STRIDE | Southeastern Transportation Research, Innovation, Development and Education Center

Technology Transfer Final Report

STRIDE Project D4

Mobility-on-Demand Transit for Smart and Sustainable Cities

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THE STRIDE CENTER

The STRIDE Center is the 2016 USDOT Region 4 (Southeast) University Transportation Center (UTC) housed at the University of Florida Transportation Institute (UFTI). Our mission is to develop novel strategies for Reducing Congestion. The Center has nine partners, representing seven states in the Southeastern U.S. The UFTI and its partners in the STRIDE Center are recognized leaders at state, regional, national, and international levels. The STRIDE Center is focused on assembling and integrating research projects throughout the region in a way that maximizes contributions to solving current and future transportation problems as well as strengthening expertise and developing new technologies. For more information see https://stride.ce.ufl.edu/.

DISCLAIMER

ACKNOWLEDGEMENT OF SPONSORSHIP AND STAKEHOLDERS

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1. Project Overview

The rapid rise of shared mobility options such as ridehailing and micromobility (including station-based bikesharing, e-bikes, and e-scooters) has prompted transportation agencies at the federal, state, and local levels to develop Mobility-on-Demand (MOD) initiatives. MOD means an integrated and connected multi-modal network of safe, affordable, and reliable transportation options that are available and accessible to all travelers. As a competitive alternative to the use of personal cars, MOD transit systems can significantly reduce traffic congestion in major roadways. Given the short history of these shared mobility options, little is known about their spatiotemporal usage patterns (i.e., how people use these services across space and time), how they shape individual travel behavior and attitudes, and under what conditions these new mobility options can be effectively integrated into the existing transit network.

To fill these knowledge gaps, STRIDE researchers, with support from industry partners Ford and Spin, completed two thrust areas of research. In the first thrust, the PIs leveraged big data analytics to analyze scooter trip characteristics and apply machine learning to predict scooter use across different neighborhoods. The PIs also conducted a five-city (Auburn, AL, Birmingham, AL, Miami, FL, Los Angeles, CA, and Washington DC) travel survey to investigate traveler preferences for micromobility options. Results from the survey are compared and analyzed. The second thrust assessed the service characteristics of ridehailing and traditional demand-response transit (i.e., non-fixed route system that requires advanced booking by customers) for hospital trips in rural and urban settings. The analysis compared service characteristics for operators and passengers, e.g., travel time, wait time, and cost, based on different scheduling scenarios.

The two thrusts are connected from a methodological point of view. The data analytics tools developed in Thrust 1 were adapted and then applied in Thrust 2. Results of this research can inform the design of MOD transit systems and contribute to building smart, sustainable, and equitable cities in the Southeastern U.S.

2. Research Goals

The project has the following research goals:

1) Reveal the spatio-temporal patterns of shared micromobility use in the U.S.
2) Evaluate how shared micromobility can be integrated into the existing transit systems to improve mobility and reduce traffic congestion
3) Examine the operational energy consumption of integrated transit systems
4) Assess innovative non-emergent medical transportation models in the Southeast U.S.
5) Assess the service characteristics of innovative models in the Southeast in support of healthcare services

3. Findings

The project has produced the following results:

1. A set of predictive models (and the accompanying software codes) that can be applied to predict micromobilility use across neighborhoods in U.S. cities and to forecast people's preferences for the new MOD transit system.

2. A MOD transit simulator with a set of performance metrics that can be used by different cities to come up with the best deployment strategies of a MOD transit system for their local contexts.
3. Behavioral insights derived from survey results that shed light on traveler preferences for innovative mobility options and the circumstances under which travelers use innovative mobility options to connect with public transit.
4. Policy insights that can inform transit and health agencies in the Southeastern U.S. to develop MOD transit systems that integrate conventional public transit and innovative mobility options such as micromobility and ridehailing.

4. Performance Metrics

Metric	# Completed
OUTPUTS	
Product(s): Number of new or improved tools, technologies, products, methods, practices, and processes created or improved	3
Technical Report: Number of client-based technical reports published	STRIDE Final Report
OUTCOMES	
Body of Knowledge: Number of trainings for transportation professionals	8
Professionals Trained: Number of professionals participating in trainings	490
IMPACTS	
Stakeholders: Number of stakeholders you met with to encourage adoption or implementation of product(s)	10
Adoption/Implementation: Number of incidences outputs of research have been implemented or adopted	6

5. Products

1) New optimization models (user model and operator model) for on-demand paratransit systems. When used for optimizing paratransit operations, these models can help paratransit operators save costs and allow paratransit riders to save travel time and have better trip experiences.

2) New discrete choice models to analyze micromobility (e.g., e-scooters and e-bikes) adoption and use. These models can be used to predict the growth trends of micromobility options in the Southeast region, which can guide transportation agencies to plan and develop the necessary infrastructure such as bike lanes to accommodate the increased micromobility-based travel. In addition, the models can shed light on the main population groups who are adopting and using micromobility options.

3) New models for estimating the potential emission benefits of replacing diesel buses with electric buses. The models can inform transit agencies on to what extent transitioning to an electric bus fleet can help achieve Department of Transportation's decarbonization goals.

6. Who benefits/will benefit from your product(s)?

- Transportation decisionmakers and modelers at state and local DOTs, MPOs, and transit agencies
- Shared micromobility operators
- Paratransit operators

7. Body of Knowledge & Professionals Trained

1) A workshop presentation on real-time forecasting of micromobility demand using a context-aware recurrent multi-graph convolutional neural network approach is scheduled in 2021 TRB workshop sponsored by AED50. Around 300 professionals attended the event.
2) Dr. Xilei Zhao gave an invited lecture, entitled "Planning micromobility for future smart cities," for the course "Miami 2030 – from smart transportation to urban transformation" at the University of Miami School of Architecture. Around 10 professionals attended the event.
3) Dr. Yan gave a presentation, entitled "Shared micromobility & public transit integration," for the UFTI I-STREET stakeholder meeting. Around 30 professionals attended the event.
4) Dr. Xilei Zhao gave an invited talk, entitled "Planning innovative mobility systems with machine learning," at the Transportation Data Science Seminar Series, hosted by Texas A&M University. Around 50 professionals attended the event.
5) Dr. Xilei Zhao gave an invited talk, entitled "Identifying key factors associated with ridesplitting adoption rate and modeling their nonlinear relationships," in the TRB AMS50 webinar series – Exploring Shared Mobility with Machine Learning. More than 20 professionals attended the event.
6) Yiming Xu gave an invited talk, entitled "Real-time forecasting of dockless scooter-sharing demand: A spatio-temporal multi-graph convolutional network approach," in the UF AI Research Catalyst Fund Seminar Series. More than 40 professionals attended the event.
7) Dr. Xilei Zhao gave an invited talk, entitled "Predicting and interpreting ridesourcing travel behavior using machine learning," in the Next Generation Transportation Systems (NGTS) Seminar, hosted by the Department of Civil and Environmental Engineering at the University of Michigan, Ann Arbor. More than 20 professionals attended the event.
8) Dr. Xilei Zhao presented SERMOS lab's research products in micromobility analytics at STRIDE Product Showcase. Around 20 professionals attended the event.

8. Stakeholder Engagement

STRIDE rep.	X. Zhao, X. Yan	Drs. Zhao and Yan met with key stakeholders listed below to seek feedback on our work.
Date of Activity	10/20/2020	
Type of Activity	phone meeting	
Location	zoom	
Stakeholder(s)	Malisa McCreedy, Director of Mobility, City of Gainesville; Debbie Leistner, Public Works Planning Manager, City of Gainesville	
STRIDE rep.	X. Zhao, X. Yan	Drs. Zhao and Yan have been regularly meeting with key stakeholders from Ford/Spin to seek feedback on our work.
Date of Activity	Sept 30, 2020 – Present (every two weeks)	
Type of Activity	phone meeting	
Location	zoom	

Stakeholder(s)	Andrea Broaddus, Sr. Research Scientist, Ford Motor Company Josh Johnson, Public Policy Manager, Spin	
STRIDE rep.	X. Zhao, X. Yan, N. Kaza, N. Kittner	We met with the key stakeholder from Bird to seek feedback on our work.
Date of Activity	Oct 29, 2020	
Type of Activity	phone meeting	
Location	zoom	
Stakeholder(s)	Laurence Wilse-Samson, Sr. Manager of Policy Research, Bird	
STRIDE rep.	J. LaMondia	Dr. LaMondia met with the Auburn University Sustainable Transportation Oversight Group to discuss plans for implementing scooters and ebikes.
Date of Activity	10/9/20	
Type of Activity	phone meeting	
Location	Zoom	
Stakeholder(s)	Amy Strickland, Ben Burmester, Brandy Ezelle, Don Andrae, et. al.	
STRIDE rep.	X. Zhao, X. Yan	We met with the key stakeholder from Miami to seek feedback on our work and explore opportunities for product adoption.
Date of Activity	Mar 24, 2021	
Type of Activity	phone meeting	
Location	zoom	
Stakeholder(s)	Carlos Cruz-Casas, Assistant Director of Miami-Dade County DOT & Public Works Division of Transportation Strategic Planning	
STRIDE rep.	X. Zhao, X. Yan	We met with the key stakeholder from LYNX, Central Florida Regional Transportation Authority, to seek feedback on our work and explore opportunities for product adoption.
Date of Activity	Apr 8, 2021	
Type of Activity	Phone meeting	
Location	zoom	
Stakeholder(s)	William Slot, Chief Innovation Officer of LYNX Doug Jamison, Senior ITS Developer of LYNX	

9. Adoption/Implementation

The PIs have presented the research at various occasions (e.g., conferences and workshops) and met various stakeholders to promote the research products. The adoption of the research products is most likely constrained to the academic audience so far. Research implementation by transportation agencies may follow in a future timeline.

10. Broader Impacts

This research will inform transportation agencies to plan for a future transformed by shared and on-demand mobility and electric vehicles and inspire them to develop innovative strategies to adopt to these emerging trends. When adopted, the research products can make transportation systems, especially public transit systems, operate more efficiently and efficiently, which will in turn improve mobility and safety for the public and promote environmental sustainability.