Semi-Annual Progress Report for University Transportation Centers

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1. ACCOMPLISHMENTS

The mission of TBD National Center is to revolutionize the understanding and management of travel behavior and demand through pioneering research and education, fostering a sustainable, efficient, and inclusive transportation system that effectively serves and adapts to the evolving needs of everyone. Led by The University of Texas at Austin and in partnership with Arizona State University, California State Polytechnic University – Pomona, Diné College, Georgia Institute of Technology, The City College of New York, University of Michigan, and University of Washington, the TBD Consortium is committed to serving all communities and the entirety of the US economy through the safe, efficient, accessible, and sustainable movement of people and goods.

What are the major goals of the program?

The TBD's overarching goal is to undertake breakthrough research that will fundamentally re-examine and transform the scientific base for measuring, monitoring, modeling, and managing traveler behaviors to foster the design, development, and operation of a people-centric, multimodal, intelligent transportation system that meets the needs of the people, institutions, and businesses for generations to come. The TBD initiative aligns with the USDOT strategic goal of transformation and anticipates significant contributions to equity and climate and sustainability goals. Among its multitude of activities, the Center aims to undertake two flagship endeavors of national significance to bring about transformative impacts in planning and decision-making. The first is a *travel behavior data (TBD) hub* that the public, transportation planners, and policy-makers alike can leverage to understand the state of the transportation system, with built-in *quality of life/well-being, energy footprint, and mobility poverty calculators* to aid in planning for efficiency, sustainability, and community well-being. The second is a panel-based multi-year *Transportation Heartbeat of America (THA) Travel Behavior and Demand Survey, including a survey of individuals, businesses, and employers*, to understand how travel behavior and demand are evolving, which will provide critical insights into the future of transportation and the priorities of the nation.

What was accomplished under these goals?

Center-Wide Accomplishments

The TBD Center has continued to advance its mission through a range of impactful activities across research, education, workforce development, and technology transfer over the past six months. TBD researchers have shared findings at leading conferences, including the 2025 Transportation Research Board (TRB) Annual Meeting and the 2025 International Scientific Committee on Transportation Survey Conference (ISTSC). Center-affiliated scholars and students have received prestigious awards, participated in high-profile media interviews, and delivered seminars and webinars to a variety of audiences. In addition, the TBD Center hosted its Annual Meeting in this reporting period to review progress and chart future directions. These and other center-wide highlights are discussed below:

- On March 5, 2025, the TBD Center hosted its Annual Meeting at The University of Texas at Austin. The event brought together faculty, students, consortium collaborators, and officials from the U.S. DOT to review progress across research, education and workforce development, and technology transfer activities, as well as to share key updates on the Center's two flagship endeavors (i.e., TBD Hub and THA Survey). The day featured presentations by TBD researchers and students and concluded with a discussion of future research directions, enhanced collaboration, and data-sharing plans.

- TBD Center members participated in the 104th Annual Meeting of the Transportation Research Board (TRB) in Washington, D.C., held from January 5-9, 2025. Center researchers and students contributed through workshops, poster sessions, and lectern presentations, engaging with the global transportation community to share TBD research findings and discuss emerging challenges and opportunities. A total of 34 presentations were made by TBD researchers at TRB (mostly by graduate students)

- A new data visualization platform called The Mobility Dashboard (TMD) was unveiled during the TBD Center's Annual Meeting. This platform facilitates the exploration of mobility trends from the American Time Use Survey – democratizing access to national-level activity-travel data for planners,

policymakers, and researchers. TMD is the second major dashboard incorporated into the TBD Hub, following the earlier launch of the Time Use, Travel, and Telework Dashboard (T3D) in May 2024.

- During the current reporting period, the first wave of the Transportation Heartbeat of America (THA) Survey was completed, with 8,212 respondents passing detailed quality control checks. The TBD team has also begun a comprehensive analysis of the first wave data to generate insights into the state of transportation behavior and attitudes across the United States.

- The TBD website continues to serve as the main hub for archiving and distributing information about the Center's activities, including research updates, workforce development initiatives, and data products. During the current reporting period, the site attracted over 2,500 visitors.

- The TBD team at ASU published an insightful policy brief in this reporting period, titled "Emerging Travel Behavior Insights from 2023 National Surveys", which presents a detailed synthesis and review of the American Community Survey, the Consumer Expenditure Survey, and the American Time Use Survey, providing key insights into travel behaviors that would aid planners and policymakers in tackling the ever-increasing uncertainty in travel demand forecasting in the post-pandemic world.

Some other overall accomplishments of the TBD Center in this reporting period are listed below:

Selected TBD Awards and Honors:

- Dr. Chandra Bhat, Director of the TBD Center, received the 2024 W.N. Carey, Jr. Distinguished Service Award from the Transportation Research Board (TRB) in recognition of his more than 30 years of leadership and service to the organization and the field of transportation research.

- TBD Associate Director Dr. Ram Pendyala was announced as the 2025 recipient of the Frank M. Masters Award by the American Society of Civil Engineers (ASCE), given for "the best example of innovative or noteworthy planning, design, or construction of transportation facilities".

- TBD Associate Director Dr. Patricia Mokhtarian delivered the keynote address at the Korean Society of Intelligent Transportation Systems Conference on October 24, 2024, in Gangneung, South Korea, titled "How will autonomous vehicles affect travel time use and subsequent travel-related choices?".

- Dr. Xinyi Wang (a former TBD graduate student advised by Dr. Patricia Mokhtarian) received the 2023 Eric Pas Dissertation Prize from the International Association for Travel Behaviour Research (IATBR).

- During this reporting period, two TBD-sponsored students were honored at the Council of University Transportation Centers (CUTC) Winter Meeting in Washington, D.C., on January 4, 2025. Amy Fong, a Ph.D. student at the University of Michigan advised by Dr. Atiyya Shaw, was named the 2024 TBD National Center Student of the Year for her contributions to transportation research. Samantha Anderson, a former TBD-sponsored master's student at the University of Texas at Austin, advised by Dr. Chandra Bhat, received the 2025 Milton Pikarsky Memorial Master's Award, recognizing her outstanding academic achievements and research impact.

Amy Fong receives the 2024 TBD Center Student of the Year Award at the CUTC Winter Meeting.

Samantha Anderson receives the 2025 Milton Pikarsky Memorial – Master's Award at the CUTC Winter Meeting.

- A team of TBD-sponsored students (Viswa Sri Rupa Anne, Md Gulam Kibria, and Yifan Liu) from Georgia Tech, advised by Dr. Srinivas Peeta, received the Best Paper Award from the TRB's AEP35 Standing Committee at the 2025 Transportation Research Board (TRB) Annual Meeting.
- Ekin Ugurel, a TBD graduate student at the University of Washington, received the 2024 Michael Kyte Region 10 Outstanding Student of the Year Award for exceptional contributions to transportation.
- TBD students Ali Kothawala, Jake Robbennolt, Lin Su, and Linus Flores-Araujo at UT Austin received 2024 Capital Area Section scholarships from the Institute of Transportation Engineers (ITE) in recognition of their academic achievements, leadership, and commitment to transportation engineering.

Selected TBD Media Interviews and Blogs:

- TBD Director Dr. Chandra Bhat has been featured in several media outlets during this reporting period, sharing insights on a wide range of transportation topics. He discussed the impacts of extreme heat on daily routines and travel patterns with the Cockrell School of Engineering News, provided commentary on the TxTag toll processing transition and the end of vehicle safety inspections in Texas on Fox 7 Austin, and offered expert insights to Newsweek on high-speed rail initiatives and highway worker safety. He also spoke with KVUE News about the future expansion of self-driving robotaxis in Austin.
- Other TBD researchers have also actively contributed to national media discussions during this reporting period. Dr. Steven Polzin was interviewed by the Washington Times on the surge in flight interruptions at DCA and by FOX 10 Phoenix on the state of electric vehicle sales. Dr. Mokhtarian was interviewed by Bloomberg to share her insights on the future of telework. Dr. Andrew Maynard continued to provide expert commentary on AV developments, including interviews with 3TV Arizona about Waymo vehicle safety, CBS 5 News regarding theft prevention in driverless cars, and the Las Vegas Review-Journal on the intersection of AI and transportation incidents. Also, Dr. Irfan Batur was interviewed by ABC15 Arizona to discuss the impacts of extreme heat on daily life and travel behaviors.

Workforce Development/Technology Transfer Events:

- TBD hosted four webinars during this reporting period: (1) A talk by Dr. Alison Conway (City College of New York) on October 10, 2024, titled "The Changing Landscape for Last-Mile Goods Movement in New York City," with 19 participants; (2) A webinar by Dr. Simon Washington (Transoft Solutions) on January 28, 2025, titled "State-of-the-Art Video Analytics in Transportation: Challenges to Progress and What the Future Holds," with approximately 100 participants; (3) A webinar by Dr. Alex Anas (State University of New York at Buffalo) on March 3, 2025, titled "Downs Law Revisited: How and Why Expanding Roadways Reduces Congestion Despite Induced Travel," with approximately 250 participants; and (4) The Lifetime Achievement Award Lecture by Dr. Hani Mahmassani (Northwestern University) on March 6, 2025, with approximately 212 participants. Recordings of these events have been made publicly available through the TBD YouTube Channel.
- TBD sponsored a visit for a group of students from the University of Texas at Austin to the City of Austin's Mobility Management Center (MMC) in November 2024. The visit provided students with firsthand exposure to traffic operations, Vision Zero initiatives, GIS-based mobility management, and real-world career opportunities in public agency transportation management.
- TBD researchers contributed to workforce development and technology transfer activities through public scholarship and outreach. Dr. Steven Polzin participated in a national webinar hosted by the Manhattan Institute, titled "At a Crossroads: U.S. Transportation Faces a Challenging Route Ahead," and published an article in Planetizen on travel safety trends. Dr. Andrew Maynard continued to engage audiences through the Future of Being Human initiative, including podcasts and online content exploring the intersection of transformative technologies and future travel behavior.

Project-Specific Accomplishments

During this reporting period, TBD researchers made significant progress on various projects. Three projects initiated last year were completed, while others have progressed into subsequent phases. Final reports for the completed projects have been distributed per U.S. DOT guidelines. A comprehensive list of all 47 TBD

projects, including their active periods, is presented in Table 1. Additionally, the TBD website has been continually kept updated to provide information and deliverables for these research projects.

Table 1. TBD Research Projects

	Project Topic/Title	Institution (PI)	Active Period	Status
1*	Travel Behavior Data (TBD) Hub	Multi-Institution (Bhat)	2023 - Present	⚙
2*	Transportation Heartbeat of America (THA) Travel Behavior and Demand Survey	Multi-Institution (Bhat)	2023 - Present	⚙
3	Measuring the Impact of Transformative Transportation Technologies on Local Government Revenues Linked to Transportation Infrastructure	ASU (Swindell)	2023 - Present	⚙
4	City-Wide Strategic EV Charging Network Design: Demand-Supply Integration via Market Dynamics	ASU (Zhou)	2023 - Present	⚙
5	Future Travel Foresight Catalyst: A Unique Approach to Exploring the Intersection of Transformative Technologies and Future Travel Behavior and Demand	ASU (Maynard)	2023 - Present	⚙
6	Exploring the Changing Dynamics of Household Vehicle Ownership and Use in the U.S.	ASU (Batur)	2023 - Present	⚙
7*	Trends in Time, Travel, Transit, Telework, and Treasure (T5)	ASU (Polzin)	2023 - Present	⚙
8	Analysis and Implications of the Vehicle Inventory and Use Survey (VIUS)	ASU (Polzin)	2024 - Present	⚙
9	Future Travel Foresight Catalyst: Phase 2	ASU (Maynard)	2024 - Present	⚙
10	Smart Transportation Digital Infrastructure: Advancing System Equity, Resilience, and Safety through Multi-Source Open-Standard Data Integration	ASU (Zhou)	2024 - Present	⚙
11	From Cross-Sectional to Longitudinal: The Impact of Sampling Strategies on Measuring Mobility Choices	ASU (Pendyala)	2024 - Present	⚙
12	Time Use, Travel, and Telework Dashboard (T3D)	ASU (Batur)	2024 - Present	⚙
13	Measuring the Last-Mile: A Comprehensive Evaluation of Synthesis Approaches to Address Data Gaps for Local Freight Decision-Making (Phase 1)	CCNY (Conway)	2023 - Present	⚙
14*	The Effects of Changing Commutes on Home Delivery Activity	CCNY (Conway)	2023 - Present	⚙
15	Exploring Top-Down Visual Attention for Transportation Behavior Analysis	CCNY (Zhu)	2024 - Present	⚙
16	Investigation of Emerging Sensing and AI/ML Technologies to Enhance the Safety of Vulnerable Roadway Users at Signalized Intersection	CCNY (Li)	2024 - Present	⚙
17	Blockchain Application on Smart Transportation Systems	CCNY (Allahviranloo)	2024 - Present	⚙
18	Analysis of Changes in the Activity Prisms of Individuals to Predict a Shared Life Experience Metric Over Different Regions and Sociodemographic Groups	CCNY (Allahviranloo)	2024 - Present	⚙
19	Deep Learning with LiDAR Point Cloud Data for Automatic Roadway Health Monitoring	CPP (Wang)	2023 - Present	⚙
20*	Addressing Mobility-Related Challenges for AAPI Older Adults	CPP (Zhang)	2024 - Present	⚙
21	Vehicle Edge Computing for Travel Behavior and Demand in Future Intelligent Transportation Systems (ITS)	CPP (Wang)	2024 - Present	⚙
22	Promoting Sustainable Travel within Communities through Behavioral Interventions and Emerging Mobility Solutions	GT (Peeta)	2023 - Present	⚙
23	How Effective Are Marker Variables at Predicting Attitudinal Factor Scores? An Out-of-Sample Evaluation	GT (Mokhtarian)	2023 - 2024	✓
24	A Pilot Experimental Project for Predicting Pedestrian Flows using Computer Vision and Deep Learning	GT (Guhathakurta)	2023 - Present	⚙
25	Empirical Investigation of Post-Disaster Travel Behavior to Points of Distribution of Relief Supplies	GT (Perez-Guzman)	2024 - Present	⚙
26	Promoting Sustainable Travel within Communities through Behavioral Interventions and Emerging Mobility Solutions: Stage 2	GT (Peeta)	2024 - Present	⚙

	Project Topic/Title	Institution (PI)	Active Period	Status
27*	How Effective Are Attitudinal Variables at Improving Travel Behavior Models? Evaluation Using an Overlapping Sample From an Attitude-Rich Survey and the 2017 National Household Travel Survey	GT (Mokhtarian)	2024 - Present	⚙
28	Improving Mobility Options through Transit Signal Priority (TSP)	GT (Hunter)	2024 - Present	⚙
29	How Complete are Your City's Streets? Evaluating the Completeness of Urban Streets Using Big Data and Computer Vision	GT (Guhathakurta)	2024 - Present	⚙
30*	Investigating Travel Survey Representativeness: Who's Missing and What Can We Do?	UM (Shaw)	2024 - Present	⚙
31	Michigan Mobility Metrics (M3): An Outcome-Focused, Multi-Year Survey Deployment and Data Collection Effort	UM (Shaw)	2024 - Present	⚙
32	Telemedicine Adoption Before, During, and After COVID-19: The Role of Socioeconomic and Built Environment Variables	UT (Bhat)	2023 - 2024	✓
33	Teleworking to Play or Playing to Telework? A Latent Segmentation Approach to Exploring the Relationship Between Telework and Nonwork Travel	UT (Bhat)	2023 - 2024	✓
34	Enhanced Network Models for Multimodal Resiliency	UT (Boyles)	2023 - Present	⚙
35	Identifying Travel Needs, Barriers, and Solutions	UT (Karner)	2023 - Present	⚙
36	Identifying Targets for Electric Vehicle Industry Improvement	UT (Machemehl)	2023 - Present	⚙
37	A Dynamic Analysis of the Built Environment-Travel Behavior Relationship Using Three Activity-Travel Surveys in the Austin, Texas Region	UT (Zhang)	2023 - Present	⚙
38*	A Model of EV Adoption and Rank-Based Contributing Factors	UT (Bhat)	2024 - Present	⚙
39	An Evaluation of the Long-Term Effects of the COVID-19 Pandemic on Public Transportation Use	UT (Bhat)	2024 - Present	⚙
40	The Reverse Side of Online Shopping: Examining Sociodemographic and Built-Environment Determinants of Delivery Returns	UT (Bhat)	2024 - Present	⚙
41	A Multidimensional Analysis for Understanding Walking Habits in Older Adults Post-Pandemic	UT (Bhat)	2024 - Present	⚙
42	The Effect of Urban Infrastructure Change on Movement	UW (Chen)	2023 - Present	⚙
43	A Pilot Study to Integrate Mobility Data Collection APPs with Personalized Recommendation Systems	UW (Huang)	2023 - Present	⚙
44	The Differential Accessibility Effects of Work from Home: Travel Behavior Outcomes and Transportation Equity Implications	UW (Shen)	2024 - Present	⚙
45	Quasi-Sparsity in Transportation Origin-Destination Demand	UW (Ban)	2024 - Present	⚙
46*	Imputing Socio-Demographics for Mobile Trajectors	UW (Chen)	2024 - Present	⚙
47	Disabled Parking CV: Scalable Methods to Analyze Disability Parking Using Computer Vision and High-Resolution Aerial and Streetscape Images	UW (Froehlich)	2024 - Present	⚙

ASU = Arizona State University; CCNY = The City College of New York; CPP = California State Polytechnic University – Pomona; GT = Georgia Institute of Technology; UM = University of Michigan; UT = The University of Texas at Austin; UW = University of Washington. ✓ = Completed; ⚙ = In progress; * = Narrative provided below.

A few illustrative details about the progress made for a sample of active projects or projects completed within this reporting period are provided below.

Project #1: Travel Behavior Data (TBD) Hub
PI: Chandra Bhat (UT) **Co-PIs:** Irfan Batur (ASU), Ram Pendyala (ASU)

Progress: Serving as one of the two TBD flagship endeavors, this project aims to develop a comprehensive Travel Behavior Data (TBD) Hub that brings a variety of data sets into a single unified platform, thus serving as a one-stop shop for instant data-driven insights on travel behavior and demand. Examples of the datasets that the Hub will bring together include, but are not limited to, the American Community Survey

(ACS), National Household Travel Survey (NHTS), American Time Use Survey (ATUS), Consumer Expenditure Survey (CES), Commodity Flow Survey (CFS), and Vehicle Inventory and Use Survey (VIUS). The team will harness the latest techniques in data aggregation, data fusion, and integration, data imputation and weighting, data prediction, and data visualization to build a national TBD hub that the public, planners, and policy-makers alike can leverage to understand the state of the transportation system. In the previous reporting periods, the team developed the first-ever dashboard integrated into the Hub, called the Time Use, Travel, and Telework Dashboard (T3D). During this reporting period, the team began developing another dashboard based on the American Time Use Survey (ATUS) data series: The Mobility Dashboard (TMD). TMD will provide a comprehensive view of travel episodes in ATUS, focusing on key aspects such as travel mode, trip purpose, trip chaining, and zero-trip making. The beta version of TMD was unveiled first time during the TBD Center's Annual Meeting in March 2025. In the next reporting period, the team will finalize the TMD, release it to the public, and integrate it into the Hub.

Project #2: Transportation Heartbeat of America ("THA") Travel Behavior and Demand Survey
PI: Chandra Bhat (UT) **Co-PIs:** Irfan Batur (ASU), Ram Pendyala (ASU), Patricia Mokhtarian (GA Tech), Atiyya Shaw (UM), Steven Polzin (ASU), Alison Conway (CCNY), Cynthia Chen (UW)

Progress: Serving as one of the two TBD flagship endeavors, this project aims to deploy a comprehensive longitudinal travel behavior and demand survey across the nation for five years to obtain a statistically representative depiction of attitudes, values, choices, socioeconomics, demographics, well-being, mobility, and accessibility. To assess rapidly changing travel behaviors, the "THA" survey employs a combination of panel and cross-sectional methods. This combination will track, for a subset of sampled individuals/households, attitudes and behaviors across multiple waves of data collection (the "panel" component), as well as incorporate fresh individuals/households in each subsequent wave (the "cross-sectional component). Uniquely, it will also include a component that tracks the "pulse" of U.S. businesses and employers with regard to employer-provided transportation benefits, work-from-home options offered to employees, and the use of e-commerce and delivery platforms to reach customers. In the previous reporting periods, the survey instrument was developed for the individual-level survey component, and data collection for the first wave was initiated. During this reporting period, the data collection from the first wave was completed, with 8,212 full responses, and the team began a detailed analysis of the data. In the next reporting period, the survey instrument will be refined, and the second wave will be deployed. Work will also begin on a business-oriented component to capture employer transportation needs and behaviors.

Project #7: Trends in Time, Travel, Transit, Telework, and Treasure (T5)
PI: Steven Polzin (ASU) **Co-PI:** Ram Pendyala (ASU)

Progress: The early 21st century has been a pivotal period for studying travel behavior and time use, with transformative shifts in how individuals allocate time and make travel decisions. This project examines trends in time, travel, transit, telework, and treasure (T5). Over the years, the team has analyzed publicly available datasets, with findings disseminated through two policy briefs, multiple presentations, and a journal article submitted to *Transport Policy*. During this reporting period, the team analyzed newly released 2023 data to capture post-pandemic trends, documented findings and policy implications in a new policy brief, and disseminated it broadly. Findings were also presented at the 3rd Symposium on Activity-Based Modeling in Bavaria (December 2024), and the journal article was refined based on reviewer feedback. As the project enters its final funding stage, major activities are complete. In the next reporting period, the team will finalize the journal article, complete the final project report, and present findings at the ASCE International Conference on Transportation and Development (ICTD).

Project #14: The Effects of Changing Commutes on Home Delivery Activity
PI: Alison Conway

Progress: The goal of this project is to investigate the relationship between work-related travel activity and propensity for home delivery to better understand the implications of teleworking for local delivery activity

in residential areas. The study aims to jointly explore personal travel behavior patterns (distinguishing individuals based on demographic characteristics, home and work built environments (e.g., land uses and building types) and commute characteristics (e.g. frequencies, modes, times of day)) and shopping patterns for several specific categories of goods – including groceries, prepared food, and parcels. During this reporting period, the team constructed and executed a structural equation model to investigate the frequency of online shopping participation and of home delivery of three types of goods (parcels, groceries, and prepared food). The team presented preliminary results at the TRB Annual Meeting, the Activity-Based Modeling Symposium, and the International Urban Freight Conference. In the next reporting period, the team will further investigate several significant relationships identified from model results in the multi-disciplinary literature to ensure a complete understanding of the contributing factors and develop specific recommendations regarding how to update the organization of city logistics for parcel and food deliveries. The team will finalize the project report and submit a journal paper for publication in the next period.

Project #20: Addressing Mobility-Related Challenges for AAPI Older Adults
PI: Yongping Zhang (CPP) **Co-PIs:** Wen Cheng (CPP)

Progress: This project aims to use both qualitative and quantitative research methods to better understand mobility-related challenges faced by Asian American and Pacific Islander (AAPI) older adults. The goal is to provide government agencies and organizations, such as the National Asian Pacific Center on Aging (NAPCA), with recommendations for policy and program changes. During this reporting period, the team conducted an extensive literature review and made significant progress in developing and evaluating the survey instrument targeting AAPI older adults. The research engaged both graduate and undergraduate students in survey question development, data collection, and data analysis. The team is currently evaluating the preliminary data collected and continuing data collection efforts to draw meaningful conclusions.

Project #27: How Effective Are Attitudinal Variables at Improving Travel Behavior Models? Evaluation Using an Overlapping Sample from an Attitude-Rich Survey and the 2017 National Household Travel Survey | **PI:** Patricia Mokhtarian (GT)

Progress: This project is one in a series of studies designed to investigate the practicality of including attitudes as explanatory variables in practice-oriented travel demand forecasting models. In this study, the team exploits the rare opportunity offered by the 2017 Georgia Department of Transportation (GDOT) Emerging Technologies (ET) survey and the 2017 Georgia add-on to the National Household Travel Survey (NHTS), having 1,245 respondents in common. The non-overlap GDOT ET survey dataset (N = 2,043) is selected as the donor sample, based on which elastic net regression (ENR) models are trained for imputation of attitudinal factor scores using marker variables (MVs). The overlap NHTS dataset is treated as if it has only MVs, with attitude scores needing to be imputed using the ENR models. The ENR models display high prediction performance in both the donor and recipient datasets. Three travel behavior variables in the recipient dataset are modeled with no attitudes, predicted attitude scores, and MVs. For each dependent variable, several attitudes show statistical significance, although their contributions to model fit vary. The results indicate that including attitudes leads to (a) better prediction of less-common alternatives (zero vehicles and hybrid/electric vehicle adoption), and (b) discovery of additional non-attitude variables that would have been considered insignificant otherwise. Thus, the study points to the value of including attitudinal variables in practice-oriented models. The project report will be finalized in the next reporting period, and a paper is currently undergoing peer review at a major transportation journal.

Project #30: Investigating Travel Survey Representativeness: Who's Missing and What Can We Do?
PI: Atiyya Shaw (UM)

Progress: This project aims to investigate household travel survey biases, identify their causes, and propose potential solutions through the following tasks: (1) a quantitative investigation of national and state transportation household survey biases across diverse metropolitan regions in the United States; (2) documentation and comparison of the sampling methods, instrument designs, and post-processing

correction methods used across various survey implementations; (3) a case study for the Detroit metro area to more closely analyze and define hard-to-reach populations and geographies, providing targeted insights for sampling strategies, outreach, and instrument design; and (4) the development of a methodological guide in the form of a white paper for use by transportation organizations, agencies, and firms. During this reporting period, the team worked closely with the Southeast Michigan Council of Governments and the Metropolitan Council. These collaborations involved numerous meetings and data-sharing efforts. Findings to date have been well-received by public and private partners, and efforts to advance and disseminate results are ongoing. In addition, results from this work were presented at the 13th International Conference on Travel Survey Methods, and the team will prepare a journal submission during the next reporting period.

Project #38: A Model of EV Adoption and Rank-Based Contributing Factors
PI: Chandra Bhat (UT)

Progress: This project examines the adoption of electric vehicles (EVs) and the broad range of motivations that contribute to EV adoption. While there is a broad interest in understanding EV adoption patterns through a study of actual individual-level adoption behaviors, the nascent stage of the EV market has made such investigations difficult. In particular, many existing EV adoption studies are confined to an examination of stated adoption intentions rather than actual revealed adoption behaviors. Accordingly, the project team examines the ways that demographics, lifestyle preferences, and perceptions of EV characteristics impact revealed EV adoption behaviors. In addition to the binary EV adoption decision, the team investigates the motivations for EV ownership. In the previous reporting periods, the team conducted a detailed review of the reasons for EV adoption found in existing studies and performed a preliminary analysis on a survey of California households. During the current reporting period, a detailed modeling effort was used to model EV adoption and the motivations for adoption in a joint framework, allowing for unobserved correlation effects between adoption and the ranked motivating reasons. Accounting for these correlations allows us to more accurately quantify the motivations that contribute most to the adoption of EVs in the entire population, rather than solely in the population of existing EV owners. In the next reporting period, the project will be completed, and the final report will be finalized.

Project #46: Imputing Socio-demographics for Mobile Trajectories
PI: Cynthia Chen (UW)

Progress: Mobile trajectory data, passively generated from numerous mobile devices, is an increasingly popular source for various transportation planning applications. Compared to household travel survey (HTS) data, which has long been used for long-term planning, mobile trajectory data offers several advantages, such as a much larger sample size, longitudinal coverage, and the ability to capture real-time changes more rapidly. However, its chief disadvantage is the absence of socio-demographic information, which this project seeks to address. The team is developing methods to impute socio-demographic attributes into mobile trajectory datasets. So far, the team has identified the datasets to be used and developed a methodological framework that begins with the compression of variables—including socio-demographics, built environment characteristics, and mobile trajectories—using techniques such as Principal Component Analysis (PCA) and autoencoders. Subsequently, the team will apply either Bayesian networks or Gaussian Processes to infer socio-demographic attributes from mobile trajectory patterns. During this reporting period, the team primarily focused on methodological development. In the next reporting period, the team will finalize the compilation of needed datasets and begin data analysis.

What opportunities for training and professional development has the program provided?
The center-wide workforce development/technology transfer events are discussed earlier in this SAPR. In terms of education, the courses offered by faculty members closely affiliated with TBD Center are presented in Table 2. While there are many additional transportation-related courses taught at each TBD institution, the scope of activities reported in this SAPR is limited to the activities of faculty members who comprise the *core* group of TBD, who are deeply engaged in advancing the activities and mission of the center.

Table 2. Courses Offered by Core Faculty Members of TBD (Fall 2024 & Winter 2025)

Semester	Level	Course No	Course Title	No*	Instructor	Unit
			Arizona State University			
Fall 24	Grad	CEE 598	Traffic Simulation Modelling and Applications	8	Zhou	SSEBE
Fall 24	Grad	PAF 501	Transportation Engineering	35	Swindell	PAF
			Cal Poly Pomona			
Fall 24	Undergrad	CE 3601-01	Transportation Engineering	56	Zhang	CE
Fall 24	Undergrad	CE 3601-02	Transportation Engineering	56	Cheng	CE
			City College of New York			
Fall 24	Undergrad	CE 101	Introduction to Civil Engineering	72	Conway	CE
Fall 24	Undergrad	CE 326	Transportation Planning	27	Conway	CE
Fall 24	Crosslisted	CE 520/H2000	Traffic Engineering	5	Li	CE
Fall 24	Grad	CE G4900	Transportation Network Analysis	5	Allahviranloo	CE
Fall 24	Grad	CE I2400	Analytical Techniques in Transportation	7	Kamga	CE
			Georgia Institute of Technology			
Fall 24	Grad	CEE 6623	Transportation Survey Methods	6	Mokhtarian	CEE
Fall 24	Grad	CEE 8813	Transportation Network Modeling and Analysis	26	Peeta	CEE
Fall 24	Undergrad/Grad	VIP Course	Autonomous and Connected Transportation (ACT) Driving Simulator	57	Peeta	VIP
			University of Michigan			
Winter 25	Undergrad	CEE 450	Introduction to Transportation Engineering	43	Shaw	CEE
			University of Texas at Austin			
Fall 24	Undergrad	CE 321	Transportation Systems	66	Bhat	CE
Fall 24	Undergrad	CE 377K	Public Transportation Engineering	20	Machemehl	CE
Fall 24	Grad	CE 392D	Dynamic Traffic Assignment	15	Boyles	CE
Fall 24	Grad	CE 392M	Public Transportation Engineering	7	Machemehl	CE
Fall 24	Grad	CE 397	Linear Regression and Discrete Choice Methods	9	Bhat	CE
Fall 24	Grad	CRP 386K	Intro Vis Comm/Geog Inf Sys Pl	27	Karner	CRP
			University of Washington			
Fall 24	Undergrad/Grad	IND E 427 & 527	Data Analytics for Systems Engineering	51	Huang	ISE
Fall 24	Grad	CET 513	Transportation Networks and Optimization	29	Ban	CEE
Fall 24	Undergraduate	CEE327	Transportation Engineering	67	Ban	CEE
Winter 25	Grad	CET 593	Transportation System Analysis	16	Ban	CEE
Fall 24	Grad	CET512	Transportation Data Collection	20	Chen	CEE
Win 25	Grad	CET581	Transportation Demand Forecasting	20	Chen	CEE

Notes: SSEBE = School of Sustainable Engineering and the Built Environment; PAF = School of Public Affairs; CE = Civil Engineering; CRP = Community and Regional Planning; CEE = Civil and Environmental Engineering; VIP = Vertically-Integrated Project; ISE = Industrial and Systems Engineering. *Enrollment number.

Many students across all levels and post-doctoral scholars at TBD institutions have participated in TBD-related activities. Table 3 provides a comprehensive listing of these individuals. During this reporting period, three students from the University of Texas at Austin achieved important milestones: Dr. Katherine Asmussen, who graduated in August 2024, accepted a position as an Assistant Research Professor at the University of Tennessee; Bonny Smith earned her M.S. in Civil Engineering in December 2024 with a thesis titled "An Evaluation of the Long-Term Effects of the COVID-19 Pandemic on Public Transit Use"; and Carol Anne Starks graduated with a B.S. in Environmental Engineering in December 2024.

Table 3. Students and Research Staff Engaged in TBD-Related Research and Education Activities

Name of Scholar	Level	Major/ Unit	Supervisor/ Advisor
	Arizona State University		
Eleanor Hennessy	Postdoc	SSEBE	Ram Pendyala
Roberto Dimas Valle	PhD Student	SSEBE	Ram Pendyala
Fan Yu	PhD Student	SSEBE	Ram Pendyala
Victor O. Alhassan	PhD Student	SSEBE	Ram Pendyala

Jinghai Huo	PhD Student	SSEBE	Ram Pendyala
Miguel Rodriguez Ocana	MS Student	SSEBE	Ram Pendyala
Roshan Varghese	MS Student	Computer Science	Ram Pendyala
Mohammed Zaid	MS Student	Information Technology	Ram Pendyala
Cal Poly Pomona			
Yichi Cheng	MS Student	Civil Engineering	Yongping Zhang
Ziliang	MS Student	Civil Engineering	Yongping Zhang
Michelle Chen	MS Student	Civil Engineering	Wen Cheng
Jordan Syrilla	MS Student	Civil Engineering	Wen Cheng
Rafael Trinidad	MS Student	Computer Science	Yunsheng Wang
Michael Ly	Undergraduate Student	Computer Science	Yunsheng Wang
City College of New York			
Fateme Rezapour Fardin	PhD Student	Civil Engineering	Alison Conway
Shradha Ghodse	MS Student	Data Science	Alison Conway/Michael Grossberg
Nikhita Kannam	MS Student	Data Science	Mahdieh Allahviranloo
Xiaoyang Lee	PhD Student	Civil Engineering	Mahdieh Allahviranloo
Bilal Abdulrahman	PhD Student	Computer Science	Zhigang Zhu /Alison Conway
Gong Qi Chen	PhD Student	Computer Science	Zhigang Zhu
Bo Shang	PhD Student	Civil Engineering	Yiqiao Li
Weicong Feng	PhD Student	Computer Science	Jie Wei
Arian Golrokh Amin	PhD Student	Civil Engineering	Camille Kamga
Wen Jie Long	Undergraduate Student	Computer Science	Yiqiao Li
Georgia Institute of Technology			
Chaeyeon Han	PhD Student	City & Reg. Plan.	Subhrajit Guhathakurta
Sujin Lee	MS Student	Urban Analytics	Subhrajit Guhathakurta
Animesh Agrawal	MS Student	Comp. Science	Subhrajit Guhathakurta
Ilsu Kim	PhD Student	CEE	Patricia Mokhtarian
Seung-eun (Katy) Choi	PhD Student	CEE	Patricia Mokhtarian
Rachael Panik	Postdoc	CEE	Patricia Mokhtarian
Viswa Sri Rupa Anne	PhD Student	CEE	Srinivas Peeta
Md Gulam Kibria	PhD Student	OR/ISyE	Srinivas Peeta
Yuming Chang	PhD Student	CEE	Srinivas Peeta
Yufei Xu	PhD Student	CEE	Srinivas Peeta
University of Michigan			
Amy Fong	PhD student	CEE	Atiyya Shaw
Ivan Shih	PhD student	CEE	Atiyya Shaw
Sungho Lim	PhD student	CEE	Atiyya Shaw
Brynn Woolley	PhD student	CEE	Atiyya Shaw
Emily Youngs	PhD student	CEE	Atiyya Shaw
University of Texas at Austin			
Katie Asmussen	Postdoc	CE	Chandra Bhat
Angela Haddad	PhD Student	CE	Chandra Bhat
Hyunjun Hwang	PhD Student	CE	Chandra Bhat
Ali Kothawala	PhD Student	CE	Chandra Bhat
Dale Robbennolt	PhD Student	CE	Chandra Bhat
Bonny Smith	MS Student	CE	Chandra Bhat
Anna Beliveau	UG Student	CE	Chandra Bhat
Justin Chang	UG Student	Comp Sci	Chandra Bhat
Emily Ann Podnar	UG Student	CE	Chandra Bhat
Devina Sharma	UG Student	CE	Chandra Bhat
Carol Anne Starks	UG Student	Environ Eng	Chandra Bhat
Kyle Bathgate	PhD student	CE	Stephen Boyles
Jake Robbennolt	PhD student	CE	Stephen Boyles
Debojjal Bagchi	MS student	CE	Stephen Boyles
Lu Xu	Postdoc	CE	Stephen Boyles
Dylan Croteau	UG Student	CE	Stephen Boyles
Doyun Lee	UG Student	CE	Stephen Boyles
Md Hamidur Rahman	PhD Student	CRP	Alex Karner
Maitreyee P. Gorase	MS Student	Information Science	Randy Machemehl

Niaz a Zafri	PhD Student	CRP	Ming Zhang
Seunggwan Park	PhD Student	CRP	Ming Zhang
Peng Cheng	MS Student	CRP	Ming Zhang
University of Washington			
Hoseok Sa	PhD Student	URBDP	Qing Shen
Congjing Zhang	PhD student	ISE	Shuai Huang
Feng Lin	PhD student	ISE	Shuai Huang
Ekin Ugurel	PhD student	CEE	Cynthia Chen
Grace Jia	PhD student	CEE	Cynthia Chen
Jeremy Chan	MS student	CEE	Cynthia Chen
Aaron Wang	MS student	CEE	Cynthia Chen
Arsalan Esmaeili	PhD student	CEE	Cynthia Chen
Kaitlyn Ng	MS student	CEE	Cynthia Chen
Lyra Chen	Research scientist	CEE	Cynthia Chen
Yuteng Zhang	MS student	ISE	Cynthia Chen
Donghun Son	Postdoc	CEE	Cynthia Chen
Adam Schultz	MS student	CEE	Cynthia Chen
Chu Li	PhD student	CSE	Jon E. Froehlich
Jared Hwang	PhD student	CSE	Jon E. Froehlich
Chithira Unnikrishnan	MS student	CEE	Jeff Ban
Shakiba Naderian	Ph.D. student	CEE	Jeff Ban

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

In the next reporting period, active first-year and second-year projects will continue to advance according to their proposed schedules, and the two flagship endeavors will proceed with major milestones. The first-wave data will be extensively analyzed for the THA Survey, and a survey report summarizing key findings will be produced. In addition, the second-wave instrument will be finalized and deployed, and initial development of the business-focused survey component will begin. The TBD Hub will continue to grow with the release of additional data products, and the existing dashboards (T3D and TMD) will be updated based on the new release of ATUS 2024 data.

While detailed project-specific plans are provided in earlier sections for a sample of projects, some key activities anticipated across the project portfolio include: finalization of modeling efforts on EV adoption motivations, online shopping returns, and post-pandemic public transit use; refinement of dashboards and visualization tools for mobility and travel behavior data (including updates to the T3D and TMD dashboards); expanded testing of sustainable travel interventions through field experiments and app-based behavioral deployments; further development of predictive models using mobile trajectories and multi-sensor VRU (vulnerable roadway users) data; and publication of methodological guidance on local freight data sources and survey representativeness improvements. In addition, some projects will complete major manuscripts for submission to leading transportation journals and prepare papers for presentation at a variety of venues, including the 2025 Modeling Mobility (MoMo) Conference, the 2026 TRB Annual Meeting, and other relevant conferences. Across the center, emphasis will also be placed on disseminating findings through policy briefs, open-access dashboards, final reports, and strategic outreach activities.

In addition, workforce development and outreach activities will continue, with a number of seminars and webinars planned for the next reporting period. Prof. Subhrajit Guhathakurta from the School of City and Regional Planning at the Georgia Institute of Technology will deliver a seminar (title to be finalized). Dr. Rachael Panik, President's Postdoctoral Fellow in Civil and Environmental Engineering at Georgia Institute of Technology, will also present a seminar in August or September 2025. Additionally, Dr. Irfan Batur, Assistant Director of the TBD Center, will host a webinar to introduce and demonstrate the newly developed Mobility Dashboard (TMD) to a broad user base, showcasing its features and applications.

2. PARTICIPANTS & COLLABORATING ORGANIZATIONS
What organizations have been involved as partners?

• Arizona Department of Transportation (ADOT), Phoenix, Arizona: Collaborative research
• Army Corps of Engineers Coastal Hydraulics Laboratory, Vicksburg, MS: datasets, collaboration, in-kind support

- CCNY College-wide Research Vision (CRV) project: collaborative research
- City of Peachtree Corners, Georgia: Transit ridership data, AV shuttle data, community engagement
- Commute Seattle and the Seattle Department of Transportation: Collaborative research
- Foothill Transit: In-kind support, panel discussion and hands-on activities for the Summer Transportation Institute
- Institute for Social Research Survey Methodology Program, Ann Arbor, MI: Collaboration and personnel exchanges
- King County Metro: Collaborative research
- Maricopa Associations of Government (MAG): Collaborative research
- Michigan Department of Transportation, Lansing, Michigan: Collaborative research and data sharing
- National Renewable Energy Laboratory (NREL), CO: In-kind support. access to their mobile application
- New York City Department of Transportation, NY: In-kind support, datasets, participation in a workshop
- Puget Sound Regional Council (PSRC): Collaborative research
- Seattle Department of Transportation: Collaborative research
- Sky Packets, New York, NY: Sensor Installation
- Southeast Michigan Council of Governments: Collaborative research and data sharing
- Town of Queen Creek, AZ: Collaborative research
- Urban and Regional Planning Department at University of Michigan: Collaboration and personnel exchanges
- Women's Transportation Seminar-Los Angeles Chapter (WTS-LA): Co-hosted Girls' Empowerment Day

Have other collaborators or contacts been involved?

- Dr. Abdul R. Pinjari, Indian Institute of Science, India
- Dr. Abolfazl Mohammadian, Univ of Illinois-Chicago, IL
- Dr. Baloka Belezamo, ADOT, Phoenix, AZ
- Dr. Basar Ozbilen, U. of California, Davis
- Dr. Bert van Wee, Delft University of Technology
- Dr. Brian German, Georgia Tech, Atlanta, GA
- Dr. Brian Lee, PSRC, Seattle, WA
- Dr. Deborah Salon, ASU, Tempe, AZ
- Dr. Giovanni Circella, Ghent Univ, Belgium
- Dr. Jason Soria, Cintra
- Dr. Joe Grengs, University of Michigan, Ann Arbor, MI
- Dr. Jon Froehlich, University of Washington
- Dr. Laurie Garrow, Georgia Tech, Atlanta, GA
- Dr. Maryam Hosseimi, UC Berkeley
- Dr. Mikhail Chester, ASU, Tempe, AZ
- Dr. Peter Stopher, ASU, Tempe, AZ
- Dr. Seungnam Kim, Chung-Ang University, S. Korea
- Dr. Steve Mooney, University of Washington
- Dr. Sung Hoo Kim, Hanyang Univ, S. Korea
- Dr. Sunghee Lee, University of Michigan, Ann Arbor, MI
- Dr. Sybil Derrible Univ of Illinois-Chicago, IL
- Dr. Taehooie Kim, Maricopa, MAG, Phoenix, AZ
- Dr. Tassio Magassy, WSP USA
- Dr. Vivien Lim, National Univ of Singapore
- Dr. Xinyi Wang, MIT, Cambridge, MA
- Dr. Yongsung Lee, U. of California, Davis
- Henry Quintin, Sky Packets, New York, NY
- Brice Nichols, PSRC, WA
- Kurt Winner, Commute Seattle, WA
- Ms. Joanne Lin, PSRC, Seattle, WA

3. OUTPUTS

Publications, conference papers, and presentations:

Journal Publications: Papers Published Within Reporting Period

1. Bhat, C.R. (2024). Transformation-Based Flexible Error Structures for Choice Modeling. *Journal of Choice Modelling*, 53.
2. Feng, F., Anastasopoulos, P. C., Guo, Y., Wang, W., Peeta, S., & Li, X. (2024). Willingness to use ridesplitting services for home-to-work morning commute in the post-COVID-19 era. *Transportation*, 1-34.
3. Haddad, A. J., Hwang, H., Batur, I., Pendyala, R. M., & Bhat, C. R. (2025). Walking patterns in older adults: Modeling the interplay of frequency, place, and purpose. *Journal of Transport & Health*, 41, 101962.
4. Haddad, A.J., A. Mondal, and C.R. Bhat (2025). Eating-out Behavior across Different Restaurant Segment Types: Implications for Transportation, Public Health, and Food Service Sectors. *Transportation Research Part A*, 192, 104337.
5. Haddad, A.J., and C.R. Bhat (2025). Telemedicine Adoption Before, During, and After COVID-19: The Role of Socioeconomic and Built Environment Variables. *Transportation Research Part A*, 192, 104351.
6. Hennessy, E. M., Wolfinbarger, J. R., Batur, I., Srivastava, N. A., Porto, M., Cotlier, G. I., Horgan, M., Searles, I., Sparks, R. M., & Chester, M. V. (2024). Changing boundaries, distributed control, and implications for transportation sustainability. *Nature Portfolio Journal (npj) Sustainable Mobility and Transport*, 1(1), 1-6.
7. Jia, G., Pendyala, R., & Chen, C. (2025). How does delivery service change food accessibility: A modified 2-step floating catchment area method. *Environment and Planning B: Urban Analytics and City Science*, 23998083241312369.
8. Karami, A., Allahviranloo, M., & Samadzad, M. (2025). The impacts of personality traits on the acceptance of shared e-scooters: Evidence from Tehran. Cities, 105633. https://doi.org/10.1016/j.cities.2024.105633.
9. Li, X., Zhang, X., Qian, X., Zhao, C., Guo, Y., & Peeta, S. (2024). Beyond centralization: Non-cooperative perimeter control with extended mean-field reinforcement learning in urban road networks. *Transportation Research Part B: Methodological*.
10. Li, Z., Idziorek, K., Chen, A., & Chen, C. (2025). Untapped capacity of place-based peer-to-peer resource sharing for community resilience. *Nature Cities*, 2(1), 47-57.

11. Robbennolt, D., A.J. Haddad, A. Mondal, and C.R. Bhat (2024). Housing Choice in an Evolving Remote Work Landscape. *Transportation Research Part A*, 190, 104285, 2024.
12. Robbennolt, J., M. Li, J. Mohammadi, and S.D. Boyles (2025). Balancing passenger transport and power distribution: a distributed dispatch policy for shared autonomous electric vehicles. In press, *IEEE Transactions on Industry Applications.*
13. Soria, J., Choi, S. E., Wang, X., & Mokhtarian, P. L. (2025). What kinds of people expect to travel by car more, or less, for non-commute purposes in the post-pandemic era? A latent class approach. *Travel Behaviour and Society*, 40, 100986.
14. Uğurel, E., Huang, S., & Chen, C. (2024). Learning to generate synthetic human mobility data: A physics-regularized Gaussian process approach based on multiple kernel learning. *Transportation Research Part B: Methodological*, 189, 103064.
15. Ugurel, E., Wu, X., Wang, R., Lee, B. H., & Chen, C. (2024). Metropolitan Planning Organizations' Uses of and Needs for Big Data. *Findings*.
16. Wang, C., & Peeta, S. (2024). Incentive mechanism for privacy-preserving collaborative routing using secure multi-party computation and blockchain. *Sensors*, 24(2), 542.
17. Wang, J., Zhou, A., Liu, Z., & Peeta, S. (2024). Robust cooperative control strategy for a platoon of connected and autonomous vehicles against sensor errors and control errors simultaneously in a real-world driving environment. *Transportation research part B: methodological*, 184, 102946.
18. Wang, Y., Guan, X., Ugurel, E., Chen, C., Huang, S., & Wang, Q. R. (2025). Exploring biases in travel behavior patterns in big passively generated mobile data from 11 US cities. *Journal of Transport Geography*, 123, 104108.
19. Zhou, A., Peeta, S., Zhou, H., Laval, J., Wang, Z., & Cook, A. (2024). Implications of stop-and-go traffic on training learning-based car-following control. *Transportation Research Part C: Emerging Technologies*, 168, 104578.
20. Zhou, A., Zhou, H., Laval, J., & Peeta, S. (2025). String instability mitigation of adaptive cruise control without modifying control laws: trajectory shaper and parameter estimation. *Transportmetrica B: Transport Dynamics*, 13(1), 2473885.
21. Zhu, Y., Li, Y., Zhao, H., Huang, X., Ou, Y., & Peeta, S. (2024). The effects of communication topology on mixed traffic flow: Modelling and analysis. *Transportmetrica B: Transport Dynamics*, 12(1), 2422373.

Presentations Within Reporting Period

1. Alhassan, V. O., Yu, F., Valle, J. R. D., Magassy, T. B., Batur, I., Salon, D., Bhat, C. R., & Pendyala, R. M. Investigating the Influence of Alternative Survey Participant Recruitment Strategies on Measurement and Inference of Mobility Patterns. Presented at the 104th Annual Meeting of the Transportation Research Board, Washington, DC, January 5-9, 2025.
2. Anne, R., Liu, Y., Kibria, G., Asensio, O., and Peeta, S. (2025). Promoting Sustainable Travel Modes through Gamified Health and Environmental Information, 104th Annual Meeting of the Transportation Research Board, Washington, D.C., January 2025. (Winner of the TRB AEP35 Best Paper Award at the conference).
3. Anne, V. S. R., and S. Peeta. 2024. Promoting Sustainable Mobility: Behavioral Interventions for Transportation Sustainability and Equity. INFORMS Annual Meeting, Phoenix, AZ, October 2024.
4. Asmussen, K.E., A.J. Haddad, and C.R. Bhat. Telework-to-Play or Play-to-Telework? Investigating the Directional Relationship Between Telework and Nonwork Travel. TRB Annual Meeting, Washington, DC, January 2025.
5. Bagchi, D., and S.D. Boyles. Error bounds for stochastic user equilibrium assignment. Presented at the Annual Meeting of the Institute for Operations Research and the Management Sciences, Seattle, WA, October 2024.
6. Bagchi, D., K. Bathgate, and S.D. Boyles. A queueing theory-based operating capacity model for multimodal port operations. Transportation Research Board (TRB) Annual Meeting, Washington, DC, January 2025.
7. Bathgate, K., D. Bagchi, and S.D. Boyles. Identifying capacities in a multimodal maritime freight network. Presented at the Annual Meeting of the Institute for Operations Research and the Management Sciences, Seattle, WA, October 2024.
8. Bathgate, K., D. Bagchi, and S.D. Boyles. Use of AIS data to characterize vessel mix in Houston port operations for simulation. Transportation Research Board (TRB) Annual Meeting, Washington, DC, January 2025.
9. Batur, I., Khoeini, S., Sharda, S., Magassy, T., Ye, X., & Pendyala, R. M. A Methodology for Evaluating Wellbeing Implications of Activity-Travel Engagement and Time Use Patterns. Presented at the 104th Annual Meeting of the Transportation Research Board, Washington, DC, January 5-9, 2025.
10. Bhat, C.R., A Study on Telemedicine Adoption, with Implications for Healthcare, Telecommunications and Land use-Transportation Planning, Invited Seminar, Indian Institute of Management (IIM) Ahmedabad, India, January 2025.
11. Bhat, C.R., An Evaluation of the Long-Term Effects of the COVID-19 Pandemic on Public transportation Use, Invited Presentation, 3rd TUM Symposium on Activity-Based Modeling, Raitenhaslach, Germany, December 2024.
12. Bhat, C.R., An Evaluation of the Long-Term Effects of the COVID-19 Pandemic on Public Transit Use, Invited Seminar, School of Infrastructure, Indian Institute of Technology (IIT) Bhubaneswar, Kansapada, India, January 2025.
13. Bhat, C.R., An Investigation of Physical Participation Dissonance and Virtual Activity Participation, Invited Virtual Seminar, Distinguished Research Seminar Series, Department of Industrial and Systems Engineering, The Hong Kong Polytechnic University (PolyU), November 2024.
14. Bhat, C.R., An Investigation of the Rich Interplay Between Physical and Virtual Activity Participations. Invited Seminar, College of Engineering Distinguished Seminar Series, Technical University of Istanbul (ITU), Istanbul, Turkey, March 2025.
15. Bhat, C.R., Gen-AI for Travel Behavior Analysis and Travel Demand Management, Invited Presentation, Pioneering Transportation Innovation with Generative AI Workshop, University of Maryland, College Park, MD, March 2025.
16. Bhat, C.R., On Teasing Out Causal Relationships in Travel Behavior Analysis, Invited Seminar, Department of Civil Engineering, Indian Institute of Science (IISc), Bangalore, India, February 2025.
17. Bhat, C.R., Transformation-Based Flexible Error Structures for Choice Modeling, Transportation Research Board (TRB) Annual Meeting, Washington, DC, January 2025.

18. Bhat, C.R., Telework-to-Play or Play-to-Telework? Investigating the Directional Relationship Between Telework and Nonwork Travel, Invited Virtual Seminar, Editors-in-Chief Session, 12th International Conference on Transportation and Space-time Economics (TSTE 2024), School of Economics and Management, Beijing Jiaotong University, November 2024.

19. Bhat, C.R., and A. Kothawala. LLMs in Travel Behavior Model Development. Transportation Research Board (TRB) Annual Meeting, Washington, DC, January 2025.

20. Chan, J.; Ng, K.; and Chen, C. (2025) Can repurposing city streets relieve congestion? A system dynamics policy analysis of Seattle. 104th annual meeting of Transportation Research Board, Washington DC.

21. Chen, C. Human mobility analysis in the THINK lab at the University of Washington, Feb 18, 2025, Nagoya Univ., Japan.

22. Chen, Z., Xu, Y., and Peeta, S. (2025). Deep-Learning-based Fair Travel Choice Prediction with Provable and Flexible Guarantees, 104th Annual Meeting of the Transportation Research Board, Washington, D.C., January 2025.

23. Conway, A. Creating Vibrant Downtowns: Balancing People, Parking, and Deliveries. New Jersey Transportation Planning Authority Webinar. March 25, 2025.

24. Conway, A. Exploring the Household-Based Freight Demand - Travel Activity Nexus. Activity-Based Modeling Symposium, Raitenhaslach, Germany, December 13, 2024.

25. Conway, A. The Changing Landscape for Last-Mile Goods Movement in NYC, University of Texas Department of Civil and Environmental Engineering. October 10, 2024.

26. D. Chen, W. Cheng, K. Syrilla. County-Oriented Geospatial Safety Performance Function via Transformer. Presented at: The 104th Annual Meeting of the Transportation Research Board, January 5-9, 2025. Washington DC.

27. Fong, A., I. Shih, A. Shaw, J. Grengs, & S. Lee (2025). Strategies to Improve Travel Survey Representativeness: U.S.-based Case Study on Weights and Convenience Sampling. 13th Conference on Travel Survey Methods, Da Nang, Vietnam.

28. Giubergia, D., A. Haddad, F. Piras, C. Bhat, and I. Meloni. Modeling Spatial and Social Interdependency Effects on Commuting Mode Choice. Transportation Research Board (TRB) Annual Meeting, Washington, DC, January 2025.

29. Haddad, A., and C.R. Bhat, Using Infrastructure to Boost Safety in a PNT World, CARMEN+ University Transportation Center Annual Symposium, Ohio State University, Columbus, OH, October 2024.

30. Haddad, A.J. and C.R. Bhat, Telemedicine Adoption Before, During, and After COVID-19: The Role of Socioeconomic and Built Environment Variables, Transportation Research Board (TRB) Annual Meeting, Washington, DC, January 2025.

31. Hwang, H., A.J. Haddad, and C.R. Bhat. Multivariate Analysis of Walking Habits After COVID-19. Transportation Research Board (TRB) Annual Meeting, Washington, DC, January 2025.

32. Kibria, G., and S. Peeta. 2024. Leveraging Partnership Between Public Transit and Emerging Private Modes to Enhance Accessibility Equity for Low-Income Populations. INFORMS Annual Meeting, Phoenix, AZ, October 2024.

33. Kothawala, A., A.J. Haddad, P. Loa, Y. Lee, G. Circella, and C.R. Bhat. Hybrid Workers' Activity Intensity: Post-Pandemic Comparison of Telework-Only and In-Person Workdays. TRB Annual Meeting, Washington, DC, January 2025.

34. Lim, S., M. Z. Li, and F. A. Shaw. (2025). From Ground to Air: Data Integration for a Human-Centric Multimodal Transportation Study. Presented at the 104th Transportation Research Board Annual Meeting, Washington D.C.

35. Liu, Y., Agrawal, S., Tenenboim, E., Zhou, A., and Peeta, S. (2025). Lane-Change Behavior of Human Drivers in Mixed-Traffic Conditions: A Safety Perspective, 104th TRB Annual Meeting, Washington, D.C., January 2025.

36. Olmedo, A., Woo, J., Y. Zhang. Analyzing Employment Projections for Trends by Ethnicity, Gender, and Region for Civil Engineers in Transportation. Presented at: The 104th TRB Annual Meeting, January 5-9, 2025. Washington DC.

37. Patricia Mokhtarian, invited speaker: How Much Do Attitudinal Variables Improve Travel Demand Models? Evaluation Using an Overlap Sample from an Attitude-rich Survey and the 2017 National Household Travel Survey. Northwestern University Transportation Center, January 30, 2025. & University of Michigan, Department of Civil & Environmental Engineering Richart-Woods Lecture, February 13, 2025.

38. Patricia Mokhtarian, invited speaker: How temporally stable are attitudes? It depends. 3rd Symposium on Activity-Based Modeling, Technical University of Munich Science & Study Center in Raitenhaslach, Germany, December 11-13, 2024.

39. Patricia Mokhtarian, invited speaker: The Insidious Problem of Selection Biases: How to Recognize Them, and What to Do about Them. Hanyang University, South Korea, October 21, 2024. & University of Central Florida, November 22, 2024.

40. Patricia Mokhtarian, keynote speaker: How will autonomous vehicles affect travel time use and subsequent travel-related choices? Korean Society of Intelligent Transportation Systems (KITS) Conference. October 24, 2024, South Korea.

41. Patrick, A., Y. Zhang. Identifying the Needs of Different Demographics and Trends. Presented at: The 104th Annual Meeting of the Transportation Research Board, January 5-9, 2025. Washington DC.

42. Polzin S. Trends in U.S. Travel Behavior: Insights and Implications Presentation at the 3rd Symposium on Activity-Based Modeling, Raitenhaslach, Bavaria, December 2024.

43. Trinidad, R., Ly, M., Wang Y., Zhang Y., & Cheng W. Vehicle Edge Computing For Future Intelligent Transportation Systems (ITS). (Poster), Presented at: The 104th TRB Annual Meeting, January 5-9, 2025. Washington DC.

44. Rahman, M.H., and A. Karner. Understanding Accessibility Sufficiency, Activity Participation, and Quality of Life: Evidence from Austin, Texas. Transportation Research Board (TRB) Annual Meeting, Washington, DC, January 2025.

45. Rezapour Fardin, F. and A. Conway. How Does Teleworking Influence Online Shopping and Home Delivery Activity?: Findings from Post-Pandemic New York City. TRB Annual Meeting, Washington, DC. January 7, 2025.

46. Robbennolt, D., A. Beliveau, and C.R. Bhat. An Investigation of Physical Participation Dissonance and Virtual Activity Participation. Transportation Research Board (TRB) Annual Meeting, Washington, DC, January 2025.

47. Robbennolt, D., A. Beliveau, I. Batur, R.M. Pendyala, P. Mokhtarian, A. Shaw, S. Polzin, A. Conway, C. Chen and C.R. Bhat, Transportation Heartbeat of America Survey Wave 1: Findings and Recommendations, 13th International Conference on Transport Survey Methods (ISCTSC 2025), Da Nang, Vietnam, March 2025.

48. Robbennolt, D., A.J. Haddad, and C.R. Bhat, A Rank-Based Model of Residential Location Preferences Before and After the COVID-19 Pandemic, Transportation Research Board (TRB) Annual Meeting, Washington, DC, January 2025.

49. Robbennolt, D., R.M. Pendyala, and C.R. Bhat, Data Collection, Weighting, and Modeling Techniques to Estimate Unbiased Population Parameters,13th International Conference on Transport Survey Methods, Da Nang, Vietnam, March 2025.

50. Robbennolt, D., S. Hardman, J. Firestone, and C.R. Bhat, A Model of Electric Vehicle Adoption and Motivating Reasons for Adoption, Invited Seminar, Department of Industrial Engineering, Bilkent University, Ankara, Turkey, March 2025.

51. Robbennolt, J., & Boyles S.D. Balancing mobility and power grid considerations with shared automated electric vehicles. Presented at the 2024 INFORMS Annual Meeting, Seattle, WA, October 2024.

52. Sendai, Japan, Resilience research at THINK lab: from human mobility to peer-to-peer resource sharing for community resilience, February 17, 2025, Tohoku University, Japan.

53. Sherafat, A., Ji, H., Zhang, Y., Cheng, W., Mora, O., and Cheng, C. Geometric-Aware 3D Object Detection for Traffic Signs. Presented at: The 104th Annual Meeting of the Transportation Research Board, January 5-9, 2025. Washington DC.

54. Simmonds, D., Inzunza, P.; Y. Zhang. Navigating Inequities: Mobility Challenges Faced by the Hispanic/Latino Population in Southern California. Presented at: The 104th TRB Annual Meeting, January 5-9, 2025. Washington DC.

55. Smith, B.V., D. Robbennolt, and C.R. Bhat. An Evaluation of the Long-Term Effects of the COVID-19 Pandemic on Public Transit Use. Transportation Research Board (TRB) Annual Meeting, Washington, DC, January 2025.

56. Ugurel, E., Huang, S., & Chen, C. (2025). Learning to generate synthetic human mobility data: a physics-regulated Gaussian process approach based on multiple kernel learning, 104th TRB Annual Meeting, Washington, DC.

57. Ugurel, E., Coenen, S., Chen, M., and Chen, C. (2025) Incident detection from novel data sources: leveraging satellite imagery alongside GPS traces, 104th TRB Annual Meeting, Washington, DC.

58. Wang, O., Li, Z., and Chen, C. (2025) The efficacy of decentralized disaster relief resource allocation within communities: the role of community-based sharing captains, 104th annual meeting of Transportation Research Board, Washington DC.

59. Yu, F., Batur, I., Haddad, A. J., Hennessy, E. M., Ocana, M. G. R., Chen, C., Zhou, X., Bhat, C. R., & Pendyala, R. M. A U-Shaped Paradigm: Understanding the Impact of Telecommuting on Public Transit Ridership Before and After the Pandemic. Presented at the 104th Annual Meeting of the Transportation Research Board, Washington, DC, January 5-9, 2025.

60. Zhang, M. and C. Peng, Mining E-Scooter Safety Policies and Plans Using GPT-4o and Latent Dirichlet Allocation (LDA) Modeling. Presented at the AAAI 2025 – AI for Urban Planning Workshop, Philadelphia, PA, March 2025.

61. Zhang, X., Li, X., Guo, Y., Qian, X., Zhao, C., and Peeta, S. (2025). Non-cooperative Urban Road Networks Perimeter Control with Extended Mean-field Reinforcement Learning. 104th TRB Annual Meeting, Washington, D.C., January 2025.

Books or other non-periodical, one-time publications: Book Chapters

1. Conway, A. (2024). "Accounting for Freight in Modern Urban Planning and Design" in Advances in Transport Policy and Planning (pp. 1–32). Ed. Lóránt Tavasszy, Michael Browne, Maja Piecyk. Elsevier.

2. Wang, C., Wang, Y. & Peeta, S. (2024). "Cooperative Roundabout Control Strategy for Connected and Autonomous Vehicles," Challenges in the Guidance, Navigation and Control of Autonomous and Transport Vehicles, Applied Sciences.

Other Publications Within Reporting Period

1. Polzin, S., Batur, I., and Pendyala, R.M. *Emerging Travel Behavior Insights from 2023 National Surveys*. Policy Brief, TOMNET-TBD University Transportation Centers. October 2024.

2. Polzin, S., Batur, I., and Pendyala, R.M., "Select Insights from 2023 National Transportation Data", Fall 2024 CTPP Status Report/Newsletter, November 2024.

Website(s) or other Internet site(s)

One of the center's significant products is the TBD website, which serves as a central hub for all information related to the Center's objectives and activities. The website includes dedicated sections for research projects, along with detailed descriptions, updates, and reports. It also houses data products and software and tools developed by TBD researchers. Additionally, the site provides a platform for sharing policy briefs, as well as disseminating TBD events and news to a global audience. Similar to previous reporting periods, the TBD website has been consistently maintained to reflect developments in TBD's research, technology transfer, education, workforce development, and outreach activities. During this reporting period, the Project #5 team also developed an affiliated web page through the ASU Future of Being Human initiative to document and promote project outputs, including articles, podcasts, and media engagements.

Technologies or Techniques (software codes and products)

As noted in prior progress reports, the TBD team at ASU has been heavily involved in the development and application of open-source tools that reflect model outputs of the TBD projects. In this reporting period, the ASU team began developing The Mobility Dashboard (TMD)—an open-source platform designed to

provide insights into travel episodes and patterns captured in the American Time Use Survey (ATUS). A beta version of the dashboard has been made publicly available. In the previous reporting periods, the ASU team released the Time Use, Travel, and Telework Dashboard (T3D) to the public. Additionally, the team updated two of their existing tools and made them available to the public: the synthetic population generator PopGen and the TOMNET Wellbeing Platform. While these tools are not described in detail here, interested readers are encouraged to visit the hyperlinked websites for further information. Additionally, R and Python code developed as part of TBD's transportation model estimation, implementation efforts, and data fusion procedures are being documented in various publications. When possible, these codes and methods are shared publicly through repositories such as GitHub (e.g., see the ASU team's GitHub page.

Furthermore, the TBD team at UW improved the Mobility Analysis Workflow (MAW) tool by adding functions to detect travel modes and infer home and work locations at the census block group level. The updated MAW, which processes and cleans app-based GPS data, is now publicly available on GitHub with detailed documentation. Additionally, the team developed a public dashboard using NREL OpenPATH data, showing travel metrics such as trip counts, trip length, and trip purposes, adjustable over time. Moreover, the TBD team at UT Austin also developed a prototype open-source port simulation model in Python, which will be made publicly available upon completion of Project #34.

Databases and Research Materials
In a number of TBD projects, integrated datasets have been developed (or are under development), using data fusion techniques to study the impact of attitudes on different transportation-related choices such as residential location choice, mode choice, vehicle ownership, and adoption of emerging mobility services and technologies. While some of the datasets are based on native survey data collection efforts undertaken by the TBD team, others have been assembled by integrating and fusing data that is already available in the public domain. All datasets assembled by TBD are being made publicly available (without personally identifiable information) via the TBD website. In the meantime, findings from the surveys have been disseminated to the community through webinars and research papers. Also, many TBD publications include applicable model specifications that can be used by practitioners to better model the recent changes in traveler behavior and values. A few specific instances of database and research materials development are as follows. The TBD team at Georgia Institute of Technology has published several datasets called ASPED (Audio Sensing for PEdestrian Detection). It is a compilation of large-scale audio and video data prepared for pedestrian detection using sound and video. ASPED consists of almost 2,600 hours of audio, more than 3.4 million continuous frames in video, and corresponding annotation of pedestrian count for each audio and video. More information is available here, here, and here. Additionally, the Transportation Heartbeat of America (THA) Survey data will also be made publicly accessible through a new dashboard integrated into the TBD Hub. This dashboard is planned to be developed in the upcoming reporting periods to expand the reach and impact of this important dataset. Table 5 provides a summary of the TBD metrics on software/data/models and number of journal publications.

Table 5. TBD Metrics on Products

Metric	Previous Period	This Period	Annual Total
Number of software/data/models	8	3	11
Number of journal publications	31	21	52

4. OUTCOMES
During this reporting period, the TBD Center made substantial progress across multiple fronts, advancing transportation knowledge, improving analytical methods, developing new research tools, and contributing to the education and development of the next generation of transportation professionals. Several projects expanded understanding of key transportation issues with direct implications for policy and practice. For example, Project #14 deepened insights into how changes in commuting behavior are associated with the rise in home delivery activity, highlighting that telecommuting, demographic characteristics (such as the presence of young children), and the security of home delivery options significantly influence delivery

patterns across different types of goods. Project #16 expanded the body of knowledge on sensing technologies for monitoring vulnerable roadway users (VRUs), offering a comprehensive review of infrastructure-based systems, connected vehicle technologies, and cooperative perception approaches. Similarly, Project #44 contributed new insights on how remote work impacts employment accessibility and mode choice, informing the design of more accessible and responsive transportation systems.

Several projects also contributed significantly to the advancement of transportation knowledge and practice. Projects #14, #15, and #16 delivered comprehensive evaluations on the applications of artificial intelligence to freight data synthesis, VRU detection, and human behavior prediction. These outputs offer actionable insights that can support improved freight planning, enhanced safety for vulnerable users, and the development of behavior-responsive transportation policies. Project #7, focusing on trends in time use and travel behaviors, produced policy briefs and national conference presentations, offering critical guidance to planners and policymakers navigating post-pandemic travel trends. In addition, Project #27 demonstrated practical methods for incorporating attitudinal variables into travel demand models, providing new tools to better forecast evolving traveler behaviors and support data-driven planning efforts.

Substantial progress was also made in developing and disseminating new research tools and datasets. The University of Washington team enhanced the MAW tool by adding functions to detect travel modes and infer home and work locations, making it a more powerful platform for processing and analyzing app-based GPS traces. MAW is now publicly available through GitHub with full user documentation. In parallel, the TBD Hub expanded with the launch of TMD, and plans are underway to release the first-wave data from the THA Survey through a dedicated dashboard, further democratizing access to important national-level transportation and mobility trends data.

Workforce development and education remained central to the Center's mission. Several projects actively engaged undergraduate and graduate students across engineering, urban planning, and computer science disciplines, equipping them with interdisciplinary research skills and strengthening the pipeline of transportation professionals. For example, Projects #13, #15, and #16 provided computer science students with exposure to transportation applications, while Project #42 involved graduate students in GPS data analysis and tool development. Student-led research achievements were notable, with multiple papers presented at major national conferences such as the Transportation Research Board (TRB) Annual Meeting and the International Scientific Committee on Transport Survey Methods (ISCTSC), reinforcing the Center's role in nurturing the future transportation workforce.

Finally, the Center remained committed to making its research products widely accessible. Public datasets, including the ASPED pedestrian detection dataset and synthesized travel behavior data products, were curated, expanded, and shared openly to support broader research and practice. All processed datasets and software codes used in the TBD Hub dashboards, such as T3D and TMD, were also made publicly available. In addition, model specifications and software codes developed through several projects were shared via public repositories to facilitate enhancements to activity-based models (ABMs) and support broader modeling efforts. Collectively, these efforts enhance transparency, democratize access to transportation data and tools, and enable broader engagement with TBD research outputs.

5. IMPACTS
What is the impact on the effectiveness of the transportation system?
TBD's research activities have generated significant insights and tools that are enhancing the operations and effectiveness of the transportation system. TBD Hub has expanded access to critical national datasets through new dedicated dashboards such as T3D and TMD, which provide policymakers, planners, and researchers with user-friendly access to trends in time use, travel, and telework patterns, enabling a more data-driven and adaptive approach to transportation planning. By helping decision-makers better anticipate emerging trends in travel behavior and demand, TBD Hub is contributing to a more resilient and responsive transportation system. Meanwhile, the first wave of the THA Survey has generated a nationally representative dataset on evolving travel behaviors, offering early insights to guide future policy and operational strategies. Further, Project #42 introduced a powerful methodology for processing app-based

GPS data to assess the impacts of urban infrastructure innovations, such as outdoor dining areas and pedestrianized streets, on mobility patterns, accessibility, and traffic operations. Project #44's findings on telework and accessibility have directly supported the design of demand management strategies, such as WFH incentives and staggered work hours, intending to alleviate congestion and promote accessibility.

What is the impact of technology transfer on industry and government entities, on the adoption of new practices, or on research outcomes which have led to initiating a start-up company?

TBD's research outcomes are already influencing the adoption of new practices across survey design, transportation planning, and technology deployment. The standardized attitudinal components developed for the THA Survey have been adopted in some major data collection efforts, including the Georgia add-on to the NextGen National Household Travel Survey (NHTS) and the Puget Sound Regional Household Travel Survey. This adoption across multiple regions ensures that future regional travel models will better integrate behavioral and attitudinal factors, strengthening the connection between research and practice.

Projects #22 and #26 have advanced the development of behavioral intervention tools to promote sustainable travel, including the piloting of app-based systems that integrate trip tracking, gamification, and targeted messaging. These projects offer a replicable platform for future field experiments aimed at encouraging behavior change. Additionally, Project #5 has continued to expand its public engagement through media commentary, the Modem Futura podcast, and the Future of Being Human Substack platform, raising broader awareness of transformative transportation trends and emerging societal impacts. All these efforts illustrate how TBD research is supporting knowledge transfer to both industry and the wider public.

What is the impact on the body of scientific knowledge?

TBD's research is making important contributions to advancing the body of scientific knowledge in travel behavior, travel demand, urban analytics, and mobility systems research. Through the TBD Hub, which brings together multiple large-scale national datasets—including ATUS, NHTS, ACS, CES, and VIUS—through a suite of dedicated dashboards, the Center has established a new model for democratizing access to comprehensive travel behavior and mobility data. Each dashboard independently processes, analyzes, and visualizes specific aspects of these datasets, offering users tools to explore patterns in time use, travel behaviors, household transportation expenditures, socio-demographic characteristics, and freight movements. Complementing these efforts, findings from the first wave of the Transportation Heartbeat of America (THA) Survey will provide fresh empirical evidence on evolving post-pandemic travel behaviors, emerging values, and shifts in accessibility patterns across diverse population groups. Together, these initiatives are expanding the empirical foundations needed to better understand contemporary transportation challenges and opportunities. By making these resources publicly accessible, TBD supports interdisciplinary research that advances understanding of transportation accessibility, travel behavior dynamics, and system efficiency, laying a stronger foundation for improved demand modeling, infrastructure investment decisions, and evidence-based policy development.

In addition to the two flagship endeavors, other TBD projects have also made significant contributions. Across multiple research efforts, TBD teams have extended methodological frontiers and generated new insights. For example, Project #42 (MAW) has introduced new techniques for analyzing the impacts of urban infrastructure changes on mobility patterns and transportation system performance. Project #44 has advanced frameworks for assessing how telecommuting reshapes employment accessibility and mode choice decisions. Project #27 has demonstrated practical methods for incorporating attitudinal variables into travel behavior models, offering strategies to improve predictive accuracy and policy relevance. Meanwhile, Project #46's innovations in imputing socio-demographic attributes onto mobile trajectory data have opened new pathways to examine differential impacts of infrastructure or policy changes that traditional data sources cannot adequately capture. Together, these efforts are strengthening both theoretical foundations and applied methods for addressing evolving transportation challenges.

Table 6 provides TBD metrics on the Center's broader impacts, including the number of new agencies adopting TBD data and tools, as well as Google Scholar citation counts for all publications by core researchers from 2023 to date.

Table 6. TBD Metrics on Impacts

Metric	2023	2024	2025 (+)	Total
Number of new agencies adopting TBD data/tools	0	2	1	3
Citations of core TBD researchers (Google Scholar)	8,100	8,870	2,637	19,607

What is the impact on transportation workforce development?

TBD has continued to play a vital role in developing the future transportation workforce by providing students with meaningful, hands-on research and training opportunities. Across consortium universities, undergraduate and graduate students have engaged in a wide range of activities—from survey design and data collection to machine learning applications, dashboard development, and GPS mobility analysis. Students working on flagship projects such as the THA Survey, TMD, and behavioral intervention platforms gained valuable skills in transportation research, statistical modeling, and public engagement. Projects such as #42 provided direct experience with large-scale GPS data processing, transportation systems evaluation, and urban mobility analysis, while students engaged in Projects #26 and #22 gained interdisciplinary training through app development and field experimentation. Through webinars, seminars, internships, and agency collaborations, TBD has created a pipeline of early-career transportation researchers and practitioners, emphasizing interdisciplinary thinking, technical skills, and sensitivity to behavioral, sustainability, and accessibility issues. Multiple students supported by TBD received national awards and presented their work at major venues such as TRB and ISCTSC, demonstrating the Center's strong impact on shaping the next generation of transportation leaders.

6. CHANGES/PROBLEMS

Changes in approach and reasons for change

During the reporting period, Project #22 expanded its scope of behavioral interventions. The original design was broadened to encompass 54 distinct message types, covering gamification elements, health and environmental benefits, and multiple framing strategies. Prior to launching large-scale randomized control trials, the project team conducted a series of small-scale pilot surveys to refine the clarity, relevance, and framing of the messages. Results highlighted the need for a broader, more nuanced intervention set to effectively capture heterogeneous traveler motivations. Consequently, the project scope expanded beyond initial expectations to include a wider variety of behavioral messaging strategies. Additionally, while simulation and optimization modeling work was methodologically completed, their full integration was deferred to Stage 2 (Project #26) to better align the framework with real-world behavioral data.

Actual or anticipated problems or delays and actions or plans to resolve them

The expansion of Project #22's scope led to slight delays. However, the additional activities strengthened the project's scientific rigor and practical applicability. The decision to defer integration of the simulation-optimization framework into Project #26 ensures that final deliverables will be more closely aligned with observed behaviors. No significant long-term project risks are anticipated as a result of these adjustments.

Changes that have a significant impact on expenditures

Nothing to report.

Significant changes in use or care of human subjects, vertebrate animals, and/or biohazards

Nothing to report.

Change of primary performance site location from that originally proposed

Nothing to report.