




UTC Semi-Annual Progress Report (SAPR#14)



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INTRODUCTION

This document constitutes the UTC Semi-Annual Progress Report (SAPR) for the Center for Teaching Old Models New Tricks (TOMNET), a Tier 1 University Transportation Center sponsored by the US Department of Transportation. The center commenced operation on November 30, 2016, and has been actively engaged in research, education, and technology transfer ever since. This SAPR, the penultimate produced under this grant, covers work accomplished, collaborations with academic, government, and industry partners, and the center outputs, outcomes, and impacts for the period of October 1, 2023, through March 31, 2024.

In the last reporting period, it is worth noting that TOMNET has been granted a one-year, no-cost time extension (NCE), extending TOMNET's grant validity through September 30, 2024. The prolonged duration of the COVID-19 pandemic significantly affected the pace of progress on several projects. This has partly stemmed from challenges associated with the administration of surveys, the ability of staff to conduct meetings and execute project tasks and technology transfer activities in person, disruptions in the availability of national-level data sets that supported the Center's research and delays due to slower than expected COVID recovery that affected the ability to gather data necessary to understand post-COVID conditions. Thus, this one-year grant extension provides the necessary time for the completion of several research projects and initiatives as well as key technology transfer activities that will facilitate the dissemination of research results for recently completed and in-progress projects.

1. ACCOMPLISHMENTS

The TOMNET University Transportation Center's mission is to advance the state-of-the-art and state-of-the-practice in transportation demand modeling by collecting and incorporating data about human attitudes, behavioral processes, perceptions, values, and preferences in travel models. The center collects comprehensive datasets by administering in-depth surveys regarding users' attitudes, perceptions, and behaviors in the present and the future, considering all the recent and expected transformative changes in transportation systems. Additionally, the center leverages a number of analysis methods and tools to advance its mission, including the application of data fusion and machine learning algorithms to integrate datasets (e.g., third-party or external/secondary datasets) with disparate information – thus facilitating the development of comprehensive models of travel demand that reflect the effects of human attitudes.

What are the major goals of the program?

Previous Semi-Annual Progress Reports (SAPR) provide information about the goals, and hence the information is not repeated in this report. The *research* mission of TOMNET is to advance the science of activity-travel behavior modeling by developing new methods for incorporating the effects of people's attitudes, values, preferences, and perceptions in transportation demand forecasting models. The *education* and *workforce development* mission of TOMNET is to train a transportation planning and modeling workforce for the future that is capable of solving complex multi-disciplinary challenges confronting the profession. In addition, a critical mission of TOMNET is to attract a *diverse body* of students into the transportation profession by undertaking a number of outreach activities that would attract students from diverse backgrounds to the profession. Finally, TOMNET aims to empower the current transportation workforce by offering a number of workshops, continuing education (short) courses, symposia, and professional development seminars/webinars on cutting-edge topics and methods that help professionals address emerging and complex transportation issues. The *technology transfer* mission of TOMNET is to disseminate information about research findings, methods, tools, and data to a global audience of transportation professionals, students, researchers, policymakers, and the broader public. The knowledge gained not only helps move advanced data fusion approaches and modeling

methods into practice but also builds a richer understanding of travel behavior which supports the public and private sector stakeholders making policy and investment decisions about transportation.

What was accomplished under these goals?

Within this reporting period, TOMNET researchers made progress on and completed several research projects. Projects launched in either previous years or the current year have been completed (54 projects) or are continuing into their subsequent phases (5 projects). The list of all active and completed TOMNET projects is provided in Table 1 with the active period for each project (total of 59 projects). **Additionally, all project entries into the RiP and/or TRiD databases have been completed.** The reports for the completed projects have been distributed in accordance with the Grants Deliverables and Reporting Requirements for FAST Act UTC Grants. The TOMNET website [project page](#) is regularly updated to provide information and deliverables for the research projects, categorized by year and lead university. The reports for **ongoing** projects will be finalized and posted on TRiD and the TOMNET website within the next reporting period.

Table 1. TOMNET Research Projects

Project Topic/Title	Institution (PI)	Active Period	Status
1* The Induced Demand Implications of Alternative Adoption Modalities of Automated Vehicles	ASU (Batur)	2023 - Present	
2* Understanding the Impacts of Extreme Heat on Human Activity-Mobility and Time Use Patterns	ASU (Batur)	2023 - Present	
3 Does Ridehailing Use Affect Vehicle Ownership or Vice Versa? An Exploratory Investigation of the Relationship Using a Latent Market Segmentation Approach	ASU (Batur)	2022 - 2023	✓
4* An Analysis of Changes in Time Use and Activity Participation in Response to the COVID-2019 Pandemic in the United States: Implications for Well-being	ASU (Polzin)	2022 - 2023	✓
5 Access to Food in a Severe Prolonged Disruption: The Case of Grocery and Meal Shopping During the COVID-19 Pandemic	ASU (Pendyala)	2022 - 2023	✓
6 A Multidimensional Analysis of Willingness to Share Rides in a Future of Autonomous Vehicles	ASU (Batur)	2022 - 2023	✓
7 Evolution of Mode Use Due to COVID-19 Pandemic in the United States: Implications for the Future of Transit	ASU (Pendyala)	2022 - 2023	✓
8* Assessing the Impact of Ridehailing Service Use on Bus Ridership: A Joint Modeling Framework Accounting for Endogeneity and Latent Attitudes	ASU (Pendyala)	2021 - Present	✓
9 The Influence of Mode Use on Level of Satisfaction with Daily Travel Routine: A Focus on Automobile Driving in the United States	ASU (Pendyala)	2021 - 2022	✓
10 The Stability of Transport-Related Attitudes over Time: A Case Study During COVID-19	ASU (Salon)	2021 - 2022	✓
11 Expected Change in US Air Travel After the COVID-19 Pandemic	ASU (Khoeini)	2020 - 2022	✓
12 Investigating Attitudinal and Behavioral Changes in U.S. Households Before, During, and After the COVID-19 Pandemic	ASU (Salon)	2020 - 2022	✓
13 How Will Use of Autonomous Vehicles for Running Errands Affect Future Autonomous Vehicle Adoption and Ownership?	ASU (Batur)	2020 - 2022	✓
14 Interaction of Familiarity, Safety Perceptions, and Willingness to Use Autonomous Vehicles in A Structural Equation Modeling Framework	ASU (Khoeini)	2020 - 2022	✓
15 Investigating the Contributing Factors to Willingness to Share Automated Vehicles with Gender Focus	ASU (Khoeini)	2020 - 2022	✓
16 The Effect of Survey Methodology on The Collection of Attitudinal Data	ASU (Pendyala)	2020 - 2022	✓
17 Real-Time Transportation Social Media Analytics Using Pulse (Pulse-T)	ASU (Kandala)	2019 - 2021	✓
18 Consumer Attitudes and Behavioral Implications in the New Era of Shared Mobility	ASU (Zhang)	2019 - 2021	✓

Project Topic/Title	Institution (PI)	Active Period	Status
19 Emerging Approaches to Autonomous Vehicles in Transportation Policy and Planning	ASU (Miller)	2019 - 2021	✓
20 Teaching the Travel Demand Flow Estimation Models: A New Deep-Learning Approach Using Multi-Source Data	ASU (Zhou)	2019 - 2021	✓
21 Causal Relationships Between Transportation Attitudes and Behaviors: Uncovering Latent Segments within a Heterogeneous Population	ASU (Pendyala)	2019 - 2021	✓
22* The Impact of Non-Transportation Attitudes, Preferences, and Personality Characteristics on Residential Location and Travel Choices	ASU (Salon)	2019 - Present	⚙️
23 Development of an Integrated Model System of Transport and Residential Energy Consumption	ASU (Pendyala)	2019 - 2022	✓
24 Attitudes Towards Emerging Mobility Options and Technologies – Phase 3: Survey Data Compilation and Analysis for Phoenix, AZ	ASU (Khoeini)	2019 - 2021	✓
25 How Important are Attitudes in Travel Behavior Models? A Comprehensive Review	ASU (Salon)	2018 - 2019	✓
26 Heterogeneity in the Relationship Between the Built Environment and Bicycling	ASU (Salon)	2018 - 2019	✓
27 The Role of Transport in How We Choose Where to Live: A Qualitative Investigation of Residential Location Choice in the Phoenix, AZ Region	ASU (Salon)	2018 - 2019	✓
28 A Comparison of Vehicle Miles of Travel Between Two Generations: Millennials versus Generation X	ASU (Pendyala)	2018 - 2019	✓
29* Attitudes Towards Emerging Mobility Options and Technologies – Phase 2: Data Collection in Phoenix, AZ	ASU (Khoeini)	2018 - 2019	✓
30 Assembling Integrated Data Sets for Analyzing Connections between Travel Behavior, Attitudes, and the Built Environment	ASU (Salon)	2017 - 2018	✓
31 An Integrated Model of Daily Activity-Travel Behavior and Well-Being	ASU (Pendyala)	2017 - 2023	✓
32 Attitudes Towards Emerging Mobility Options and Technologies – Phase 1: Survey Design for Phoenix, AZ	ASU (Khoeini)	2017 - 2018	✓
33 Drivers' Attitudes Toward Rerouting: Impacts on Network Congestion	GT (Laval)	2021 - 2023	✓
34* What is the New Normal? An Analysis of Post-COVID-19 Commute and Work Patterns	GT (Mokhtarian)	2021 – 2023	✓
35 Mode Substitutional Patterns of Ridehailing and Micro-Mobility Services	GT (Circella)	2020 – 2023	✓
36 Response Willingness in Consecutive Travel Surveys	GT (Mokhtarian)	2020 - 2021	✓
37 Combining Disparate Surveys across Time to Study Satisfaction with Life	GT (Mokhtarian)	2019 - 2020	✓
38* Heterogeneous Preferences for Activities While Traveling in Autonomous Vehicles: Relationships with Travel Contexts and Attitudes	GT (Circella)	2019 - Present	⚙️
39 Latent Vehicle Type Propensity Segments: Considering the Influence of Household Vehicle Fleet Structure	GT (Mokhtarian)	2018 - 2019	✓
40* Attitudes Towards Emerging Mobility Options and Technologies – Phase 2: Data Collection in Atlanta, GA	GT (Circella)	2018 - 2019	✓
41 An Investigation of the Contribution of Targeted Marketing Data to the Prediction of Attitudes	GT (Mokhtarian)	2017 - 2019	✓
42 Attitudes Towards Emerging Mobility Options and Technologies – Phase 1: Survey Design for Atlanta, GA	GT (Circella)	2017 - 2018	✓
43 An Empirical Assessment of the Role of Attitudes and Identification in Safety Research	USF (Mannering)	2020 - 2021	✓
44 Addressing Potentially Missing Relevant Information on Attitudes and Other Behavioral Elements as Unobserved Heterogeneity in Highway Safety Studies	USF (Mannering)	2020 - 2022	✓
45 Exploration of the Relationships between Leisure Activity Participation Frequency and Social Capital	USF (Maness)	2020 - 2022	✓
46 An Exploratory Analysis to Estimate the Value of Free Charging Bundle in Electric Vehicle Purchases	USF (Maness)	2020 - 2021	✓

Project Topic/Title	Institution (PI)	Active Period	Status
47 An Exploration of Contemporary Issues in Highway Safety, Evolving Transportation Alternatives, and Activity and Travel Behavior Modeling	USF (Maness)	2019 - 2020	✓
48 Attitudes Towards Emerging Mobility Options and Technologies – Phase 3: Survey Data Compilation and Analysis for Tampa, FL	USF (Maness)	2019 - 2022	✓
49 Emerging Econometric and Data Collection Methods for Capturing Attitudinal and Social Factors in Activity and Travel Behavior Modeling	USF (Mannering)	2018 - 2019	✓
50* Attitudes Towards Emerging Mobility Options and Technologies – Phase 2: Data Collection in Tampa, FL	USF (Maness)	2018 - 2019	✓
51 Investigation of the Role of Attitudinal Factors on Adoption of Emerging Automated Vehicle and Vehicle Safety Technologies	USF (Mannering)	2017 - 2018	✓
52 Attitudes Towards Emerging Mobility Options and Technologies – Phase 1: Survey Design for Tampa, FL	USF (Maness)	2017 - 2018	✓
53* Incorporating Mobility on Demand into Public Transit in Suburban Areas: A Comparative Evaluation of Cost-Effectiveness	UW (Shen)	2022 - Present	⚙️
54 Grid-Aware Robust Fast-Charging Station Deployment for Electric Buses Under Socioeconomic Considerations	UW (Zhao)	2022 - 2023	✓
55 Mobility Analysis Workflow (MAW): An Accessible, Interoperable, and Reproducible Container System for Processing Raw Mobile Data	UW (Chen)	2021 - 2022	✓
56 Attitudes and Trust in Leveraging Integrated Sociotechnical Systems for Enhancing Community Adaptive Capacity – Phase IV	UW (Chen)	2020 - 2021	✓
57 Attitudes and Trust in Leveraging Integrated Sociotechnical Systems for Enhancing Community Adaptive Capacity – Phase III	UW (Chen)	2019 - 2020	✓
58 Attitudes and Trust in Leveraging Integrated Sociotechnical Systems for Enhancing Community Adaptive Capacity – Phase II	UW (Chen)	2018 - 2019	✓
59 Attitudes and Trust in Leveraging Integrated Sociotechnical Systems for Enhancing Community Adaptive Capacity – Phase I	UW (Chen)	2017 - 2018	✓

ASU = Arizona State University; GT = Georgia Institute of Technology; USF = University of South Florida; UW = University of Washington. ✓= Accomplished; ⚙️ =In progress; * = Narrative provided below.

TOMNET center’s topical expertise and center goals were very conducive to allowing the center’s activities to address emerging issues, specifically, the impacts of COVID on travel behavior. This capability has enabled critical projects that add significant insights into emerging travel behaviors and support industry efforts to update planning and modeling methods and tools to respond to post-COVID conditions. Those activities, including numerous presentations and publications, are enumerated in this report.

A Sampling of Progress on Active and Recently Completed Research Projects

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: Induced Demand Implications of Alternative Adoption Modalities of Automated Vehicles
PI: Irfan Batur (ASU) **Co-PI:** Ram Pendyala (ASU) – in collaboration with TBD, Univ of Texas at Austin

Progress: There is considerable concern about the induced demand implications of the advent of automated vehicles (AVs). In a future with AVs, people may undertake more trips, shift away from alternative modes of transportation, increase their trip lengths, and even consider relocating to more distant residential areas where land is cheaper. This is because both drivers and passengers will be relieved of the driving task, which makes car travel more convenient and less burdensome. This research project recognizes that induced demand resulting from the adoption of AVs is inter-related to the adoption modality. AVs may be purchased and owned personally or used as a mobility-on-demand service (or both). Launched within the previous reporting period, this project aims to shed light on the relationship between AV adoption modality and the likelihood of making additional trips in an AV future. The relevant literature was reviewed and a joint model of two outcome variables was estimated, wherein AV adoption

modality affects the likelihood of making additional trips. During this reporting period, the manuscript resulting from this project was presented at the 2024 TRB Annual Meeting and during an invited talk at Clemson University. In the next reporting period, the team will refine the manuscript based on feedback received during these events and submit it to the journal *Transport Policy* for publication consideration.

Project #2: Understanding the Impacts of Extreme Heat on Human Activity-Mobility and Time Use Patterns | **PI:** Irfan Batur (ASU) **Co-PI:** Ram Pendyala (ASU)

Progress: There is growing interest in understanding the interaction between weather and transportation and the ability of communities and the nation's infrastructure to withstand extreme conditions and events. In recent years, extreme heat conditions are being felt across the globe with increasing frequency. This research project aims to provide detailed insights into how people adjust and change their activity-travel patterns and time use behavior in the face of extreme heat conditions. This project was launched within the previous reporting period. So far, the project team has conducted an extensive literature review and merged the American Time Use Survey (ATUS) data series with weather data to facilitate a comparison of activity-mobility patterns between extreme heat days and non-extreme days. Additionally, the team has estimated a series of models to understand the impact of extreme heat, even after accounting for other variables. During this reporting period, the manuscript produced by this project was presented at both the 2024 TRB Annual Meeting and the 2024 PSR Annual Congress and gave an invited talk at the University of Texas at Arlington. The manuscript was also submitted to the *Transportation Research Part D* journal for potential publication. After receiving reviewer comments and requests for revisions, the project team refined and resubmitted the manuscript in this reporting period, anticipating its publication following this revision. Should further comments be received, the team plans to address them in the next reporting period and will continue to disseminate the project's findings through various channels.

Project #4: An Analysis of Changes in Time Use and Activity Participation in Response to the COVID-19 Pandemic in the United States: Implications for Well-being
PI: Steve E. Polzin (ASU) **Co-PI:** Irfan Batur (ASU)

Progress: This research project aims to investigate the well-being implications of changes in activity-travel and time use patterns brought about by the COVID-19 pandemic. The study uses American Time Use Survey (ATUS) data from 2019 and 2020 to assess changes in activity-travel and time use patterns. It applies two methods – a wellbeing scoring method and a time poverty analysis method – to evaluate the impacts of these changes on society. The findings reveal how individuals allocated their time across a limited set of activities available during the pandemic, as well as whether individuals experienced diminished (or improved) well-being as a result of changes in their activity time use patterns during the pandemic. In the previous reporting periods, the research team presented the project's findings at the 2023 TRB Annual Meeting and successfully [published](#) the manuscript in the *Transportation Research Record* journal. Within this reporting period, the team continued to disseminate the project findings and gave an invited talk at the University of Texas at Arlington.

Project #8: Assessing the Impact of Ridehailing Service Use on Bus Ridership: A Joint Modeling Framework Accounting for Endogeneity and Latent Attitudes
PI: Ram Pendyala (ASU) **Co-PI:** Sara Khoeini (ASU) (collaboration with D-STOP, Univ of Texas at Austin)

Progress: Transit ridership has been on the decline for several years. One key contributing factor is the rise of ridehailing service usage and its impact on transit use. This study provides a comprehensive and holistic assessment of the impacts of ridehailing service use on transit ridership while controlling for a host of socio-economic, demographic, and attitudinal factors. The study utilizes the TOMNET's T4 Survey dataset. Study results indicate that ridehailing use frequency is significantly associated with a decrease in bus use, suggesting that ridehailing serves as a substitute for bus use (more than it serves as a

complement). The findings suggest that transit agencies need to explore pathways towards leveraging ridehailing services to better complement transit usage. The team presented the study findings on several occasions previously, including at the 2022 TRB annual meeting. Within this reporting period, the team continued to disseminate the project findings and gave an invited talk at Clemson University. Following feedback received during these presentations, the team has also been working on improving the manuscript and plans to submit it to *Transport Policy* for publication in the next period.

Project #22: The Impact of Non-Transportation Attitudes, Preferences, and Personality Characteristics on Residential Location and Travel Choices | **PI:** Deborah Salon (ASU), **Co-PI:** Hue-Tam Jamme (ASU)

Progress: This project aims to assess how non-transportation housing preferences impact transportation choices, especially car ownership and use. The research is based on an original national survey with over 2000 respondents collected in fall 2022. During this reporting period, the team continued to refine the three manuscripts drafted in the last period, and will submit them for publication in the next few weeks. The topics include interest in car-free living, the correlation between car dependence and life satisfaction, and how parents' travel to school affects their children's current school travel mode. The research team gave two presentations at the ACSP (urban planning) conference, and PI Salon gave one invited talk based on this work at [the Institute of Transportation Studies at UC Davis](#). The project so far has gone in a different direction from the original title. The team did conduct some analysis specifically aiming to identify the impact of non-transportation attitudes and preferences on home location and travel choices, but the three manuscripts discussed above have been the research team's priority to complete first because the team thinks those findings are larger contributions to the literature at this point. The team plans to return to this question with these data after the other manuscripts are submitted for publication.

Projects #29 #40 #50: Attitudes Towards Emerging Mobility Options and Technologies (T4 Survey)
PI: Sara Khoeini (ASU), Giovanni Circella (GT), Michael Maness (USF)
Co-PI: Ram Pendyala (ASU), Deborah Salon (ASU), Patricia Mokhtarian (GT), Fred Mannering (USF)

Progress: Survey design, sample recruitment, data collection, data cleaning and weighting, and dissemination of initial results have all been completed during the 2017-2020 time period. During the reporting period, the research team continued work on data analysis and behavioral choice modeling, presenting the results at various venues and writing scientific papers. The project [webpage](#) reflects all of the activities and outputs related to the TOMNET Transformative Technologies in Transportation (T4) Survey products. Further analysis of T4 survey data has been continuing (projects #1, #3, #6, #8, #9, #13, #14, #15, #16, #35, and #38 in Table 1); these efforts are in progress or have been completed during this reporting period. The resulting manuscripts were presented at various occasions (including the 2024 TRB Annual Meeting) and they are either published previously or in the process of being published in various prestigious journals. Specifically, in this reporting period, the T4 Survey dataset has been made publicly available through the ASU Library Research Data Repository, so that the data will assist researchers and others in studying various questions related to emerging mobility options and technologies.

Project #34: What is the New Normal? An Analysis of Post-COVID-19 Commute and Work Patterns
PI: Patricia Mokhtarian (GT) **Co-PI:** Giovanni Circella

Progress: This project is partially funded through UTC match funding provided by the Georgia Department of Transportation (GDOT); however, TOMNET funding is also being used, to augment the sample size and to enable launching the survey in a timely manner despite a 9-month delay in receiving the GDOT funding. The study addresses a number of questions associated with changes in telework adoption and travel patterns on the "back side" of the COVID-19 pandemic (if not yet, at the time of data collection, completely post-COVID), and intentions to continue to work remotely in the future. To that end, the

project team designed and fielded an online survey of employed Georgia residents. Data collection closed on June 30, 2022, and netted around 1,900 responses after data cleaning. The sample has been weighted to be representative of the employed Georgia population with respect to 10 variables. The 166-page final report was completed during this reporting period and made available on the Center’s website.

Project #38: Heterogeneous Preferences for Activities While Traveling in Autonomous Vehicles: Relationships with Travel Contexts and Attitudes
PI: Giovanni Circella **Co-PI:** Patricia Mokhtarian (GT)

Progress: Although the literature on autonomous vehicles (AVs) has been growing with a focus on adoption, expected changes in travel behavior, and travel demand and land use in the future, few studies have analyzed envisioned activities in AVs, which will affect all those outcomes at the micro level. To address this gap, this study examines preferred activities AVs, and especially their heterogeneity. In doing so, it uses the T4 survey that was collected in four regions of the southern United States from June 2019 to March 2020. A latent-class cluster analysis (LCCA) enables us to identify a few distinctive combinations of preferred in-vehicle activities, separately for one group of respondents with respect to hypothetical alone trips (N=1,995) and for another group with respect to family trips (N=1,381). In sum, this study investigates a wide range of in-vehicle activities (including the option of not to ride in an AV), identifies groups of activities preferred together, and explains respondents’ choices with respect to various attitudes and travel contexts. The study is essentially complete, and the final report will be submitted in the next reporting period.

Project #53: Incorporating Mobility on Demand into Public Transit in Suburban Areas: A Comparative Evaluation of Cost-Effectiveness | **PI:** Qing Shen (UW) **Co-PI:** Cynthia Chen (UW)

Progress: This research project aims to develop a framework for comparing the cost-effectiveness of transit services incorporated with mobility-on-demand (TIMOD) to fixed-route bus transit, individual car commuting, and commercial ride-hailing services. The goal is to provide insights into the potential benefits and trade-offs of introducing TIMOD services in suburban areas. During this reporting period, to estimate the cost of TIMOD trips, the research team conducted data collection and analysis within two Metro Flex service areas (representing TIMOD services in the Seattle area) characterized by distinct built environments. The team developed a transportation simulation procedure that estimates travel times and costs for the alternative modes and essentially compared the costs of alternative modes to that of TIMOD. Additionally, the team authored a research paper that was presented at the 2024 TRB Annual Meeting. In the next reporting period, the team plans to incorporate equity considerations into the cost-effectiveness analytical framework by assessing the net equity impact of TIMOD and alternative scenarios for various groups. Ultimately, the project's findings will be disseminated through journal paper(s) and integrated into the dissertation of a PhD student funded by this project.

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

In the *education* and *workforce development* domain, all of the TOMNET partners offered a number of undergraduate and graduate courses at their respective institutions during the Winter and Spring of 2024. Table 2 offers a detailed summary of the courses offered by faculty members closely affiliated with the TOMNET center. It should be noted that there are many additional transportation-related courses taught at each institution at both undergraduate and graduate levels; however, the scope of activities reported in this SAPR is limited to the activities of faculty members who comprise the *core* group of TOMNET who are *deeply engaged* in advancing the activities and mission of the center.

Table 2. Courses Offered by Core Faculty Members of TOMNET (Winter & Spring 2023)

Semester	Course Level	Course No	Course Title	No	Instructor	Unit
Arizona State University						
Spring 24	Grad	CEE 579	Transportation Data Collection and Analysis Methods	11	Pendyala	SSEBE
Spring 24	Grad	CEE 598	Traffic Flow Theory	9	Zhou	SSEBE
Spring 24	Undergrad	CEE 372	Transportation Engineering	77	Zhou	SSEBE
Spring 24	Undergrad/Grad	PUP 430/ 550	Transportation Planning and the Environment	89	Salon	SGSUP
Spring 24	Undergrad	PUP/GIS 394	Introduction to Data for Urban Planners and Geographers	12	Salon	SGSUP
Georgia Institute of Technology						
Spring 24	Undergrad	CEE 3770	Statistics & Applications	42	Mokhtarian	CEE
Spring 24	Grad	CEE 6632	Simulation in Transport	11	Laval	CEE
University of South Florida						
Spring 24	Grad	TTE6308	Statistical and Econometric Methods II	2	Mannering	CEE
University of Washington						
Winter 24	Grad	URBDP 532	Current Topics in Transportation Planning and Policy	20	Shen	URBDP
Winter 24	Grad	INDE 599	Special Topics In Industrial Engineering	9	Zhao	ISE
Winter 24	Grad	CET512	Transportation Data Collection	22	Chen	CEE
Spring 24	Undergrad	CEE415	Machine Learning for Civil Engineers	15	Jia	CEE

Notes: SSEBE = School of Sustainable Engineering and the Built Environment; SGSUP = School of Geographical Sciences and Urban Planning; CEE = Civil and Environmental Engineering; URBDP = Urban Planning; ISE = Industrial and Systems Engineering.

In addition, TOMNET faculty supervised several students and post-doctoral scholars, providing them guidance and mentorship necessary to pursue independent research and discovery or secure positions in academia or government and industry. Students currently engaged in TOMNET related research and education activities are listed in Table 3. Besides graduate students pursuing Master’s and PhD degrees, the TOMNET consortium engages undergraduate students in various research endeavors in an effort to provide research experiences for undergraduate students and inspire them to pursue advanced studies and a career in transportation systems engineering and planning.

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

Name of Scholar	Level	Major/ Unit	Supervisor/ Advisor
ARIZONA STATE UNIVERSITY			
Eleanor Hennessy	Postdoc	SSEBE	Pendyala
Roberto Dimas Valle	PhD Student	SSEBE	Pendyala
Fan Yu	PhD Student	SSEBE	Pendyala
Victor O. Alhassan	PhD Student	SSEBE	Pendyala
Miguel Rodriguez Ocana	MS Student	SSEBE	Pendyala
Roshan Varghese	MS Student	Comp Science	Pendyala
Ashwath Bhat Laxminarayana	MS Student	Comp Science	Pendyala
Nicole Corcoran	PhD Student	SGSUP	Salon
Rababe Saadaoui	PhD Student	SGSUP	Salon
GEORGIA INSTITUTE OF TECHNOLOGY			
Jason Soria	Postdoc	CEE	Mokhtarian
Seung-Eun (Katy) Choi	PhD Student	CEE	Mokhtarian
Ilsu Kim	PhD Student	CEE	Mokhtarian
UNIVERSITY OF SOUTH FLORIDA			
Trang Luong	Graduate Student	CEE	Maness
Divyamita Mishra	Graduate Student	CEE	Maness
Tung Vo	Graduate Student	CEE	Maness
Eren Yuksel	Graduate Student	CEE	Mannering
UNIVERSITY OF WASHINGTON			
Lamis Ashour	PhD Student	UDP	Qing Shen
Mingming Cai	PhD Student	UDP	Qing Shen

Xinyi Zhao	PhD Student	ISE	Chaoyue Zhao
Grace Jia	PhD Student	CEE	Cynthia Chen
Arsalan Esmaeili	PhD Student	CEE	Cynthia Chen
Kaitlyn Ng	MS Student	CEE	Cynthia Chen
Jeremy Chan	MS Student	CEE	Cynthia Chen
Anurag Agarwal	MS Student	Data Science	Cynthia Chen
Lamis Ashour	PhD Student	UDP	Qing Shen
Mingming Cai	PhD Student	UDP	Qing Shen

In the *technology transfer* domain, Arizona State University continued the [TOMNET webinar series](#) that is presented to a worldwide audience. The webinars are provided in a hybrid or full remote format with recordings available on the TOMNET website. In addition to ASU, GT and USF were also active in organizing transportation webinars. These events are advertised widely and very well attended. Table 4 presents a list of TOMNET-sponsored seminars at ASU, GT, and USF for the period covered by this SAPR.

Table 4. Key TOMNET-Sponsored Technology Transfer Events

Inst	Title of Seminar/ Webinar	Speaker Name and Affiliation	Date
ASU	The Drive for Dollars: How Fiscal Politics Shaped Urban Freeways and Transformed American Cities	Brian D. Taylor, PhD University of California, Los Angeles, USA	3/19/2024
GT	Urban and Transportation Studies Using VR Experiments	Prof. Seung-Nam Kim Chung-Ang University	11/9/2023
USF	Traffic Flow as a Simple Fluid: Towards a Scaling Theory of Urban Congestion	Jorge Laval, Georgia Tech	10/13/2023
USF	Understanding How Transportation Affects People and Communities	Tia Boyd, AICP, USF	2/9/2024
USF	Travel Demand Modeling and Freight Planning	Jolene Hayes, AICP, Fehr & Peers	2/23/2024
USF	Move, Connect, Thrive: The Power of Active Transportation	Jason Jackman, USF	3/29/2024

Note: ASU = Arizona State University; GT = Georgia Institute of Technology; USF = University of South Florida

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

As we enter the final stretch of the center’s existence, TOMNET has planned several activities for the next reporting period to ensure the center's portfolio of accomplishments is widely recognized and to bring it to a proper closure. In the research domain, TOMNET faculty members will continue making progress on research projects and the results will be disseminated widely through various channels. Particularly, TOMNET has so far contributed to, or fully funded, four surveys on new transportation technologies, community resilience and disaster-response, leisure and social-capital activity engagement, and COVID-19 travel implications. Using these diverse and rich datasets, TOMNET researchers will continue to produce tangible research outputs that can significantly benefit policy and decision making in the transportation sector, particularly in the wake of recent natural and technological disruptions. The TOMNET research team will publish findings in journal and conference papers. The working papers from TOMNET’s active research projects are being finalized and planned for publication in books and peer-reviewed journals. Dissemination of these research products will further advance TOMNET education and workforce development goals as well as technology transfer mission.

TOMNET core faculty members will continue to teach undergraduate and graduate courses at their respective institutions while enhancing the content to reflect discoveries and trends in the profession. TOMNET faculty members will continue to mentor students and guide them to completion of their studies and appropriate career pathways. In the technology transfer domain, TOMNET will continue to organize webinars and in-person seminars such as those listed previously in the report.

Researchers at Georgia Tech plan to continue giving presentations to academic and practitioner audiences on the post-pandemic outlook for teleworking, and other topics of current research interest. In the next reporting period, Dr. Mokhtarian will: (1) continue collaboration with noted Dutch scholar Prof. Bert van Wee (Technical University of Delft), on a “meta-theory for travel choices” and they plan to submit

a paper on this work to Transport Reviews, (2) revise and resubmit a paper based on the keynote talk she gave to the International Association for Travel Behaviour Research conference in December 2022, and (3) visit a colleague at Chang'An University in Xi'an, China, to collaborate on research.

TOMNET will continue to engage in K-12 outreach activities. In a post-COVID era, online platforms have been used to continue K-12 outreach programs. However, Arizona State University conducted an [in-person summer transportation institute](#) during June 4-9, 2023. High school students lived on campus and immersed themselves in a summer transportation experience that saw them enjoy activities and field trips organized by the Arizona Department of Transportation, Valley Metro, and the City of Phoenix. TOMNET researchers are working very closely with the American Council of Engineering Companies (ACEC) Arizona to bring 1200 middle school students for an engineering-centric infrastructure-focused STEM tour of the Mountain America football stadium on the ASU campus. This activity is intended to get middle school students excited about prospective career pathways in engineering and STEM fields. The event is scheduled to be held April 30, 2024 and will be documented in the next SAPR. During the period covered by this SAPR, the Director of TOMNET worked closely with team members from multiple entities of the university – including stadium staff, an organization called School Connect that helps organize school field trips, and ACEC Arizona leadership – to organize the entire event. At Georgia Tech, Dr. Mokhtarian has been meeting regularly with civil engineering undergraduate students to discuss transportation as a degree specialization and career pathway.

Finally, TOMNET leadership is organizing a two-day Grand Finale event for the center, scheduled for May 23-24, 2024, at the Georgia Institute of Technology in Atlanta, GA. This event will bring together approximately 40 TOMNET-affiliated scholars, including faculty, students, and alumni, as well as regional, state, and federal transportation planning agency staff. The event will provide TOMNET scholars and researchers with an exciting opportunity to showcase the outputs of the TOMNET enterprise and its impact on the field of Travel Behavior and celebrate its many accomplishments and achievements since its founding.

2. PARTICIPANTS & COLLABORATING ORGANIZATIONS

TOMNET researchers have been actively collaborating with a number of organizations and partners in academia and industry. These partnerships have created many opportunities for the impact of TOMNET to be felt on a broad scale. TOMNET researchers work very closely with the Atlanta Regional Commission, the Maricopa Association of Governments, the Georgia Department of Transportation, the Puget Sound Regional Council, and the King County Metro Transit Department.

What organizations have been involved as partners?

- *Atlanta Regional Commission: Collaborative research and personnel exchange*
- *City of Westport, Westport, WA: Collaborative research, supplied facilities*
- *Culdesac Tempe, Tempe, AZ, Collaborative research*
- *TBD University Transportation Center, University of Texas at Austin*
- *Georgia Department of Transportation: In-kind support, datasets, collaborative research, funding of matching-project research*
- *Grays Harbor County Emergency Management*
- *King County Metro, Seattle, WA: In-kind support, datasets, collaborative research*
- *Laurelhurst Earthquake Action Preparedness, Seattle, WA: Collaborative research*
- *Maricopa Association of Governments, Phoenix, Arizona: In-kind support, datasets, collaborative research*
- *Mobility Innovation Center, Seattle, Washington: Collaborative research and funding of matching-project research*
- *Northwest Healthcare Response Network*
- *Northwestern University: Collaborative research*
- *Oak Ridge National Laboratory – National Transportation Research Center: Collaborative research*
- *Ocosta Public School District*
- *Office of Emergency Management, City of Seattle: Collaborative research*

- Office of Planning and Community Development, City of Seattle: Collaborative research
- The Puget Sound Regional Council
- Shoalwater Bay Tribe
- South Beach Regional Fire Authority
- South Park Information and Resource Center
- The AAA Foundation for Traffic Safety
- Universidad de Chile and Universidad de Concepcion (Chile), University of Leeds (UK) and German Aerospace Institute – DLR (Germany): Collaborative research
- University of Washington School of Public Health
- Washington Emergency Management Division
- Washington State Department of Transportation: Collaborative research and funding of matching-project research
- Washington State Parks
- Westport Police Department
- Westport Tsunami Safety Committee, Westport, WA: Collaborative research
- World Conference for Transport Research Society (WCTRS): Writing of a chapter, larger international collaboration

Have other collaborators or contacts been involved?

TOMNET core research members are actively collaborating with researchers across the world to produce cutting-edge research products and advance the discipline of traveler behavior, values, and attitudes. The list of researchers that work closely with TOMNET researchers includes:

- Dr. Chandra Bhat, PhD, University of Texas at Austin, TX
- Dr. Abolfazl Mohammadian, University of Illinois-Chicago, IL
- Dr. Sybil Derrible University of Illinois-Chicago, IL
- Dr. Laurie Garrow, Georgia Tech, Atlanta, GA
- Dr. Brian German, Georgia Tech, Atlanta, GA
- Dr. Joseph Saleh, Georgia Tech, Atlanta, GA
- Dr. Patrick Singleton, Utah State University, Logan, UT
- Dr. Lauren Steimle, Georgia Tech, Atlanta, GA
- Dr. Dima Nazzal, Georgia Tech, Atlanta, GA
- Dr. Timor Besedes, Georgia Tech, Atlanta, GA
- Dr. Rolf Moeckel, Technical University of Munich, Germany
- Dr. Alejandro Tirachini, University of Chile, Chile
- Dr. Konstadinos Antoniou, TU Munich, Germany
- Dr. Barbara Lenz, German Aerospace Institute
- Dr. Dick Ettema, Utrecht University, Utrecht, Netherlands
- Dr. Clark Miller, Arizona State University, Tempe, AZ
- Dr. Vivien K. G. Lim, the National University of Singapore
- Dr. Bert van Wee, TU Delft, the Netherlands
- Dr. Francisco Bahamonde-Birke, Tilburg Uni., Netherlands
- Dr. Veronique Van Acker, Luxembourg Institute of Socio-Economic Research (LISER)
- Dr. Sangho Choo, Hongik University, South Korea
- Dr. Yongsung Lee, University of California at Davis
- Dr. Shin-Hyung Cho, Seoul National University, S. Korea
- Dr. Seung-Nam Kim, Chung Ang University
- Dr. Calvin Thigpen, Lime
- Dr. Hue-Tam Jamme, Arizona State University, Tempe, AZ
- Dr. Matthew Bhagat-Conway, UNC Chapel Hill
- Dr. Natalia Barbour, TU Delft, the Netherlands
- Dr. Bahar Dadashova, Texas A&M University, TX
- Dr. Soheil Sohrabi, University of California, Berkeley, CA
- Dr. Brian H. Y. Lee, Puget Sound Regional Council
- Baiba Pudane, PhD Candidate, TU Delft, the Netherlands
- Jia Tang, PhD student from Nanjing University
- Casey Gifford, King County Metro, WA
- Brian Van Abbema, King County Metro, WA
- Nicole Aguirre, King County Metro, WA
- Ryan Miller, King County Metro, WA
- Bart Treece, Uni. of Wash. Mobility Innovation Center, WA
- Anthony Buckley, Washington State DOT, WA
- Tim Lehman, Indigenous Planning Strategist, City of Seattle
- Executive Board of the Intl Assoc of Trav Beh Research

3. OUTPUTS

The following is a list of **publications, conference papers, and presentations** produced by TOMNET core faculty members during the reporting period covered by this SAPR. To the extent possible, papers and presentations likely to be listed in other UTC SAPR documents have been omitted.

Arizona State University

Papers Published Within Reporting Period

1. Asmussen, K. E., Mondal, A., Batur, I., Dirks, A., Pendyala, R. M., and Bhat, C. R. (2024). An Investigation of Individual-level Telework Arrangements in the COVID-era. *Transportation Research Part A*, 179, 103888.

Presentations Within Reporting Period

1. Batur I., A. Mondal, V. O. Alhassan, K.E. Asmussen, C.R. Bhat, and R.M. Pendyala. *The Induced Demand Implications of Alternative Adoption Modalities of Automated Vehicles*. Presented at the 103rd Annual Meeting of the Transportation Research Board, Washington, DC, January 7-11, 2024.
2. Batur I., V. O. Alhassan, M.V. Chester, S.E. Polzin, C. Chen, C.R. Bhat, and R.M. Pendyala. *Understanding How Extreme Heat Impacts Human Activity-Mobility and Time Use Patterns*. Presented at the 103rd Annual Meeting of the Transportation Research Board, Washington, DC, January 7-11, 2024.
3. Anderson, S.M., K.E. Asmussen, S. Saxena, I. Batur, R.M. Pendyala, and C.R. Bhat. *An Investigation of Dissonance in Telework Frequency*. Presented at the 103rd Annual Meeting of the Transportation Research Board, Washington, DC, January 7-11, 2024.
4. Hwang, H., A. Haddad, I. Batur, S. Saxena, R.M. Pendyala, and C.R. Bhat. *An Analysis of Walking Frequency Before and After the Pandemic*. Presented at the 103rd Annual Meeting of the Transportation Research Board, Washington, DC, January 7-11, 2024.
5. Bhat, C.R. and R.M. Pendyala. *Some Recent Findings on Tele-Activity Adoption and the Effects of Tele-Activities on Travel Behavior*. Presented at the 103rd Annual Meeting of the Transportation Research Board [Workshop: Hybrid Work, Activity Patterns, and Travel Choices in the Post-Pandemic Era], Washington, DC, January 7-11, 2024.
6. Pendyala, R.M. *Emerging Transportation Technologies: A Panacea or Predicament?* Clemson University Transportation Seminar Series | October 6, 2023.
7. Pendyala, R.M. *A Tale of Two Disruptions: Adaptation of Human Activity-Mobility Patterns in Response to the Pandemic and Extreme Heat*. The University of Texas at Arlington | Seminar Series | February 21, 2024.
8. Batur I., V. O. Alhassan, M.V. Chester, S.E. Polzin, C. Chen, C.R. Bhat, and R.M. Pendyala. *Understanding How Extreme Heat Impacts Human Activity-Mobility and Time Use Patterns*. Presented at the 2024 PSR Annual Congress | Moving Forward: Improving Transportation in Region 9 | March 11-12, 2024.
9. Polzin, S.E. (panelist). [The Imperiled Future of Big-City Mass Transit](#). Organized by the American Enterprise Institute (AEI). Wednesday, February 21, 2024.
10. Polzin, S.E. "Modeling for a Changing Transportation World" Schofer Symposium, Northwestern University, November 18, 2023.
11. Polzin, S.E. "Change and Uncertainty in Transportation" Keynote, Indianapolis MPO Speaker Series, November 8, 2023.
12. Salon, D. (2024) Car-Free Living in Car-Dependent America? University of California, Davis Institute of Transportation Studies Seminar, Davis, CA. ([link](#))
13. Salon, D. (2023) The remarkably low cost of private car mobility in the United States. Association of Collegiate Schools of Planning, Chicago, IL. Joint with Matt Bhagat-Conway.
14. Salon, D. (2023) School Commute Shapes Sustainable Transportation across Generations. Association of Collegiate Schools of Planning, Chicago, IL. Joint with Hue-Tam Jamme, Jordyn Hitzerman, Rababe Saadaoui, and Nicole Corcoran.

Policy Briefs Within Reporting Period

1. Polzin, S., Batur, I., and Pendyala, R.M. *COVID Recovery? Changing Travel Behaviors? Insights From the 2022 ACS, ATUS, and CE Data Sets*. Policy Brief, TOMNET-TBD University Transportation Centers. December 2023.

Georgia Institute of Technology

Papers Published Within Reporting Period

1. Wang, X. and Mokhtarian, P.L. (in press) Examining the Treatment Effect of Teleworking on Vehicle-Miles Driven: Applying an Ordered Probit Selection Model and Incorporating the Role of Travel Stress. *Transportation Research Part A*.
2. Wang, X., Kim, S-H., and Mokhtarian, P.L. (in press) Identifying Teleworking-Related Motives and Comparing Telework Frequency Expectations in the Post-Pandemic World: A Latent Class Choice Modeling Approach, *Transportation Research Part A*.

Presentations Within Reporting Period

1. Mokhtarian, P.L. Does Teleworking Increase or Decrease Travel? Using Selection Models to Obtain (Counterfactual) Longitudinal Results from Cross-Sectional Data. University of Hong Kong, January 17, 2024.
2. Mokhtarian, P.L. What Explains the Gap between Teleworking Expectations and Eventual Realization? A Blinder-Oaxaca Approach. Technical University of Delft, December 18, 2023.
3. Mokhtarian, P.L. Teasing Causality out of Cross-Sectional Data: An Example or Two from Recent Teleworking Research. Symposium in Honor of Joseph Schofer, Northwestern University, November 18, 2023.

University of South Florida

Papers Published Within Reporting Period

1. Dzinyla R., Alnawmasi, N., Adanu, E., Dadashova, B., Lord, D., and Mannering, F. (2024). A Multi-Year Statistical Analysis of Driver Injury Severities in Single-Vehicle Freeway Crashes With and Without Airbags Deployed. *Analytic Methods in Accident Research* 41, 100317.

2. Sohrabi, S., Lord, D., Dadashova, B., and Mannering, F. (2024). Assessing the Collective Safety of Automated Vehicle Groups: A Duration Modeling Approach of Accumulated Distances Between Crashes. *Accident Analysis and Prevention* 198, 107454.
3. Barbour, N., Abdel-Aty, M., and Mannering, F. (2024). Retaining the Transportation Benefits of COVID-19 Induced Work From Home: Understanding Role of Worker Productivity. *International Journal of Sustainable Transportation*, 1-13.

Presentations Within Reporting Period

1. Fred Mannering. Plenary Speaker, Region 10 Transportation Conference, University of Washington, Seattle, WA, Oct 2023.
2. Fred Mannering. Speaker, Eminent Scholars Seminar Series, College of Engineering, University of Alabama, Tuscaloosa, AL, Oct 2023.
3. Fred Mannering. Keynote Speaker, The Sixth International Forum and Exhibition on Traffic Safety, Dammam, Saudi Arabia, Dec 2023.
4. Fred Mannering. Data analytics and the promise of artificial intelligence to improve highway safety, Smart City Seminar, University of Central Florida, Jan 2024.
5. Fred Mannering. Perspectives on Highway Safety: Contemporary issues and the forthcoming age of autonomous vehicles, MIT Mobility Initiative, Massachusetts Institute of Technology, Mar 2024.

University of Washington

Papers Published Within Reporting Period

1. C. Cano-Calhoun, D. Abramson, and C. Chen (2024) On Your Own, Together: Regional Perspectives on Community Resource-sharing for Disaster Preparedness in Washington State. *Journal of Urban Affairs* (accepted).
2. E. Uğurel, X. Guan, Y. Wang, S. Huang, Q. Wang, and C. Chen (2024) Correcting Missingness in Passively-generated Mobile Data with Multi-Task Gaussian Processes. *Transportation Research Part C*, Volume 161, 2024, 104523.
3. E. Uğurel, S. Huang and C. Chen (2023) Gaussian Process Learning for Location-Based Service Data, 2023 Asia Pacific Signal and Information Processing Association Annual Summit and Conference (APSIPA ASC), Taipei, Taiwan, 2023, pp. 1204-1207.
4. X. Guan, G. Jia, K. C. Kosaraju, V. Gupta, and C. Chen (2023) Underreporting in COVID-19 Case Data Causes Policy Objectives Being Unmet. *IEEE Transactions on Computational Social Systems*.
5. F. Lin, X. Qian, B. Mortazavi, Z. Wang, S. Huang and C. Chen (2023) Modeling User Choice Behavior under Data Corruption: Robust Learning of the Latent Decision Threshold Model, *IJSE Transactions*, DOI: 10.1080/24725854.2023.2279080.
6. Idziorek, K., Abramson, D., Kitagawa, N., Yamamoto, T., and Chen, C. Factors influencing willingness to share resources post-disaster: a cross-cultural comparison between US and Japanese communities. *Natural Hazards Review*, 24(4), 2023.
7. Lin, J., Jenelius, E., Cebecauer, M., Rubensson, I., and Chen, C. (2023) The Equity of Public Transport Crowding Exposure. *Journal of Transport Geography*, 110, 103631.
8. Shea, K.; Chen, C.; and 76 other authors. (2023) Multiple Models for Outbreak Decision Support in the Face of Uncertainty. *Proceedings of the National Academy of Sciences*, 120(18), e2207537120.

Presentations Within Reporting Period

1. Cai, M., Lamis, A., Shen, Q. Lewis, E., and Chen, C. Incorporating mobility on demand into public transit in suburban areas: A comparative evaluation of cost-effectiveness. Presented at the 103rd Annual Meeting of the Transportation Research Board, Washington, DC, January 7-11, 2024.
2. Jia, G., Uğurel, E., Ng, K., Pendyala, R.M., and Chen, C. COVID-19 and telecommuting-induced changes in individual activity and travel patterns. Presented at the 103rd Annual Meeting of the Transportation Research Board, Washington, DC, January 7-11, 2024.
3. Li, Z., Chen, A., Idziorek, K., and Chen, C. Community resilience: the potential of peer-to-peer transportation sharing. Presented at the 103rd Annual Meeting of the Transportation Research Board, Washington, DC, January 7-11, 2024.
4. Esmaili, A., Oshanreh, M.M., Naderian, S., MacKenzie, D., and Chen, C. Assessing the spatial distribution of public electric vehicle charging stations with emphasis on equity considerations in King County, Washington. Presented at the 103rd Annual Meeting of the Transportation Research Board, Washington, DC, January 7-11, 2024.
5. Wu, X., Wang, Y., Uğurel, E., Chen, C., Huang, S., and Wang, R. The effect of sparsity in location-based service data on derived human mobility metrics. Presented at the 103rd Annual Meeting of the Transportation Research Board, Washington, DC, January 7-11, 2024.
6. Esmaili, A., Naderian, S., Uğurel, E., Ban, X., and Chen, C. Understanding transit ridership recovery patterns with two perspectives: rebounding from rock bottom or proximity to pre-COVID-19 ridership. Presented at the 103rd Annual Meeting of the Transportation Research Board, Washington, DC, January 7-11, 2024.
7. Shakur, A., Guan, X., Esmaili, A., Huang, S., and Chen, C. A novel approach for reducing vehicle miles traveled by simply re-sequencing trips. Presented at the 103rd Annual Meeting of the Transportation Research Board, Washington, DC, January 7-11, 2024.
8. Uğurel, E., Huang, S., and Chen, C. (2023) Multi-task, multi-kernel learning for location-based service (LBS) data, APSIPA (Asia-Pacific Signal and Information Processing Association), Taipei, Taiwan.
9. Chen, C., Multi-task, multi-kernel learning for location-based service (LBS) data, APSIPA (Asia-Pacific Signal and Information Processing Association), Taipei, Taiwan, November 2nd, 2023.

10. Cynthia Chen, Boston, MA, Fusing multiple, biased datasets to recover missing trips: a behaviorally-informed likelihood-based approach, Northeastern University, November 27th, 2023.
11. Cynthia Chen, Virtual, Learning big and small, heterogenous datasets for transportation planning resilience analyses, Drexel University, January 17th, 2023.

In summary, TOMNET core faculty generated 14 journal articles and 1 policy brief within the reporting period covered by this SAPR. These publications are attributable to funding provided by the TOMNET UTC. During this reporting period, the **core** TOMNET researchers delivered 34 presentations at various venues.

Website(s) or other Internet site(s)

One of the center's significant products is the TOMNET [website](#), which includes dedicated pages for showcasing descriptions and updates on TOMNET research [projects](#) and reports, as well as the [datasets, surveys, software, and tools](#) developed and produced by TOMNET researchers. It also functions as a platform for sharing policy [briefs](#) and disseminating TOMNET [events](#) and [news](#) to a global online audience. Similar to previous reporting periods, the TOMNET website has been consistently maintained to reflect developments in TOMNET's research, education, workforce development, and outreach activities.

Software Programs, Codes, and Products

As noted in prior progress reports, the TOMNET team at ASU has been heavily involved in the development and application of open-source tools that reflect model outputs of the TOMNET projects. So far, the beta versions of the synthetic population generator called [PopGen](#) and the [TOMNET Wellbeing Platform](#) have been created and made available for public use. These tools have been explained in previous reports in detail (interested readers can also refer to the hyperlinked websites for further information). **In this reporting period, the ASU team has also released the Time Use, Travel, and Telework Dashboard (T3D), which is an open-source platform designed to offer insights into time use, travel, and telework trends and patterns within the United States.** Updated versions of these tools developed in open-source format are being posted on the TOMNET website. Moreover, R and Python codes associated with other TOMNET transportation model estimation and implementation efforts as well as data fusion procedures are being documented in various publications, including the TOMNET GitHub [page](#). The TOMNET team at the University of Washington has also developed Mobility Analysis Workflows Tutorials, which can be found at this [link](#). Furthermore, they have been actively working on developing a toolkit designed to assist transit agencies in evaluating the distributional cost-effectiveness of TIMOD services within their respective communities.

Databases and Research Materials

In a number of TOMNET projects, integrated datasets have been developed (or are under development), using data fusion techniques with a view to studying 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 automated vehicle technologies. Some of the datasets are based on native survey data collection efforts undertaken by the TOMNET team. Other datasets have been assembled by integrating and fusing data that is already available in the public domain. All datasets assembled by TOMNET are being made available (without personally identifiable information) via the TOMNET website for the broader community. In the meantime, findings from the surveys have been disseminated to the community through a series of webinars and research papers. As mentioned in the previous SAPR, the COVID Future Survey Waves 1-3 data has been made available to the public via [this link](#) on the ASU data repository called Dataverse. Specifically, in this reporting period, the TOMNET team has released the TOMNET Transformative Technologies in Transportation (T4) Survey dataset to the public via the ASU Library Research Data Repository on the ASU's Dataverse platform.

It should be noted that the majority of TOMNET core team publications include applicable model

specifications that can be used by practitioners to better model the recent changes in traveler behavior and values due to new transport technologies as well as the pandemic. These model specifications showcase robust and statistically viable solutions to integrate attitudes in travel behavior analysis.

Table 5. TOMNET Metrics on Products

Metric	Annual Target	Previous Period	This Period	Annual Total	Assessment
Number of software/data/models	2	1	1	2	Datasets are being cleaned, weighted, and documented. The codes are in beta versions.
Number of journal publications	15	16	14	30	Greatly exceeded the annual target.

4. OUTCOMES

The TOMNET Transformative Technologies in Transportation (T4) Survey is creating the much-needed knowledge base to understand the potential evolution of travel choices of residents in several major cities in the sunbelt (where transit is generally not very mature) in the wake of changes brought about by the advent of new mobility services, e.g., shared mobility and ridehailing, as well as automated vehicles and micromobility. Data and insights from the T4 survey, and subsequent publications documenting survey results, help provide critical information that agencies need to minimize the potential negative impacts and maximize the potential positive impacts of new transportation technologies. During this reporting period, several studies based on the T4 survey were presented at various venues.

The community resilience survey that the TOMNET team at the University of Washington has implemented is also very beneficial in understanding the mental and physical elements that impact community disaster preparedness and resilience, and the survey is particularly relevant to the current pandemic situation. The findings from this research can inform strategies for enhancing community adaptive capacity using social and transportation networks to accomplish essential activities, both on an everyday basis and during times of disruptions wrought by disasters.

TOMNET researchers are also studying the potential impacts of COVID-19 on people's travel behavior, time use, and activities before, during, and after the pandemic to help decision-makers plan and adapt transportation systems to the pandemic-induced new normal. The COVIDFuture Survey Wave 1-3 datasets have been released to the public, aiding in planning a strong recovery as well as retaining positive behaviors (e.g., more walking and bicycling) that occurred during the pandemic. The data paper which accompanies the released data has been published in [Nature Scientific Data](#). It is worth highlighting that the summary of the collected data during Wave 1 has been published in [PNAS Policy Report](#), by a team led by TOMNET Associate Director Deborah Salon. During the reporting period covered by this report, the team has published a series of additional papers, based on these datasets, documenting *changes* in traveler behavior and values that occurred over the course of the pandemic, and the likely changes that may stick into a new normal. In the next reporting period, **the TOMNET team (in collaboration with researchers from the University of Illinois Chicago) will deploy the fourth wave of the survey** to further understand activity-travel patterns and trends in the post-pandemic world.

During this reporting period, TOMNET researchers at ASU also launched an important planning tool called the Time Use, Travel, and Telework Dashboard (T3D), an open-source platform designed to offer insights into time use, travel, and telework trends and patterns within the United States. T3D aims to make data from the American Time Use Survey (ATUS) accessible to researchers, planners, policymakers, and the public, facilitating the democratization and wider utilization of publicly available datasets, in accordance with the technology transfer mission of TOMNET. The dashboard features three specific pages focused on Time Use, Travel, and Telework, enabling users to explore patterns and trends. T3D uses preprocessed ATUS data series and offers the ability to conduct both within and between-year

as well as cross-segment analyses for a detailed understanding of evolving trends in how Americans spend their time, travel, and work. Additionally, the dashboard includes tools that allow analyses to be tailored to various population subgroups and market segments by combining up to three attributes from a range of socio-economic, demographic, and household characteristics of respondents available in ATUS.

Improved techniques in addressing transportation issues

Previous SAPRs discussed the significance of TOMNET research to understand the role of attitudes in the adoption of new transport technologies, response to disasters and pandemics, and safety research. Other ongoing TOMNET research efforts shed light on best practices for travel survey data collection and analysis. The project titled “The Effect of Survey Methodology on the Collection of Attitudinal Data” suggests that the weighting of survey data based on socioeconomic attributes cannot completely remove the potential bias of the respondent sample when it comes to analyzing attitudes and lifestyle preferences. This project illustrates the importance of studying attitudes through multivariate econometric and statistical model estimation. Similarly, the project titled “Response Willingness in Consecutive Travel Surveys” is highlighting the advantages and disadvantages of recruiting survey respondents from among those who responded to previous surveys. TOMNET research shows that it can be very cost-effective to do so, which is welcome news for budget-limited planning agencies and researchers. However, new respondents should also be recruited, with an eye to counteracting the demographic biases that tend to be amplified at successive stages of repeated recruitment. The results of this study can be used to estimate specifically the magnitude of the biases, and accordingly determine how best to counteract them. Together with the TOMNET study to evaluate the usefulness of targeted marketing data in attitudinal travel behavior research, these research outcomes have collectively enhanced knowledge regarding data collection and utilization and advanced the profession’s ability to maximize the use of available data in accurately modeling behavioral processes.

Enlargement of the pool of trained transportation professionals

TOMNET has been very successful and productive in engaging undergraduate and graduate students, besides post-doctoral researchers. TOMNET trainees include minorities and women, and the number of students engaged in TOMNET activities has grown considerably. These students are unlikely to have been involved in transportation research and education in the absence of TOMNET. The updated [TOMNET website](#) now includes the names, affiliations, degrees, and headshots of over 100 students and scholars who have been deeply engaged in TOMNET research during their education. TOMNET has been tracking progress in achieving outcomes relative to targets established in the Technology Transfer Plan. Table 6 shows a summary of progress.

Table 6. TOMNET Metrics on Outcomes

Metric	Annual Target	Previous Reporting Period	This Reporting Period	Annual Total	Assessment/notes
Number of unique individuals that downloaded/used TOMNET data/codes/tools	100	~100	~300	400	The main published data source in this reporting period is the Survey and the main online tool released is the T3D dashboard.
Number of students/scholars participating in TOMNET research	30	30	+3	33	Some students are the same across the periods; so, the total number reflects the unique cases.

During this reporting period, former TOMNET graduate student Xinyi Wang, who earned her PhD in July 2023 under the supervision of Dr. Mokhtarian at Georgia Tech and is currently a postdoctoral scholar at

the Massachusetts Institute of Technology, received the 2023 Best Ph.D. Thesis Award from the Georgia Tech School of Civil and Environmental Engineering in December 2023, and another Best Ph.D. Thesis Award from the Georgia Tech Chapter of the Sigma Xi Science and Engineering Honor Society in March 2024.

Xinyi Wang's dissertation received the 2023 Best Ph.D. Thesis Award from the Georgia Tech School of Civil and Environmental Engineering in December 2023, and another Best Ph.D. Thesis Award from the GT chapter of the Sigma Xi Science and Engineering honor society in March 2024. Congratulations to Xinyi!!!



5. IMPACTS

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

Charting a sustainable pathway for smart cities of the future requires detailed data about people's movements, transportation preferences, and attitudes and perceptions towards new mobility options and technologies. The data and tools being developed under the auspices of TOMNET are making it possible for agencies to more accurately forecast the potential impacts of transformative transportation technologies, resulting in the ability to formulate policies and strategies that foster a more effective and **equitable** transportation system. TOMNET's work is accelerating a data-driven informed decision-making approach to transportation investments and improvements that will advance mobility for all. The overall impacts of multiple surveys funded by TOMNET, in understanding how travelers are affected by and respond to new technologies and disruptive forces, including mobility-on-demand services, automation, electrification, health and wellbeing, pricing and taxation, safety, COVID-19 pandemic, leisure activities, and community networks are very significant, and yet difficult to quantify. So far, the three waves of COVID Future Survey dataset have been released to the public and more than 300 unique individuals have downloaded the data. The other TOMNET surveys will also be released to the public after documentation and weighting have been completed. It is envisioned that the findings, analytical models, and raw datasets can significantly enhance our understanding of people's behaviors, perceptions, and choices and therefore substantially elevate the future of transport system planning and policymaking. Table 7 illustrates the number of agencies that have used TOMNET products annually as a quantitative metric to measure TOMNET impact. However, it is difficult to determine the exact number because some agencies use published findings and data sources without notifying the TOMNET team. However, this table presents the number of agencies that have adopted TOMNET data sources and/or modeling tools, to the best of the team's knowledge and awareness.

At the University of Washington, the TOMNET researchers analyze the data gathered from the TOMNET surveys and community outreach activities to provide insights for transportation and emergency planners. This analysis aims to address uncertainties in preparing for disruptions, such as people's expected responses to earthquakes and tsunamis, preferred locations for healthcare and medication, community resources available for alternative purposes in a time of need, and willingness to share resources within a community. Furthermore, the researchers aim to explore ways to optimize transportation and communication sources by leveraging social relationships and local knowledge. In addition to the earthquake and tsunami scenarios the team focused on prior to the COVID-19 pandemic, the research team has expanded their focus to include studying changes in travel behavior during

pandemic scenarios. Furthermore, the TOMNET research project led by the University of Washington (Project #53) has led to advancements in addressing transportation challenges, particularly in evaluating the integration of mobility-on-demand (MOD) with public transit in suburban regions. The study offers insights into the cost-effectiveness of various transportation modes and the potential to innovate practices and adopt new techniques within the transportation sector.

Table 7. TOMNET Metrics on Impacts

Metric	2018	2019	2020	2021	2022	2023	2024	Total
Number of new agencies adopting TOMNET data/tools	2	1	1	1	0	1	1	7
Citations of TOMNET Publications	3,381	3,825	4,565	4,987	5,180	5,548	2,288 (+)	29,774

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

ASU/GT/USF: Results from the T4 Survey are helping to craft realistic future scenarios that can drive travel forecasts. Several agencies have expressed interest in adopting and implementing the well-being estimation and analysis tool (the TOMNET Wellbeing Platform). TOMNET research has also led to improved specification of transportation forecasting models in agencies by demonstrating the presence of market segments that follow different causal structures in decision-making and have different proclivities towards multitasking. A number of agencies have adopted the latest version of the synthetic population generator called PopGen, which is currently supported and enhanced continuously through the support of TOMNET funding. The Travel Forecasting Resource (tfresource.org) was enabled through funding provided by TOMNET; this resource is used by practitioners, students, scholars, and researchers worldwide (including thousands of individuals in the United States) to learn about best practices in transportation demand forecasting, planning, and network modeling. TOMNET research is helping to craft new and improved transportation safety campaigns, with explicit recognition that different messaging is required for different market segments (due to heterogeneity in safety behaviors). TOMNET has also provided guidance to ADOT for weighting the Arizona sample of the National Household Travel Survey (NHTS) using PopGen. Lastly, COVID Future survey data and findings are very informative in shaping the vision for a new normal, and how the profession can maximize the positive aspects and minimize the negative impacts of the pandemic.

Researchers at the University of Washington are building upon earlier work to test and promote an appreciative inquiry approach to disaster mitigation planning, that highlights community strengths over vulnerabilities. Such an approach to hazard planning has the potential to help communities develop mitigation strategies that will benefit them on an everyday basis as well as in the case of a disaster. The analysis conducted during previous reporting periods highlights the importance of trust in supporting communities during a disaster. Trust in community networks turns out to be more important than other factors including socio-demographics, level of preparedness, and place attachment.

What is the impact on the body of scientific knowledge?

Table 7 presents the number of citations for research papers that were produced by the core TOMNET team since 2018. During these years, citations to publications are credited to TOMNET based on the financial resources provided by TOMNET for the specific studies and products. The two distinguished TOMNET faculty who have an outsized contribution to these citation statistics are Fred Mannering and Patricia Mokhtarian. Over the past years, **Professor Fred Mannering** received the **2021 HNTB-CUTC Lifetime Achievement Award in Transportation Research and Education** and **Professor Patricia Mokhtarian** was named the **2021 recipient of the Lifetime Achievement Award** by the **International Association for Travel Behavior Research** for her significant contributions to the field. Dr. Mokhtarian is the first woman to receive this prestigious honor since its creation in 2003. In this reporting period, we

are also thrilled to announce another significant achievement: **Dr. Patricia Mokhtarian has been elected to the prestigious National Academy of Engineering.** This recognition highlights Dr. Mokhtarian's dedication to travel behavior research and her substantial contributions throughout her career.

In an early celebration, Dr. Mokhtarian's students hosted a potluck dinner in February 2024 to honor her election to the National Academy of Engineering.

L to R: Seung-Eun Choi, Dr. Jason Soria, Ilsu Kim, Ilsu's wife Jiwan, and (center) Dr. Pat Mokhtarian



The research team at the University of Washington has developed a comprehensive analytical framework to evaluate the cost-effectiveness of integrating mobility-on-demand (MOD) and public transit in suburban areas. The framework incorporates measurements of externalities that are related to GHG emissions. In addition, the empirical analysis involved a comparison of different suburban contexts with distinct built environment characteristics. This research also has important practical values, as it provides an adaptable approach for transit agencies to make informed decisions about how to best meet the needs of their riders in a cost-effective manner.

The newly published report (Project #34) by Georgia Tech's TOMNET team about working from home in the state of Georgia will increase knowledge of teleworking and its related impacts as the pandemic dramatically waned in strength in 2022. Some key results are listed earlier in this SAPR. Pat Mokhtarian had a spate of media interviews in this reporting period:

1. Interviewed for *Generating Buzz: Remote Work in a Post-Pandemic World*. Georgia Tech podcast, March 29, 2024, ([link](#)).
2. Quoted in *Outside* article by Gloria Liu, March 12, 2024: "Colorado's I-70 Has America's Most Notorious Ski Traffic. Is There a Solution?" ([link](#)).
3. Quoted in *New York Times* article by Lydia DePillis, Emma Goldberg, and Ella Koeze, November 6, 2023: "Most Americans still have to commute every day. Here's how that experience has changed." ([link](#))

The TOMNET team at ASU has published an insightful policy brief in this reporting period, titled "COVID Recovery? Changing Travel Behaviors? Insights From the 2022 ACS, ATUS, and CE Data Sets". This Policy Brief presents a very detailed synthesis, compilation, 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. In this reporting period, TOMNET Deputy Director Dr. Steven Polzin also gave an interview to Fox10Phoenix about the EV charging network as charging stations expand across the nation ([link](#))

What is the impact on transportation workforce development?

To date, various TOMNET activities have engaged undergraduate, graduate, and postdoctoral scholars in research and technology transfer activities related to emerging transportation technologies, impacts of the pandemic, resilience issues in rural and remote areas, survey data collection, advanced statistical modeling, and data fusion. Consistent with the central theme of TOMNET, researchers studied the role of attitudes in shaping travel behavior and choices. In the outreach activities to date, TOMNET provided

opportunities for professionals and academics to learn about TOMNET research results, data and software products, and policy implications through various webinars, conference presentations, reports, and publications. Below are special transportation workforce development activities that were specifically accomplished within the reporting period covered by this SAPR.

At the University of Washington, TOMNET activities have engaged undergraduate, graduate and postdoctoral scholars in community-engaged research about transportation issues in rural and remote areas, particularly as related to emergency planning and hazard mitigation. In previous phases of the mega multiphase project, students were trained to use WeTable participatory GIS equipment to engage collaboratively with experts in urban planning, transportation planning, and hazard mitigation planning on potential planning interventions for remote coastal communities. In the community workshop activities to date, the TOMNET researchers provided opportunities for the public to learn about disaster planning best practices and to share local knowledge with planners and hazard mitigation specialists. They have also engaged multiple undergraduate students in this project so that they learn technical skills relevant to data collection and analysis.

At the University of Washington, TOMNET core faculty members have been working with PhD students/candidates to develop their skills and knowledge in emerging mobility services and the appropriate responses from transit agencies in response to the rapidly changing mobility landscape. The activities in this program will provide students with the tools they need to succeed in the field and polish their skills for future academic and professional careers. The team has provided funding and support to support the integration of TOMNET research findings into research and education experiences, with a view to generating new ideas and approaches for addressing transportation challenges and improving the efficiency and sustainability of transportation systems. Professors and investigators are integrating the results of this program into their courses and providing students with the most updated knowledge and insights about topics related to emerging mobility.

6. CHANGES/PROBLEMS

There are no changes to or problems with the scope, mission, budget, or operations of TOMNET.

7. SPECIAL REPORTING REQUIREMENTS

The institution has submitted all required financial and progress reports to date.