin Guler, March 7, 2024.
 - Women in Transportation 2024 Panel, March 11, 2024.

2. Industry and Public Agency Outreach

- The NYU team at C2SMARTER participated in NYC Town+Gown’s Vision Zero event in November 2023. Town+Gown brings University research to NYC public agency practitioners.
 - A-EYE URBAN: Exploring the Opportunities of Low-cost Computer Vision Solutions for Enhancing the Urban Roadway Safety, presented by Dr. Fan Zuo
 - Cycling Safety Analysis: A Close Look at Vehicle Type Association with Bicycle Collisions, Injuries, and Fatalities, presented by Suzana Duran Bernardes
 - Slowing Down for Safety: A Longitudinal Study of the Fixed Speed Cameras in NYC, presented by Dr. Jingqin Gao
- C2SMARTER hosted members of the NYCDOT Strategic, Regional, and Freight Planning teams at NYU to present current Center research and identify future collaboration opportunities.
- PI Chow and Dr. Gao have held multiple meetings with several divisions and the commissioner of the New York City Fire Dept. and NYC Dept. of Transportation to discuss the FDNY Traffic Digital Twin.

- PI Vignon and his team have been in contact with Con Edison and NYCDOT on an ongoing basis as part of the EV Charging Infrastructure Planning project.
- For the Tripchain Planner project, PI Pandey and his team have met with the North Carolina Department of Transportation as well as collaborated with the City of Arlington and Replica, Inc., who is interested in using this project as a use case on their website.
- For NYU’s JFK Landside project, the team introduced the computer vision, deep learning-based AI techniques used to acquire data from camera video and images to several Port Authority NYNJ divisions: PA-TMC/JFK-AOC, ITS, the Traffic Engineering Division, and the Landside Operations Division. This introduction occurred during the kickoff meeting on March 22, 2024.
- The UW team is communicating with Seattle DOT (SDOT), who are providing data and other support to the team for the CV testbed as part of the Urban Traffic Control project.
- For the Control of CAV for Congestion Reduction project, NYU’s Prof. Jiang is collaborating with partner Dr. Yu Jiang of Clear Motion Inc. to disseminate project findings.
- The UTEP research team has repeatedly met with both the El Paso MPO staff and the Sun Metro staff to discuss their Enhancing Transit Safety and Access project and to gather feedback. The research team has also contacted Jonathan Lopez, the CEO of Glide, a local e-scooter sharing company, and Armida Martinez, Lead Planner at the City of El Paso.
- The Charting Equitable Outcomes project enlisted the participation of several organizations and industries, including the Metropolitan Housing and Communities Policy Center, the Brooklyn Borough President, and the Center for Resilient Cities and Landscapes at Columbia University.
- UW PI Abramson and his team disseminated their efforts to 150 coastal planners, leaders, emergency managers, and researchers who attended the NSF-supported Cascadia CoPes Hazards Research Hub’s Navigating Coastal Hazards Workshop in Astoria, OR, March 11-12, 2024.

3. Media Coverage and Public Understanding

- C2SMARTER’s FDNY Traffic Digital Twin Project (led by NYU’s Prof. Joseph Chow, Prof. Kaan Ozbay, and Dr. Jingqin Gao) was covered in several media outlets:
 - [The New York Times](#); [Smart Cities World](#); [1010 WINS](#); [Streetsblog NYC](#); [Smart Cities Dive](#); [NY Daily News](#); [Bloomberg](#). German public radio/tv.
- Professor Chow’s parcel delivery model, which helps the industry better understand the implications of the parcel delivery boom that was triggered by COVID-19, was [NYU News](#) and [TechXplore](#).
- NYC DOT issued a [press release](#) regarding data gathered from the automated enforcement against overweight trucks, which concluded its 90 day warning period in November based on C2SMART/C2SMARTER’s implemented work.
- [NYU News](#) published a story in November detailing C2SMARTER’s presence at IEEE’s ITSC 2023 Conference in Bilbao, Spain.
- City Tech shared a press release on the C2SMARTER Research Social Event on their [website](#).
- The New York Daily News published an [article](#) regarding the findings from the Transit Accessibility report; the report was also featured in an [article](#) published by Planetizen.
- The Rutgers team’s work with NYCDOT to implement direct overweight enforcement at the BQE testbed received coverage from various media sources:
 - Nyc.gov [press release](#); [AMNY.com](#); [Brooklyn Heights Blog](#); [News 12, the Bronx](#)
- PI Abramson, his UW team, and members of the Drone/STEAM club at Ocosta High School were featured in a Seattle Times’s Pacific NW Magazine [article](#).

E. Plans for Next Reporting Period

C2SMARTER’s 1st year research projects are schedule to end in this period and the 2nd year research agenda will be finalized after federal budget approval.

- The following C2SMARTER Student Learning Hub sessions are planned for the spring 2024 academic semester, with more to follow:
 - Building Interactive Maps with JavaScript, HTML, and CSS
 - Analyzing scope and limitations of using GeoAI Toolbox available in ArcGIS Pro/Online
- The Charting Equitable Outcomes project will partner with Brooklyn and Queens-based youth organizations and hold outreach sessions and workshops around urban highway topics.
- The Rutgers team will work with various state agencies in order to support the new corresponding handbook update on the accuracy of the automated WIM-based overweight enforcement.
- City Tech’s faculty will complete travel, presentations, and student competitions for presenting their work and report activities to the project team for documentation and dissemination.
- During the next 6-month reporting period, the K-12 STEAM Club project team is organizing a visit by Ocosta High School project participants to the UW campus in Seattle to meet with research groups.

II. Participants and Collaborating Organizations

A. Partner Organizations

Table 1: C2SMARTER Active Partnerships with Updates during this Reporting Period

Organization Name	Location	Contribution			
		Financial Support	In-kind Support	Collab. Research	Personnel Exchanges
AirSage	Atlanta, GA		X	X	
Brooklyn Borough President	Brooklyn, NY			X	
Cascadia Coastlines and Peoples Haz.	Cascadia, WA			X	
Ctr for Resilient Cities & Landscapes	New York City, NY			X	
City of Arlington	Arlington, TX		X	X	
City of El Paso	El Paso, TX			X	
City of Greensboro	Greensboro, NC			X	
City of Madison	Madison, WI			X	
City of Seattle	Seattle, WA			X	
City of Westport	South Beach, WA			X	
ClearMotion	Billerica, MA			X	
Con Edison	New York City, NY			X	
Dollaride	New York City, NY		X	X	
El Paso MPO	El Paso, TX			X	
GLIDE Scooter	El Paso, TX			X	
Institute for Public Architecture	New York City, NY			X	X
INRIX	Kirkland, WA			X	
ITSJPO	Washington, DC			X	
KAIST	Daejeon, S. Korea			X	X
King County Metro	Seattle, WA			X	
Kistler Instrument Corp.	Buffalo, NY		X	X	
LJA Engineering	Austin, TX			X	
MCity	Ann Arbor, MI			X	X
Metro Housing and Commun. Policy	New York City, NY			X	
Metropolitan Transp. Authority	New York City, NY	X	X	X	
National Renewable Energy Lab	Golden, CO			X	
NCHRP	Washington, DC	X		X	
NJ Dept. Of Transportation	Ewing, NJ	X	X	X	
NJ Sports Exhibition Authority	Lyndhurst, NJ			X	

Noblis	Reston, VA	X		X	
NC Dept. of Transportation	Raleigh, NC			X	X
Northeast Corridor Commission	Washington, DC			X	
NYC Dept. of Cultural Affairs	New York City, NY			X	
NYC Dept. of Transportation	New York City, NY	X	X	X	
NYC Fire Dept. (FDNY)	New York City, NY		X	X	
NY Lawyers for the Public Interest	New York City, NY			X	
NY Metro. Transportation Council	New York City, NY			X	
NY State Dept. of Transportation	Albany, NY	X		X	
NYS Energy Research & Development	New York, NY	X	X	X	
Oak Ridge National Laboratory	Oak Ridge, TN			X	
Ocosta Jr. HS After School Program	Ocosta, WA			X	X
Open Mobility Foundation	Los Angeles, CA			X	
Port Authority of NY & NJ (PANYNJ)	New York City, NY	X	X	X	
Replica	Oakland, CA		X	X	
Seattle DOT	Seattle, WA			X	
Sun Metro	El Paso, TX			X	
Texas Dept. of Transportation	Austin, TX			X	
Washington Dept. of Transportation	Olympia, WA		X	X	
Washington State Parks	Olympia, WA			X	
Westport Maritime Museum	Westport, MA				X

B. Other Collaborators or Contacts

1. Collaborations within the Consortium

Several ongoing research projects feature collaborations between researchers across the consortium:

- **Multi-Horizon Urban EV Charging Infrastructure Planning: Integrating Activity Patterns, Grid Dynamics, and Uncertainty** is a collaboration between faculty at New York University & University of Washington
- **Multi-Modal Tripchain Planner for Disadvantaged Travelers to Incentivize Transit Usage** is a collaboration between faculty at North Carolina A&T & New York University
- **Tech Transfer with Undergraduate Research & Workforce Development** will include faculty mentoring by faculty at NYC College of Technology & New York University
- For their Digital Twin Flood project, the team has brainstormed with other flood and food desert experts at NCA&T including Dr. Leila Heshami-Beni in the Department of Built Environment at NCA&T.
- For NYU’s Knowledge Capture project, Co-PI Dr. Bian collaborated with Prof. Quanyan Zhu from NYU’s Department of Electrical and Computer Engineering for the digital twin research on urban mobility systems. Bian also collaborated with Prof. Zhibin Chen (NYU-Shanghai) for EV charging research.
- Control of CAV for Congestion Reduction is a collaboration between the Tandon departments of Civil and Urban Engineering along with Electrical and Computer Engineering.
- NYU hosted students and faculty from City Tech for a poster presentation and social at NYU; students from both institutions were able to display their own posters as well as inquire about the research efforts of their peers.
- PI Nassif and his Rutgers team are collaborating with Prof. Wenwen Zhang from the Bloustein School of Planning and Public Policy at Rutgers University; this involves exploring the potential uses of physical testbeds to investigate the feasibility of utilizing biometric sensors.

2. Collaborations outside the Consortium

- The TSU team has collaborated with Dr. Aobo Wang, a research scientist at the University of Nevada, Reno, on designing the traffic signal timing for FLDI.
- For the Digital Twin Flood project, PI Pandey collaborated with Dr. Sami Hasnine, Assistant Professor at Virginia Tech, and Dr. Hyoshin (John) Park, an Associate Professor at Old Dominion University.
- UW is working with MCity within the University of Michigan and Seattle DOT, who is providing data related support to the project team on CAV testbed for the Urban Traffic Control project.
- NYU Prof. and Control of CAV for Congestion Reduction PI Jiang is collaborating with Prof. Kyriakos G Vamvoudakis, Georgia Institute of Technology.
- For the Enhancing Transit Access and Safety project, team leadership contacted Dr. Natalia Zuniga at Argonne National Laboratory on her research on e-scooter as well as Alex Lee-Warner and Cory Yong at INRIX on a possible purchase of e-scooter usage data.
- PI Kaufman sought report feedback from New York Lawyers for the Public Interest, as well as two New Yorkers with disabilities for the Transit Accessibility project.
- Professor Joseph Chow actively collaborates with various industry partners, including Replica and Dollaride, with whom he is working on a project titled Clean Transit Access Program.
- Dr. Ozbay and Dr. Gao actively collaborate with ITSJPO, NJDOT, NYCDOT, NYSDOT on various projects.
- PIs and Co-PIs of NYU's FDNY Traffic Digital Twin project submitted joint proposals with NYCDOT, NJSEA, FDNY, Morgan State University, Penn State, Oak Ridge National Laboratory, Northeast Corridor Commission (NECC), Replica, and Open Mobility Foundation.
- The NYU team is collaborating with NYC DOT on WIM Site Selection for NYCDOT funded through NYC Town+Gown to prioritize deployments, as well as red light/speed camera violation and crash analysis.
- NYU PIs also have funded projects by NYSERDA on EV charging locations for Dollaride vans, the Equitable Commute Project (which analyzes E-bikes for Delivery Workers and their battery usage), and Creating Community Mobility and Energy Hubs.
- NYU PIs are funded to conduct Statewide Equity Analysis under the SEMPACT Region 2 UTC.
- Professor Ozbay's team continues to work with Noblis on USDOT's Benefits/Cost Lessons Learned project, as well as on the NCHRP CAT study.
- Professor Nassif is working with NJDOT on the Bridge Resource Program, as well as REEFENSE - A Mosaic Oyster Habitat (MOH) for coastal defense (DARPA).
- The UTEP team has numerous ongoing projects with TTI and Texas agencies.
- The UW teams are working with local agencies in Seattle and Washington.
- K-12 STEAM Club project team members collaborated with the Cascadia Coastlines and Peoples Hazards Research Hub, Vanderbilt's Smart & Connected Communities project team, and the UW Climate Impacts Group's Northwest Climate Resilience Collaborative.

3. International Collaborations

- For the Digital Twin Flood Project, Prof. Pandey collaborated with Dr. Tarun Rambha with the Indian Institute of Science, Bangalore.
- NYU Knowledge Capture Co-PI Bian collaborated with Prof. Zhenning Li and his group members from University of Macau for the vehicle-based safety and mobility research.
- NYU continues to collaborate with Korea Advanced Institute of Science & Technology (KAIST).
- The Rutgers team collaborates with KAIST Prof. Hyo-Gyoung Kwak to write papers related to finite element modeling of structural beam members.
- Rutgers has a collaboration with Prof. Peter H. Bischoff from the University of New Brunswick, Canada, to write papers related to the deflection and flexural strength of prestressed beams with FRP tendons.

III. Outputs

A. Publications, Conference Papers, and Presentations

1. List of Journal Publications

- Chow, J., Rath, S. “A deep real options policy for sequential service region design and timing.” *Computers & Operations Research*. Volume 161, January 2024.
- Giordano, M., & Chow, J. Y. “An e-scooter service region and fleet allocation design problem with elastic demand.” *Transportation Research Part D: Transport and Environment*, 130, 104153. 2024.
- Gao, J., Ozbay, K., & Hu, Y. “Real-time anomaly detection of short-term traffic disruptions in urban areas through adaptive isolation forest.” *Journal of Intelligent Transportation Systems*, 1-18. 2024.
- Zhou, Y., Chen, J., Chung, E., & Ozbay, K. “CAV-Enabled Active Resolving of Temporary Mainline Congestion Caused by Gap Creation for On-Ramp Merging Vehicles.” *IEEE Transactions on Intelligent Transportation Systems*. 2023.
- Khan, J. A., Wang, W., & Ozbay, K. “BELIEVE: Privacy-Aware Secure Multi-Party Computation for Real-Time Connected and Autonomous Vehicles and Micro-Mobility Data Validation Using Blockchain—A Study on New York City Data.” *Transportation Research Record*, 2678(3), 410-421. 2024.
- Bagheri, M., Bartin, B., & Ozbay, K. “Implementing artificial neural network-based gap acceptance models in the simulation model of a traffic circle in SUMO.” *Transportation Research Record*, 2677(12), 227-239. 2023.
- Bartin, B., Jami, M., & Ozbay, K. “Estimating roadway horizontal alignment from geographic information systems data: An artificial neural network–based approach.” *Journal of Surveying Engineering*, 149(4), 04023015. 2023.
- Li, Y., Vignon, D. “Ride-hailing and Congestion Policy in NYC,” *Transportation Research Part A*. Under review.
- Zhi, L., Bian, Z., Ozbay, K., Chen, Z. “Synthesis of Electric Vehicle Charging Data: A Real-World Data-Driven Approach” *Communication Research in Transportation*. Accepted.
- Kaval, E., Bian, Z., Ozbay, K. “Data-driven quantification of the resilience of traffic enforcement policies under emergency conditions: A Comparative study of two major winter storms in Buffalo, New York” *Transportation Research Part D: Transport and Environment*. Submitted.
- Li, T., Bian, Z., Lei, H., Zuo, F., Yang, Y., Zhu, Q., Li, Z., Ozbay, K. “Multi-level Traffic-Responsive Tilt Camera Surveillance through Predictive Correlated Online Learning,” *Transportation Research Part C: Emerging Technologies*, Under Review.
- Li, T., Bian, Z., Lei, H., Zuo, F., Yang, Y., Zhu, Q., Li, Z., Ozbay, K. “Digital Twin-based Driver Risk-Aware Intelligent Mobility Analytics for Urban Transportation Management” *Transportation Research Part C: Emerging Technologies*, Under Review.
- Davis, H., Chow, J. “Aggregate Urban Truck Tour Synthesis from Public Data.” *Transportation Research: Part A*. Under Review.
- Guo, Q., Ban, X. “Network Multi-scale Urban Traffic Control with Mixed Traffic Flow.” *Transportation Research Part B*, Submitted, 2nd revision. 2024.
- Wang, H., Yin, Z., Jiang, Z.P. “Real-Time Hybrid Modeling of Francis Hydroturbine Dynamics via a Neural Controlled Differential Equation Approach.” *IEEE Access*. 2023.
- Nasreddine W., Bischoff P.H., Nassif H. “Deflection Behavior of Beams prestressed with bonded FRP tendons”, *FRPRCS Symposium*, Vol 360, pp 491-510.
- Nassif H., Nasreddine W., Ozkul O. “Analysis of Beams Prestressed with Hybrid (Steel/Carbon Fiber-Reinforced Polymer) Tendons using the Conservation of Energy Approach” *Engineering Structures*, Elsevier, Vol. 294. 2024.
- Nasreddine W., Obeidah A., Bischoff P.H., Nassif H “Assessment of Deflection Prediction Models for Cracked Prestressed Concrete Beams”, *ACI Structural Journal*, Vol. 120, No. 6, pp 167-179. 2023.

- Nasreddine W., Obeidah A., Bischoff P.H., Nassif H. "Deflection Prediction of Cracked Prestressed Concrete Beams Based on Integration of Curvature" ACI Structural Journal, Submitted 2023, Under Review.
- Nasreddine W., Obeidah A., Harajli M., Nassif H. "Evaluation of Flexural Strength and Ductility of Hybrid Prestressed Concrete Members" ACI Structural Journal, Submitted 2023, Under Review.
- Holland, R., Du, J., Obeidah, A., Meng, W., Nassif H. "Early-age Crack-free Ultra-High-Performance Concrete under Restrained Ring Test for Large-scale Production as An Overlay." Construction and Building Materials, Submitted September 23, Under Review.

2. List of Conference Papers

- Kaval, E., Bian, Z., Ozbay, K. "Data-driven quantification of the Resilience of enforcement policies on transportation systems: A Comparative study of two major winter storms in Buffalo, New York." Accepted in 103th Annual Meeting of the Transportation Research Board (TRB). 2024.
- Zhang, R., Lan, T., Bian, Z., Ozbay, K. "MSinT: a Multi-view Spatio- Informed Transformer for Overweighted Vehicle Forecasting." Accepted in 103th Annual Meeting of the Transportation Research Board (TRB). 2024.
- Zuo, D., Bian, Z., Zuo, F., Ozbay, K. "Risk Estimation for Vehicles and Road Sections Using a Data-driven Risk Field Model." Accepted in 103th Annual Meeting of the Transportation Research Board. 2024.
- Bian, Z., Zuo, D., Gao, J., Ozbay, K., Li, Z. "Informed along the road: roadway capacity driven graph convolution network for network-wide traffic prediction." Accepted in 103th Annual Meeting of the Transportation Research Board (TRB). 2024.
- Davis, H., Chow, J., "Assessing New York City Urban Freight's Readiness for Electric Trucks." CSuM2024 (7th Conference on Sustainable Mobility). Abstract accepted. 2024.
- Angah, O., Zhang, Y., Ban, X. "Connected and automated transportation system in a Multi-agent environment." IEEE-IV Symposium. 2024.
- Chakraborty, S., Gao, W., Vamvoudakis, K., Jiang, Z.P. "Adaptive Optimal Output Regulation of Discrete-Time Linear Systems: A Reinforcement Learning Approach." 62nd IEEE Conference on Decision and Control (CDC) (pp. 7950-7955). 2023.
- Ha, W., Chakraborty, S., Lin, X., Ozbay, K., Jiang, Z. P. "Automated Lane-Changing with Reinforcement Learning and Perception-in-the-Loop", submitted to IROS. 2024.
- Cornelisse, D., & Vinitsky, E. "Human-compatible driving partners through data-regularized self-play reinforcement learning." *arXiv preprint arXiv:2403.19648*. 2024.
- Nassif, H. Na, C., Ghanchi, Z., Abed, M. "Validation of Predicted Stress in Polypropylene Fiber-Reinforced Self-Consolidating Concrete (FR-SCC) under Restrained Shrinkage Conditions." American Concrete Institute (ACI) Spring Convention. 2024.
- Nasreddine, W., Bischoff, P., Nassif, H. "Deflection Behavior of Beams Prestressed with Bonded FRP Tendons." 16th International Symposium on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structure (FRPRCS). 2024.
- Lou, P., Nassif, H., Yang, C. "Prediction of Maximum Live Load Effects for Bridges Based on Weigh-in-Motion (WIM) Data." Transportation Research Board (TRB) Annual Meeting. 2024.
- Holland, R., Ruzsala, M., Nassif, H. "Correlation of Direct Tension and Short-Term Tensile Creep Performances of non-proprietary UHPC." International Workshop on Fiber Reinforcement Concrete: from Design to Structural Application. 2023.
- Korfmacher, M., St. Jarre, L. "Drone-Based Photovoice and Gameplay Motivation: Piloting Novel Youth Engagement for Resilience Planning." Cascadia CoPes Hazards Research Hub's Navigating Coastal Hazards Workshop. 2024.

3. List of Presentations

- C2SMARTER was well represented at Transportation Research Board’s (TRB) 103rd Annual Meeting this year, with [40 papers](#) accepted by researchers and professors affiliated with the center.
- Zuo, F. “A-EYE URBAN: Exploring the Opportunities of Low-cost Computer Vision Solutions for Enhancing the Urban Roadway Safety.” NYC DOT DDC’s Town+Gown Vision Zero Research on the Road Event, November 2023.
- Duran Bernardes, S. “Cycling Safety Analysis: A Close Look at Vehicle Type Association with Bicycle Collisions, Injuries, and Fatalities.” NYC DOT DDC’s Town+Gown Vision Zero Research on the Road Event, November 2023.
- Gao, J. “Slowing Down for Safety: A Longitudinal Study of the Fixed Speed Cameras in NYC.” NYC DOT DDC’s Town+Gown Vision Zero Research on the Road Event, November 2023.
- Chow, J. “Data structures for transportation equity analysis.” Mathematical Foundations for Equity in Transportation Systems, January 2024.
- Vignou, D., Bahrami, S. “Safety, Liability, and Insurance Markets in the Age of Automated Driving.” University of Illinois Urbana Champaign Kent Seminar Series, February 2024.
- Pandey, V. “Transportation Systems of the Future: Planning and operations in the era of information and connectivity.” Guest Speaker Presentation for the CAEE Graduate Seminar Class, NCA&T. November, 2023.
- Chow, J. “Mathematical Foundations for Equity in Transportation Systems.” Data Structures for Transportation Equity Analysis. Presented at the Institute of Pure and Applied Mathematics, January 2024.
- Davis, H. “Preparations for the future of freight mobility.” Guest Speaker Presentation for the CAEE University of New Orleans class TR 6010. September, 2023.
- Davis, H. “Properly Evaluating Technologies to Deliver Freight in the Future” Rotary Club of Baton Rouge. Baton Rouge, LA. March, 2024.
- Davis, H. “Applying the CEQR manual to transportation projects.” NYU Professor Hossein's 3000 level Civil Engineering class. November, 2023.
- Jiang, Z.P. “Control of CAV for Congestion Reduction” invited presentations at Michigan State University and the University of Michigan, 2023.
- Norman, M. Radical Middle Grounds: New Agendas for Medium-Density Housing. November, 2023.
- Kaufman, S. “Emerging Leaders in Transportation Ideation Activity.” Emerging Leaders in Transportation Workshop, February, 2024.
- Korfmacher, M., St. Jarre, L. “Drone-Based Photovoice and Gameplay Motivation: Piloting Novel Youth Engagement for Resilience Planning.” NSF Smart & Connected Communities team meeting, March, 2024.
- Korfmacher, M., St. Jarre, L. “Drone-Based Photovoice and Gameplay Motivation: Piloting Novel Youth Engagement for Resilience Planning.” University of Washington Industrial & Systems Engineering Graduate Seminar, April, 2024.

B. Policy Papers

Nothing to report at this time

C. Websites and other Internet Sites

The [C2SMARTER website](#) disseminates information about the Center’s activities and research, with 8,058 unique page views during this reporting period.

- The NYU Tandon team created a website with a description of their research faculty to support the matching of City Tech students with NYU Tandon faculty mentors. [Tech Transfer through Undergraduate Research & Workforce Development - C2SMARTER Home \(nyu.edu\)](#)

- NYU’s Knowledge Capture team aided in creating a [website](#) dedicated to C2SMARTER’s Digital Twin projects and undertakings. They also assisted in creating a [site](#) for the TRB Digital Twin Workshop.
- NYU’s JFK Landside team is working to enhance the work zone monitoring web-based [tool](#) developed from the previous C2SMART project. This tool can perform real-time detection of traffic counts by vehicle classification and work zone detection, including worker detection.
- UW’s Urban Traffic Control team, along with MCity collaborators, set up a Github to host and share software packages, interface integration method and documentation, data, and testing documents and results. The site will be made open for public access once testing is complete.
- NYU Prof. Vinitsky and team created a [website](#) for the Building Intersection Digital Twins project.
- A [webpage](#) was created on the NYU Rudin Center for Transportation website to showcase the release of the new report, “Accelerating progress: Making transit accessible for all New Yorkers.”
- A [webpage](#) was created on the NYU Rudin Center for Transportation website detailing the entirety of the 2024 Emerging Leaders in Transportation Program. The project team also published a [post](#) to the Emerging Leaders in Transportation Alumni LinkedIn Group, where past participants can reconnect and create a strong professional network with each other.

D. New Methodologies, Technologies or Techniques

- Professors Ozbay and Nassif continue to work directly with the NYC Department of Transportation to study and implement Weigh-In-Motion sensors throughout New York City, as well as on C2SMARTER’s Smart Urban Roadway Testbed on the Brooklyn Queens Expressway.
- Through NCA&T’s Digital Twin Flood project, geospatial analysis techniques are being integrated with machine learning methods for automatic assessment of flood risk vulnerabilities, especially when available data is sparse and not detailed.
- The UW Urban Traffic Control team identified new methods in multiscale signal-vehicle coupled control as well as new testing methods for CAV related control.
- Prof. Vinitsky and team have developed two new technologies:
 - A new algorithm, human-regularized self-play, that enables creation of drivers that are highly capable of long-distance driving while still mimicking human behaviors.
 - A new driving simulator, GPUdrive, that runs on GPU and can reach simulator speeds of hundreds of thousands of steps per second.
- The Rutgers team has developed scripts to integrate information from diverse sources, enabling the identification of overweight trucks, which are then used to issue notices of liability (NOLs).
- The UW K-12 STEAM Club project team and community partners are adapting the SHOWED method for photovoice thematic qualitative analysis to develop a new technique of mappable drone-flown photo and videovoice.

E. Inventions, Patents, and Licenses

- The NYU JFK Landside team has filed a provisional patent application with a part of the vision-based technique (work zone detection) and is conducting customer discovery and applying for NSF I-Corps.

Table 2: Outputs Performance Metrics

Performance Metric	Achieved in period	Annual target
Conferences organized	6	5
Keynote / invited talks	7	15
Peer-reviewed papers	59	40
Workshops, seminars, or forums	37	10

F. Other Products

- The Rutgers/NYU team behind the Brooklyn Queens Expressway project produced [WIM data](#) for Queens bound overweight enforcement.
- The TSU team developed a traffic signal timing strategy for the FLDI to be shared in the project.

IV. Outcomes

A. *Increased Understanding and Awareness of Transportation Issues*

- The NYU Control of CAV for Congestion Reduction project's experimental validation and application of learning-based control for autonomous vehicle lane changing combined with perception provide insights for combining learning-based control with perception. This helps develop better controllers to take real-time action in safety-critical scenarios, which can lead to lesser congestion and hazards.
- The research outputs from the Transit Accessibility report have contributed to increased understanding and awareness of accessibility issues in public transportation. The report highlighted the challenges faced by people with disabilities in accessing public transportation, raising awareness among policymakers, officials, and the general public about the importance of improving accessibility.
- The testbed located at the Brooklyn-Queens Expressway (BQE) is using data from disparate sources, facilitating the identification of overweight trucks, utilized to issue notices of liability (NOLs).
- The UW K-12 STEAM Club project team increased youth training in rules and environmental constraints on unmanned aerial vehicle operation.

B. *New Policies, Regulation, Rulemaking, or Legislation*

- The Transit Accessibility report's findings will contribute to the development of new policies, regulations, and legislation aimed at improving accessibility to reach the MTA's goal of being 95% station accessible by 2055. The report's recommendation to ensure adequate capital funding levels for ADA upgrades may lead to discussions within the MTA and among policymakers about the allocation of funds for accessibility improvements in future capital project planning meetings.
- The work undertaken by the Rutgers team on the BQE project has resulted in two changes:
 - Legislation: The amendment to the direct overweight enforcement legislation was passed by the NYS Assembly and signed by the NYS Governor in late 2023.
 - New Standard: The amendment to Section 2.26 of the NIST HB 44 was proposed as a voting item for the upcoming NCWM Annual Meeting in July 2024, to be held in Cleveland, OH.

C. *Increases in the Body of Knowledge*

- NCA&T's Tripchain Planner project's work has contributed towards efficient optimization-based algorithms for solving multicriteria shortest path problem while considering multiple modes, such as incorporating equity concerns associated with the project.
- NCA&T's Digital Twin Flood project's research results on digital twin technologies and geoAI are poised to impact how transportation challenges are treated. GeoAI can enable more efficient geospatial data analysis, especially when datasets are image based (such as flood inundation maps). It can also enable effective resource allocation and route planning.
- NYU's JFK Landside project provides the agency partner (Port Authority of NY&NJ) with a better understanding of the emerging AI-based solutions using computer vision and cameras.
- NYU Prof. Vinitzky and his team's paper on Building Intersection Digital Twins has demonstrated a new way to build models of human-driving that improve on the ability to create driving agents that can operate well in complicated scenarios.
- As a result of the Charting Equitable Outcomes project, a repository for and process by which communities can record and engage with the issues around urban infrastructure and its detrimental effects on the surrounding communities was created.
- A paper produced by the Rutgers team in collaboration with the University of New Brunswick's Prof. Peter H. Bischoff was recognized as the Best Theoretical Paper Award at the 16th International Symposium on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures. The paper was related to the deflection and flexural strength of prestressed beams with FRP tendons.

D. Improved Processes, Technologies, Techniques and Skills in Addressing Transportation Issues

- The outcome of TSU’s Flipped Left Diamond Interchange Design study improved signal timing design.
- NYU Prof. Vinitzky’s team created a new driving simulator that can simultaneously evaluate hundreds of scenes. This allows researchers to evaluate impacts of congestion reduction schemes more quickly.
- The Transit Accessibility report and showcase event emphasized the importance of leveraging existing and emerging technologies for real-time tracking and measurement data to improve accessibility improvements, accountability and monitoring. The recommendations will prompt planning within the MTA for infrastructure and accessibility updates.
- The Rutgers team showcased the state-of-the-art WIM sensor (Piezo-Quartz sensor) and software-based ALPR system for identifying overweight trucks for future enforcement practices.

E. Enlargement of the Pool of Trained Transportation Professionals

- For NCA&T’s Tripchain Planner project, three graduate students have been trained and mentored throughout the process. These students have been trained in the skillsets needed to be successful transportation professionals.
- On NCA&T’s Digital Twin Flood project, two graduate students have been trained and mentored throughout the process. These students have been trained in the skillsets needed to be successful transportation professionals.
- TSU students who are working on the Flipped Left Diamond Interchange Design project received extensive training in traffic signal timing design, microscopic traffic simulation modeling, and intersection performance analysis, which are essential skills for traffic engineers.
- City Tech is utilizing undergraduate research as a mechanism to increase knowledge of the transportation industry. Their project created a cohort of up to 18 students per academic year focused on transportation research. Transportation internships such as the NYSDOT TCI program were directly advertised to this cohort.
- The NYU JFK Landside team is training new student researchers with the ability to run computer vision-based models that were developed.
- The UW Urban Traffic Control project will help train next generation transportation practitioners and researchers with emerging technologies and systems (CAVs in particular).
- Via the Charting Equitable Outcomes initiative, youth were engaged in providing context and personal stories to inform decisions around infrastructural decisions.
- The Rutgers team has worked to enlarge the pool of trained professionals in various ways:
 - The team offered technical support to NYCDOT regarding direct overweight enforcement.
 - The team conducted workshops for NJDOT engineers aimed at enhancing design practices.
 - The team delivered presentations at regional weights and measures associations meetings (CWMA, WWMA, NEWMA, and SWMA), as well as at the national conference meeting (NCWM). These presentations aimed to help personnel understand the distinction between "static" scales and "dynamic" WIM systems, and how direct overweight enforcement could benefit their states.

Table 3: Outcomes/Impacts Performance Metrics

Performance Metric	Achieved in period	Annual target
Multi-modal models / systems reducing congestion created	9	5
New or enhanced cyber/physical testbeds created and shared	5	3
Data and technology tools/platforms deployed to agencies or public users	3	5
Tools, methods, or procedures to measure equity	4	5
Community impact and deployments	3	5

F. Adoption of New Technologies, Techniques, or Practices

- Through the Rutgers BQE WIM research, NYCDOT approved the use of the WIM system with Quartz sensors and the ALPR system with non-proprietary cameras.

V. Impacts

A. Effectiveness of the Transportation System

- The number of overweight trucks decreased by more than 50% following the commencement of direct overweight enforcement on the BQE. This reduction is expected to decrease fatal accidents, traffic congestion, and pollution, while also extending the service life of bridges and improving driver safety.
- NYU's Knowledge Capture framework design accelerated the process of extracting evaluation results and performance measures from current ITS projects. This allows researchers to better understand the effectiveness of current ITS projects on the transportation systems.
- UW's Urban Traffic Control project helps develop research and testing methods on how to best utilize CAVs to reduce congestion and improve efficiency, while considering safety and equity.
- The methodology proposed in the Control of CAV for Congestion Reduction project can reduce the probability of accidents in lane-changing scenarios to minimize injuries and fatalities. The project is based on lane-changing scenarios to improve the efficiency of vehicle movement.

B. Technology Transfer – New Practices or Companies

Nothing to report at this time.

C. Increase in the Body of Scientific Knowledge

- Sharing NYU's FDNY Traffic Digital Twin project information has increased understanding of how a traffic digital twin can address real-world transportation problems. The team explained Digital Twin concepts to several stakeholders within FDNY/NYC DOT who had no prior knowledge, and received requests from professors, practitioners and media who expressed interest in the technology.

D. Transportation Workforce Development

- NYU's FDNY Traffic Digital Twin project provided field training to student researchers on field survey data collection. Upon completion of the project, the project team will also provide online learning courses and workshops on TDT and AI model used in the project.
- C2SMARTER once again co-sponsored and organized TransportationCamp- NYC, held in October 2023. TransportationCamp featured hundreds of enthusiastic participants (students as well as industry professionals) who engaged in networking and user-generated session topics.
- Graduate research assistants involved with the NCA&T Tripchain Planner project have been trained to use relevant software and programming tools. These include Python programming, bash scripting, Github source code management, and working with Linux operating systems.
- Graduate research assistants involved with NCA&T's Digital Twin Flood project have been trained to use relevant software and programming tools. These include QGIS, python libraries for geospatial processing (shapely, geopandas, and folium), and working with flood projection software such as OpenFlows Flood and HEC-RAS. Students have also attended conferences and have learned ways to interact with other professionals and present their research.
- The students working on TSU's Flipped Left Diamond Interchange Design project received extensive training in traffic signal timing design, microscopic traffic simulation modeling, and intersection performance analysis. These are essential skills for traffic engineers.

- Training in the JFK Landside AI vision-based tool and video analytics will be included as part of the NYU project. Additionally, the student researcher will offer a course through the C2SMARTER Student Learning Hub on the techniques used to train students and young professionals in transportation.
- The UW Urban Traffic Control project will aid in training next generation transportation professionals with the knowledge and skills of deal with CAVs and related emerging technologies.
- The Emerging Leaders in Transportation program was held on February 13-18, 2024, successfully bringing together 36 early-career professionals for a transformative experience. Participants engaged in insightful panels and discussions, fostering innovation and creative thinking, and developed plans to incorporate innovative tools and practices within their organizations. Participants enhanced their leadership skills through interactive workshops and interactions with industry experts, and built a strong professional network within the industry, which will benefit them throughout their careers. The Emerging Leaders in Transportation project hosted several events over the program:
 - Panel of Transportation Leaders: included leaders from Optibus, Amtrak, Lyft Bikes & Scooters, MTA NYC Transit, and Port Authority of New York and New Jersey.
 - Tour of Amtrak’s Penn Station Control Center
 - Building Your Influence: an interactive workshop run by Emily Gallo, Director of Infrastructure and Mobility Equity, HNTB, at the NYU Robert F. Wagner School of Public Service.
 - Communicating Ideas in Transportation: interactive session focused on communicating ideas, led by transportation journalist John Surico, Professor at the NYU Journalism Institute.
 - Workplace Improvement Ideation: Developing a unique proposal for designing and implementing a new project regarding several aspects of professional life.
- The Rutgers team delivered presentations to personnel from all relevant states at four regional weights and measures associations meetings (CWMA, WWMA, NEWMA, and SWMA), as well as at one national conference meeting (NCWM), aimed at enhancing their understanding of the topic.
- On behalf of the UTEP project centered around Enhancing Transit Access and Safety, research assistants Emiliano Rio Reyes, Kiana Haghjoo, and Saima Zaheen attended the Border-to-Border Transportation Conference, in El Paso, Texas in September of 2023.
- NYU students affiliated with the Building Intersection Digital Twins project attended the Neural Information Processing Symposium to attend workshops and talks to learn more about the field.
- Through the Digital Twin Flood project, NCA&T students have been trained in GIS and geospatial analysis skills related to understanding the interdependence between flooding and infrastructure.
- TSU students involved in the Flipped Left Diamond Interchange Design project were introduced to and trained in a new signal timing software called TranSync.
- For NYU’s FDNY Traffic Digital Twin project, two one-hour training sessions were provided to 17 student researchers on how to conduct effective field surveys for traffic data collection.
- The Rutgers team offered a one-day bridge design workshop to the New Jersey Department of Transportation (NJDOT), focused on the design of steel girder bridges. This workshop provided an opportunity for NJDOT engineers to learn the philosophy of AASHTO LRFD Bridge design, along with various examples of steel girder design based on the AASHTO LRFD Bridge Design Specifications (BDS). One of the objectives was to evaluate the service life of the bridge.
- As a result of their experience in UW’s K-12 STEAM Club, participating Ocosta Junior High Students formed the Ocosta News Network, a video-journalism club oriented to community information and public service announcements. Two of these students have also been studying for the FAA Part 107 drone pilot license exam, and are expected to take the exam during Summer 2024.

VI. Changes/Problems

Nothing to report at this time.