

Center for Teaching Old Models New Tricks (TOMNET)
A USDOT Tier 1 University Transportation Center

PROJECT PROPOSAL: 2018-2019

Title: Attitudes Towards Emerging Mobility Options and Technologies – Phase 2: Pilot and Full Deployments

Principal Investigator: Sara Khoeini, PhD, School of Sustainable Engineering and the Built Environment, Assistant Research Professor

Co-Principal Investigator: Ram Pendyala, PhD, School of Sustainable Engineering and the Built Environment, Professor

1. Introduction/Problem Statement

Emerging mobility options and technologies including autonomous vehicles and mobility-on-demand services are bringing transformative changes in the transportation landscape. To enhance transportation forecasting models considering the increasing penetration of disruptive forces, people’s attitudes towards and perceptions of these technologies and services need to be measured and understood. Armed with such an understanding, it will be possible to specify and develop behavioral models that account for attitudes and perceptions, adoption cycles, and adaptation patterns. This project proposes the survey design, two phases of respondents’ recruitment, data analysis and modeling for a sample of more than one thousand individuals across the Phoenix metro area.

Autonomous vehicles (AV) (also referred to as driverless cars or self-driving cars) are capable of navigating without human input using an array of technologies such as radar, lidar, GPS, odometry, and computer vision. Most industry experts suggest that autonomous vehicles will be on the road within a few years (1). The Secretary of Transportation in the US stated at the 2015 Frankfurt Auto show that he expects driverless cars to be in use all over the world by 2025 (2). Google plans to have its driverless cars on the market no later than 2018 (3). The Institute of Electrical and Electronics Engineers (IEEE) is predicting that up to 75% of all vehicles will be autonomous by 2040 (4). Virtual ridehailing companies such as Uber and Lyft are beginning to change the transportation landscape in significant ways as they provide door-to-door mobility-on-demand through the use of mobile apps. In general, information technology is making rideshare and transit travel options more convenient using location-aware services and real-time data analytics.

With the emergence of new transportation technologies and services, it is critical for transportation forecasting models to be enhanced to account for market dynamics that will result from increased penetration of disruptive forces in the transportation domain. To enhance transportation forecasting models, people’s attitudes towards and perceptions of these technologies and services need to be measured and understood. Armed with such an understanding, it will be possible to specify and develop behavioral models that account for attitudes and perceptions, adoption cycles, and adaptation patterns. It is envisioned that such models will help decision-makers better plan transportation infrastructure systems and design marketing and policy strategies that maximize the benefits of these disruptive technologies. Attitudes and perceptions are likely to vary by socioeconomic characteristics, existing travel patterns and mobility experiences, and land use and built environment attributes.

Phase 1 of this project started in August 2017 and lasted for a year. A comprehensive literature review with respect to survey design and methodology was performed. A complete list of survey goals, objectives and detailed research questions was compiled. Accordingly, survey questionnaire has been designed with the following main sections: A) Attitudes and Preferences; B) Residential Choice and Vehicle Ownership; C) Current Travel Patterns; D) Mobility on Demand and Shared Mobility Services; E) Autonomous Vehicles, and F) Household and Individual Attributes.

During the second phase of the project, data collection will happen in two phases: pilot and full deployment. The pilot phase of data collection is planned for September 2018 with the goal to have a sample size of 250 from residents of the Phoenix metro area. During the pilot data collection, the paper survey questionnaires will be mailed out to 2,500 randomly selected household addresses obtained from marketing companies. In the meantime, the link to an online version of the survey will be sent out to 3,500 random email addresses. The goals of the pilot survey are to evaluate response rates across two survey methods and test the survey content and sampling plan.

The phase of full data collection is planned for fall 2018 across the Phoenix metro area (as well as Atlanta, Tampa, and Austin). During the full deployment, the research team will finalize the survey instrument, data collection method, content and sampling plan based on the results from the pilot deployment. Consequently, during summer 2019 we will collect survey data with the goal sample size of 1000 residents in the Phoenix metro area to understand how the market may perceive, adopt, and adapt to transformative transportation technologies mainly autonomous vehicles and mobility-on-demand services.

During phase 3, the research team will compile and clean the data, deeply analyze it using advanced statistical methods, estimate econometric models, and produce the required reports and documentation. It is envisioned that such outputs will help decision-makers better plan transportation infrastructure systems and design marketing and policy strategies that maximize the benefits of these disruptive technologies. This project will provide a data collection protocol and methodology that can be widely adopted.

The same data collection effort with the same questionnaire will be collected across multiple jurisdictions. As part of a coordinated effort among TOMNET partners, Georgia Tech will collect the data for a similar sample size from Atlanta metro area, Georgia, while and the University of South Florida will apply the survey in the Tampa metro area, Florida. Moreover, the University of Texas at Austin, who has been our close collaborator for many years, will also deploy the same data collection. The data collected across multiple jurisdictions will eventually be aggregated to produce a single dataset with a sample size of around four thousand responses. Adding pilot and full survey sample sizes of the Phoenix metro area plus the sample sizes of the other three metro areas would ideally create a total sample size of 4250. This dataset will be unique in terms of large sample size, contents, and spatial expansion across multiple southern metro areas.

2. Project Objectives

The overall goal of this project is to collect a rich set of data that includes information about people's travel behavior and their attitudes towards and perceptions of advanced transportation technologies and mobility options with a view to inform the development of robust behavioral models of technology adoption capable of reflecting impacts of these disruptive forces on traveler behavior and values. This project will provide a data collection protocol and methodology that can be widely adopted.

3. Proposed Methodology and Data

During phase 1 of the project, a complete review of previous studies on attitudes towards and behavioral impacts of autonomous transportation technologies and innovative mobility services have been conducted. A comprehensive review of previous studies helped identify data needs and behavioral dimensions of interest to focus in this study. According to these findings, the survey goals and objectives have been defined clearly.

The goal of the T4 survey is to understand people's perceptions towards new transportation technologies, as well as to measure how general attitudes (e.g., technology savviness, environment friendliness, etc.) influence attitudes towards new transportation technologies. Furthermore, the study aims at understanding the role of current travel behavior and current use of mobility-on-demand services on perceptions of automated mobility, and willingness to adopt autonomous vehicles. The questionnaire was designed to identify how people's travel patterns, residential choices, vehicle ownership, and mode choice decisions will change in response to transformative changes in transportation. The goal is to obtain a database able to enlighten the study of long-term impacts on people's lifestyle and well-being, as well as the general impacts on energy consumption, emissions, congestion, and urban planning, and thus revise future demand models and activities forecasting models accounting for adaptation of these new transportation technologies. Based on the defined goals and objectives, the survey instrument has been designed during the first phase of the project.

The survey design and review team, consisting of junior and senior members of the field across different TOMNET core institutes, met regularly every week during the first phase of the project and discussed all details of the survey questionnaire with full consideration. After many rounds of survey design and review processes, the paper and online survey questionnaires became ready. The paper version of the survey consists of a 12-page booklet in A4 paper with the cover letter printed on the first page. The online version of the survey has been designed using Qualtrics. The survey outline is summarized in the following. More details on literature review and survey design procedures can be found in the project report of Year 1 of this study (5).

Survey Outline

- Section A: Attitudes and Preferences
 - A series of general attitudinal statements with Likert scale agree/disagree response options
- Section B: Residential Choice and Vehicle Ownership
 - Current home address, type, and tenure, and choice process
 - Number and types of vehicles owned at the household
 - Vehicles driving assistant options
 - Respondent's and household members' driving status
- Section C: Current Travel Patterns
 - Commuting status, destination type, and address
 - Commuting frequency, duration, distance, and parking status
 - Frequency of different commuting travel mode
 - Frequency of different leisure/shopping/social trips travel mode
 - Physical or mental conditions
 - Total miles drives weekly
 - Long-distance trips frequency, modes, and distance
- Section D: Mobility on Demand and Shared Mobility Services
 - Ridehailing services use frequency
 - Details about the respondent's last trip with ridehailing services
 - Total amount spent on ridehailing monthly
 - Impact of ridehailing on the usage of other travel modes
 - A series of attitudinal statements with Likert scale agree/disagree response options
 - Stated preference choice question
- Section E: Autonomous Vehicles
 - Familiarity with AVs
 - Potential reaction to AVs whenever they become available in the market
 - Impact of AV usage on residential choice and commuting duration
 - Impact of AV on vehicle ownership and renting

- Perception of the time remaining to publicly availability of AVs
- A series of attitudinal statements with Likert scale agree/disagree response options
- Stated preference choice question
- Section F: Background Information
 - Age, Gender, Race, Place of birth, Education, Household structure, and Income

In the pilot deployment, the survey instrument takes both forms of online and paper-based mail-out/mail-back survey. After pilot phase data collection, response rate and data quality will be used to decide between the two forms, and the full deployment will be conducted based on the best approach. The unique aspects of this survey are the combination of AV and ride-hailing services in a single survey; inclusion of battery of general attitudinal questions/statements (in addition to specific attitudinal statements on AV and ride-hailing services); random address-based sample (not convenient sample); consideration of residential location (long term), vehicle ownership (medium-term), and activity-travel (short term) impacts; and stated preference choice scenarios with 9 designed blocks.

The target sample size for the pilot version is 250 responses, and the target sample size for the full deployment is one thousand responses in the Pheonix metro area. For each deployment, the survey team will purchase marketing data which includes names, mail addresses, and email addresses of a random sample of people in Maricopa County which includes the majority of the Phoenix metro area and some rural areas as well. We assume a 5 percent response rate for mail surveys and a 1 percent response rate for online surveys when buying marketing data. The response rate, accuracy, and survey cost in the pilot deployment will determine the survey method (online vs. mail) and sampling plan for the full deployment. After data collection, data extraction and data cleaning process will be conducted. Once a clean sample is prepared for each participating metro area (Phoenix, Atlanta, Tampa, and Austin), the datasets will be aggregated and a unique full dataset will be prepared for various research analyses and modeling. The comprehensive analysis of the data including developments of econometric models to understand people's perceptions and potential behavior toward new transport technologies will be conducted during the third phase (Year 3) of the project.

4. Work Plan (Project Tasks)

The following tasks will be undertaken in this project.

Task 1 - Survey Pilot Deployment in Pheonix: Prior to undertaking the full-fledged data collection effort, the project team will conduct a small scale pilot survey using a random sample of households purchased at the marketing company in both paper and online formats. Participants in the pilot survey will be given the opportunity to offer feedback about the survey and identify areas for improvement. The pilot data, collected from about 250 respondents, will be analyzed in detail with a view to enhance the design of the survey and ensure that there is no ambiguity in survey questions. Moreover, if the response rate of the online version found out to be reasonably good, considering the significantly lower cost and higher data completeness of the online version the full deployment will happen in an online format. Otherwise, the full deployment will happen in the mail format or combination of mail and email survey methods+.

Task 2 – Analysis and Evaluation of Pilot Survey: The pilot data will be analyzed initially at the descriptive level to understand if there is any shortcoming in the survey questionnaire design. Moreover, the cost, accuracy, and response rate of the pilot data will be evaluated to come up with the best plan for conducting the full deployment. Pilot data will be analyzed beyond the descriptive level as well in conjunction with the full data. One of the very important research areas that Pilot data will contribute to is survey methods by comparison between online and paper survey platforms in terms of the respondents' socioeconomic and attitudinal profiles in addition to survey logistics aspects.

Task 3 - Survey Full Deployment: In this task, a full-fledged data collection will take place. The survey will be administered in accordance with the survey design plan developed in Task 2. If it was decided to

conduct a mailing survey, an address database will be purchased from a vendor to mail surveys and postcards; households will be able to complete the survey online or by mailing back a paper version of the survey. If it was decided to conduct an online-only survey, an email list will be purchased from a marketing company and invitations to participate in the survey online will be emailed to the potentials respondents. If the survey design calls for an incentive, then a token of appreciation will be included in the package.

Task 4 - Data compilation and documentation: Upon completion of the data collection effort, the project team will compile the electronic databases and thoroughly document the data. A number of data validity checks will be performed so that the final data sets assembled in this project are clean and free of obvious logic errors. For the final cleaned data set, multi-dimensional raking procedures will be used to weight the sample households so that the weighted sample is representative of the general population. Data documentation, including a detailed data dictionary and description of the data collection methodology, will be prepared to support permanent data archival according to established data documentation standards.

Task 5 - Submission of final deliverables: The final deliverables of the project will include a comprehensive report documenting the sampling plan, data collection details, and data documentation. The project will also result in the delivery of a fully documented and weighted data set that can be used to study attitudes towards and behavioral impacts of autonomous vehicles and emerging mobility services. The final datasets will be saved and archived in CSV format to facilitate ease of use in any software platform.

5. Project Schedule

The project schedule is shown in Figure 1 below.

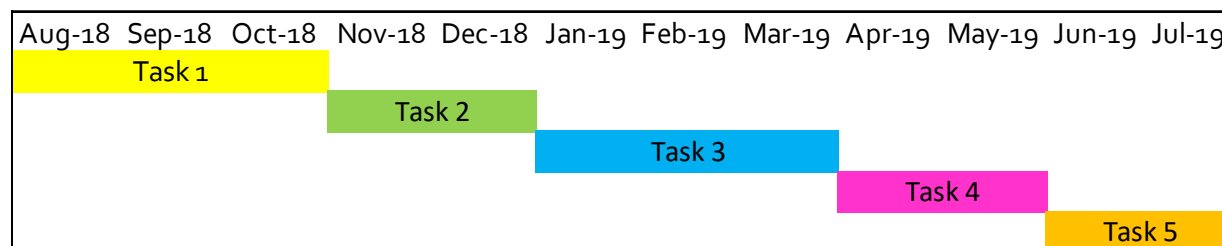


Figure 1 Project Schedule

As per the schedule, the pilot deployment will be undertaken between August and October 2017, the first three months of the project. The actual full data collection will commence by the summer of 2019. It is anticipated that this task will take three months. The remaining time will be assigned to data cleaning, weighting, geocoding and preparing final deliverables, which will be submitted in July 2019.

6. Relevance to the Center Theme/Mission

This research project involves the collection of attitudinal data to better understand how people perceive and value autonomous vehicles, mobility-as-a-service options, and other disruptive and transformative transportation technologies. Transportation planning agencies are increasingly seeking to forecast travel demand and mobility patterns/choices under alternative future states; however, they are limited in their ability to do so due to a severe paucity of data and behavioral insights on how individuals may adopt and adapt to various disruptive transportation services and technologies. Many studies to date have not gathered data about attitudinal variables, which are likely to play a very important role in shaping the behavioral responses to alternative technologies and services. This project directly addresses the theme of the center by collecting attitudinal data together with behavioral and socio-economic information. The resulting data set can be used to develop new behavioral forecasting models that explicitly account for attitudes, perceptions, and values. Therefore, the attitudinal data collection effort contemplated in this project directly

addresses the mission of TOMNET, namely, to advance data and methods to explicitly reflect the role of attitudes, perceptions, values, and preferences in activity-travel behavior and mobility choice models.

7. Anticipated Outcomes and Deliverables

The proposed project will result in the development of a rich dataset incorporating information about people's socioeconomic attributes, current travel behavior, attitudes toward and perception of new mobility choices and advanced technologies in transportation, and expected impact of advanced mobility options on traveler behavior and values. The project will result in the delivery of harmonized data sets that can be pooled or analyzed separately in subsequent phases (years) of the overall research enterprise. Furthermore, this project includes the estimation of models to model users' perceptions and predict the impacts of new mobility services and technologies on different choices (residential/work location, vehicle ownership, and activity-travel patterns). The latter outcome is expected for the next phase of the project while the main dataset will be produced during this phase of the project.

The project will result in the publication of a final report that documents the entire study including sampling plan and data collection plan. The data sets and documentation will be made available to all members of the TOMNET team to facilitate collaborative data analysis and modeling efforts. It is anticipated that the survey design and sampling plan developed in this research effort can be used by any jurisdiction in the country interested in collecting similar data within its metropolitan region or context. Moreover, the application of different survey methods in the pilot phase of data collections produces complementary insights about the advantages and disadvantages of different survey methods and how the respondents' profiles are different across different survey methods.

8. Research Team and Management Plan

The research team is led by Dr. Sara Khoeini, who will serve as the Principal Investigator for the project at ASU. Professor Ram Pendyala will serve as the co-principal investigator for the project and will assist in each and every project task. The project will support one highly qualified Ph.D. student, and a few undergraduate research assistants (who will assist with survey administration and data entry).

Sara Khoeini is an Assistant Research Professor of Transportation Systems in the School of Sustainable Engineering and the Built Environment at Arizona State University. She is the Assistant Director of TOMNET. Sara has extensive experience in the study of traveler behavior and attitudes, particularly in the context of managed lane operations. She has deep expertise in statistical analysis of transportation data and travel behavior modeling. She has conducted special-purpose surveys to collect information about changes in travel behavior in response to changes in transportation system conditions. She has published her work in a variety of journals and has been active in several professional organizations. Sara has her Ph.D. from the Georgia Institute of Technology, MS from Clemson University, and her undergraduate degree from K.N.T. University of Technology in Iran.

Ram M. Pendyala is a Professor of Transportation Systems in the School of Sustainable Engineering and the Built Environment at Arizona State University. He serves as the Director of TOMNET. Pendyala is an expert in activity-travel behavior modeling and has led the development of a number of large-scale behaviorally robust microsimulation model systems. He has published extensively in the literature and serves as the Chair of the Transportation Research Board's Planning and Environment Group (2015-2018). He previously served as Chair of the Travel Analysis Methods Section (2009-2015) as well as the Traveler Behavior and Values Committee (2003-2009). He has also served as the Chair of the International Association for Travel Behavior Research (IATBR). He is currently an Associate Editor for Transportation Research Part D. He has his Ph.D. and MS degrees in Civil and Environmental Engineering with a specialization in transportation from the University of California at Davis, and his Bachelor's degree in Civil Engineering from the Indian Institute of Technology-Madras in India.

Sara Khoeini will be the primary point of contact for all aspects related to this research and will manage all aspects of the project. She will work closely with a graduate student and a few undergraduate students to accomplish the project tasks. She will also coordinate efforts with other research groups conducting the same survey in other US metropolitan areas to ensure consistency in the survey data and products. Ram Pendyala will assist in various project tasks and provide significant input on the design of the survey and sampling plan.

9. Technology Transfer Plan

The project team believes in executing an effective technology transfer plan by disseminating project information and results widely to the professional community. During the one-year duration of this particular project, each milestone will be disseminated using one of the TOMNET communication mechanisms (e.g., website, webinar, seminar, and teleconference). Project team members will prepare articles about the survey, data set, and modeling results for publication in refereed journals and conference proceedings. Project team members will participate in conferences and deliver presentations about this work and the outcomes of the effort. The project will also result in the preparation of data and survey products that can be shared with the broader professional community so that other jurisdictions can mimic the study without any difficulty. The project team will conduct webinars and seminars and post all interim reports and technical memoranda online at the TOMNET website. It should be noted that the main project outcomes that are based on the survey results analysis and modeling will be generated during the next phase of this project (Year 3) and the main output of this phase is the collected dataset that will be distributed among the TOMNET researchers. The survey questionnaire and the data collection protocol will be distributed to the entire community to transfer the team knowledge and efforts in designing one of the longest and in-depth surveys with respect to new transport technologies.

10. Workforce Development and Outreach Plan

The project incorporates a strong workforce development and outreach plan. The project will employ a full-time Ph.D. graduate student as a graduate research associate. The doctoral student will be involved in all aspects of the project including survey design, sampling plan, data collection, and data analysis. Undergraduate students will also be recruited to participate in the research endeavor; they will be expected to help with data entry, data checks, and data documentation. At ASU, project team members will engage with the National Summer Transportation Institute, a three-week residential summer program for high school students that aims to expose them to transportation-related careers. Finally, the project will also welcome high school students who may be interested in serving as volunteer researchers under the TOMNET Scholar Initiative. Findings from the project will be integrated into graduate-level courses taught at various institutions in the consortium so that the research and workforce development activities of the center are seamlessly blended together.

11. References

John D. Stoll, The Wall Street Journal (2016, May 10). Retrieved on 2017, June 6 from:

<https://www.wsj.com/articles/gm-executive-credits-silicon-valley-for-accelerating-development-of-self-driving-cars-1462910491>

Jan Hauser, Wirtschaft (2015, Oct 19). Retrieved on 2017, June 6 from:

<http://www.faz.net/aktuell/wirtschaft/unternehmen/verkehrsminister-foxx-selbstfahrende-autos-in-10-jahren-standard-13811022.html>

Driverless car market watch. Retrieved on 2017, June 6 from:

http://www.driverless-future.com/?page_id=384

IEEE 2012 news. Retrieved on 2017, June 6 from:

http://www.ieee.org/about/news/2012/5september_2_2012.html

Attitudes towards Emerging Mobility Options and Technologies – Phase 1: Survey Design. Center for Teaching Old Models New Tricks (TOMNET) Tier 1 University Transportation Center, 2018.

12. Qualifications of Investigators (One-page CV per Investigator)

SARA KHOEINI

Assistant Research Professor, Sustainable Engineering and the Built Environment
Arizona State University (ASU), Tempe, AZ 85287-3005 Email: Sara.Khoeini@asu.edu

Education

Ph.D., Civil Engineering (Transportation), Georgia Institute of Technology, May 2014.
M.Sc., Civil Engineering (Transportation), Clemson University, Dec 2009.
B. Sc., Civil Engineering, K.N. Toosi University of Technology, Aug 2007.

Employment and Professional Experience (last 25 years)

Assistant Research Professor, Sustainable Engineering and the Built Environment, ASU, March 2017 – present

Research Affiliate, School of Civil and Environmental Engineering, Georgia Institute of Technology, April 2015 – Feb 2017

Research Scientist I, School of Civil and Environmental Engineering, Georgia Institute of Technology, March 2014 – March 2015

Fields of Interest and Expertise

(1) Urban transportation systems planning; (2) Travel behavior analysis; (3) Transportation demand modeling and forecasting; (4) Geographic Information Systems; (5) Statistical analysis of transportation data; (6) Travel survey methods and data collection; (7) Sustainability and energy

5 Recent Relevant Publications

1. **S. Khoeini**, and R. Guensler. “Socioeconomic Assessment: Conversion of I-85 High-Occupancy Vehicle to High-Occupancy Toll in Atlanta, Georgia”; Transportation Research Record: Journal of the Transportation Research Board, National Academy of Sciences; No. 2450.1, pp. 52-61, 2014.
2. **S. Khoeini**, R. Guensler. “Using Vehicle Value In place of income For Pricing Economic Analysis: A case study on Atlanta I-85 HOT lane”; Research in Transportation Economics, Special issue on “road pricing in US”, Vol. 44, pp. 33-42, 2014.
3. F. Castrillon, M. Roell, **S. Khoeini**, R. Guensler. “The I-85 HOT Lane’s Impact on Atlanta’s Commuter Bus and Vanpool Occupancy”; Transportation Research Record Journal of the Transportation Research Board, National Academy of Sciences; No. 2470, pp. 169-177, 2014.
4. V. Elango, **S. Khoeini**, Y. Xu, R. Guensler. “Longitudinal GPS Travel Data and Breach of Privacy via Enhanced Spatial and Demographic Analysis”; Transportation Research Record: Journal of the Transportation Research Board, National Academy of Sciences; No. 2345, pp. 86-98, 2013.
5. **S. Khoeini**, R. Guensler, M. Rodgers, V. Elango. “Sensitivity of commuters’ demographic characteristics to license plate data collection specifications: A case study for HOV-to-HOT project in I-85 corridor, Atlanta, GA”; Transportation Research Record: Journal of the Transportation Research Board, National Academy of Sciences; No. 2308, pp. 37-46, 2012.

Honors and Awards

Student of The Year, Georgia Tech National Center for Sustainable Transportation, 2013

WTS Helene M. Overly Memorial Scholarship, 2013

Best Student Paper Award, Freeway & Managed Lane Operations Meeting and Conference, Atlanta, GA, 2013

Ranked 2nd, Nationwide Graduate School Entrance Examination, Civil Engineering-Surveying, Iran, 2007

RAM M. PENDYALA

Professor, Sustainable Engineering and the Built Environment
Senior Sustainability Scientist - Global Institute of Sustainability
Arizona State University (ASU), Tempe, AZ 85287-3005 Email: pendyala@asu.edu

Education

Ph.D., Civil Engineering (Transportation), University of California-Davis, December 1992.

M.S., Civil Engineering (Transportation), University of California-Davis, June 1990.

B.Tech., Civil Engineering, Indian Institute of Technology-Madras, June 1988

Employment and Professional Experience (last 25 years)

Professor, Sustainable Engineering and the Built Environment, ASU, 2006-2014 & 2016-present.

Frederick R. Dickerson Chair Professor, School of Civil and Environmental Engineering, Georgia Institute of Technology, 2014-2016

Senior Sustainability Scientist - Global Institute of Sustainability, ASU, 2011-Present.

Asst/Assoc/Professor, Civil & Environmental Engineering, Univ of South Florida, 1994-2006.

Assistant Professor, Civil Engineering, University of Louisiana at Lafayette, 1992-1994.

Fields of Interest and Expertise

(1) Multimodal transportation systems planning; (2) Activity-travel behavior analysis; (3) Transportation demand modeling and forecasting; (4) Mobility analytics and visualization; (5) Statistical and econometric analysis of transportation data; (6) Dynamic mobility management; (7) Travel survey methods and data collection; (8) Built environment – transportation – energy

5 Recent Relevant Publications (from over 200)

1. Garikapati, V. M., Pendyala, R. M., Morris, E. A., Mokhtarian, P. L., and McDonald, N. (2016). Activity Patterns, Time Use, And Travel of Millennials: A Generation in Transition? *Transport Reviews*, 36(5), pp. 558-584.
2. Pinjari, A. R., Augustin, B., Sivaraman, V., Imani, A. F., Eluru, N., and Pendyala, R. M. (2016). Stochastic Frontier Estimation of Budgets for Kuhn–Tucker Demand Systems: Application to Activity Time-Use Analysis. *Transportation Research Part A*, 88, pp. 117-133.
3. Shin, J., Bhat, C. R., You, D., Garikapati, V. M., and Pendyala, R. M. (2015). Consumer Preferences and Willingness to Pay for Advanced Vehicle Technology Options and Fuel Types. *Transportation Research Part C*, 60, pp. 511-524.
4. Garikapati, V. M., You, D., Pendyala, R. M., Jeon, K., Livshits, V., and Vovsha, P. S. (2015). Tour Characterization Framework Incorporating Activity Stop–Sequencing Model System. *Transportation Research Record: Journal of the Transportation Research Board*, 2494, pp. 77-86.
5. Archer, M., Paleti, R., Konduri, K., Pendyala, R., & Bhat, C. (2013). Modeling the connection between activity-travel patterns and subjective well-being. *Transportation Research Record: Journal of the Transportation Research Board*, 2382, pp. 102-111.

Graduate Student Supervision/Advising

Graduated: 10 PhDs (includes 2 women), 50 Masters; **Current Supervision:** 4 PhDs

Recent Honors and Awards

Pyke Johnson Award for Best Paper in Planning and Environment, Transportation Research Board of the National Academies, 2011 and 2013

Invited Speaker, Distinguished Lecture Series, Department of Civil and Environmental Engineering, Florida International University, 2015

Invited Keynote Speaker at 5 International/National Conferences, 2014-2016

13. Budget Including Non-Federal Matching Funds

Institution: Arizona State University

Project Title: Attitudes towards Emerging Mobility Options and Technologies – Phase 1: Data Collection

Principal Investigator: Dr. Sara Khoeini, Assistant Research Professor

Budget Period: 8/1/2018 to 7/31/2019

CATEGORY	Budgeted Amount from Federal Share	Budgeted Amount from Matching Funds	Explanatory Notes; Identify Source of Matching Funds
Faculty Salaries		\$20,000	ASU: Dr. Khoeini = \$15,000 Dr. Pendyala = \$5,000
Other Staff Salaries			
Student Salaries (includes data entry costs)	\$20,000		
Fringe Benefits	\$2,946	\$5,954	Faculty: 29.77% of salaries Grad RA: 14.73% of salaries
Total Salaries & Benefits	\$22,946	\$25,954	
Student Tuition Remission	\$17,228		Full calendar year tuition
Operating Services and Supplies (data storage)		\$500	ASU: Pendyala Startup Funds
Domestic Travel		\$1,000	ASU: Pendyala Startup Funds
Other Direct Costs (specify): Survey Related Costs (address database, URL, printing and mailing)	\$20,000		
Other Direct Costs (specify)			
Total Direct Costs	\$60,174	\$27,454	
F&A (Indirect) Costs: 54.5% of MTDC (excludes tuition)	\$23,406	\$14,962	
TOTAL COSTS	\$83,580	\$42,416	Total Project Cost: \$125,996

Grant Deliverables and Reporting Requirements for UTC Grants (November 2016)
Exhibit F

UTC Project Information	
Project Title	Attitudes towards Emerging Mobility Options and Technologies – Phase 1: Data Collection
University	Arizona State University
Principal Investigator	Sara Khoeini
PI Contact Information	Address: 660 S College Ave, CAVC Room 549 PO Box 873005, Tempe, AZ, 85287-3005 Email: Sara.Khoeini@asu.edu
Funding Source(s) and Amounts Provided (by each agency or organization)	US Department of Transportation (Federal UTC): \$83,580 Arizona State University (Cost Share): \$42,416
Total Project Cost	\$125,996
Agency ID or Contract Number	
Start and End Dates	8/1/2017 - 07/31/2018
Brief Description of Research Project	Emerging transportation technologies including electric and autonomous vehicles and emerging mobility services such as ride-hailing and vehicle sharing are bringing about transformative changes in the transportation landscape. With the emergence of new transportation technologies and services, it is critical that transportation forecasting models be enhanced to account for behavioral dynamics that will result from the increasing penetration of disruptive forces in the transportation marketplace. To enhance transportation forecasting models, people’s attitudes towards and perceptions of emerging technologies and services need to be measured and understood. Armed with such an understanding, it will be possible to specify and develop behavioral models that account for attitudes and perceptions, adoption cycles, and adaptation patterns. It is envisioned that such models will help decision-makers better plan transportation infrastructure systems and design marketing and policy strategies that maximize the benefits of these disruptive technologies. This project aims to collect survey data from a sample of 1000 residents in the Phoenix metro area to understand how the market perceives, adopts, and adapts to transformative transportation technologies. During the one-year duration of the project, the research team will review relevant behavioral studies, design the survey instrument and sampling plan, conduct a survey pre-test, perform full-fledged data collection through the administration of a comprehensive attitudinal and behavioral survey, compile and clean data, and produce reports and documentation. Thus, the focus of this phase-I effort is to

	collect a rich dataset of users' attributes and current mobility choices, together with attitudes, perceptions and stated preferences towards new mobility options and technologies. It is envisioned that this project will result in the development of a data collection protocol and methodology that can be widely adopted in any jurisdiction interested in replicating the study. (285 words)
Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	The main outcome of this project at the end of this project year is a harmonized comprehensive survey about users' attitudes and perceptions toward new transport technologies. The survey questionnaire and deployment plan can be widely adopted anywhere in the country. The collected dataset will be used to shed light on questions regarding users' responses to new transport choices.
Impacts/Benefits of Implementation (actual, not anticipated)	Eventually, the collected valuable dataset will help transport modelers to more accurately account for new transport choices in their models and will assist policy-makers to place more effective policies to maximize the positive impacts and minimize the negative impacts of these transformative forces.
Web Links <ul style="list-style-type: none"> • Reports • Project Website 	https://www.tomnet-utc.org/asu-av-survey-project.html