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Incorporating New Mobility Options into Travel Demand Forecasting and Modeling

Technical Memorandum

Implementation of Research Findings and Products

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Background

The transportation field is undergoing a transformative change in response to several technological innovations resulting in the emergence and widespread adoption of new mobility options (NMOs) such as shared micro-mobility, transportation networking companies (TNCs), connected and autonomous vehicles (CAVs). Shared micro-mobility (bikeshare and e-scooters) can potentially contribute to transportation planning goals of reducing automobile dependency and its ensuing negative consequences (such as congestion, crashes, and air pollution). The overall impact of shared micro-mobility can potentially be concentrated in dense urban cores, and around large institutional centers (such as universities and industrial campuses). However, it would be necessary to evaluate how shared micro-mobility alternatives are used in conjunction with public transit as first/last mile connections. Thus, the spatial reach of these alternatives can possibly extend beyond dense urban cores and into suburban regions. TNCs provide individuals with convenient door-to-door car trips without the additional challenges associated with driving/bicycling (such as having to find a parking spot, concentrating on driving and physical effort of bicycling). The convenience offered by TNCs (such as Uber, Lyft, and Via) has allowed for tremendous growth in ridehailing demand. TNCs can potentially affect vehicle ownership decisions, activity or trip generation, trips destination, mode choice for subset of trips and contribute to additional vehicles on roadway affecting traffic assignment. Further, the emergence of CAVs is likely to bring about major changes to the transportation system including significant changes to signal and parking infrastructure. Adoption of CAVs will have both long term (like residential location and vehicle ownership decisions choice) and short-term impact (like activity participation, travel mode and routing). One of the primary tools available to understand such potential impacts and future uncertainty are travel demand forecasting models (TDFMs). However, many of the current generation TDFMs do not explicitly include these NMOs.

The objective of the current research was to: *"develop a practitioners' guide for implementation of best practices for DOTs and MPOs looking to incorporate NMOs into TDFMs."*

Project Tasks and Outcomes

Towards accomplishing the objectives, the research team proposed to develop a *Guidance document for agencies* toward incorporating NMOs within a TDFM. The guidance document aims to provide jurisdictions with (a) a set of metrics to evaluate if TDFM needs to be updated for NMOs, (2) an outline of the TDFM modules that might need to be updated to incorporate the impact of NMOs, (b) a data-supported process to evaluate which modules need to be updated (including data needs), (c) model estimation guidance for modules selected for update, (d) performance measures to evaluate the effectiveness of the updated TDFM and (e) interpretation and analysis of the updated TDFM.

The research team conducted an exhaustive literature review of studies developing travel demand forecasting models (TDFMs) for NMOs from (a) academic articles (journal and conference papers) and (b) reports from transportation agencies including metropolitan agencies, US Department of Energy, US DOT and state DOTs. Based on the literature review, we identified three NMOs of interest for consideration in the guidance document including: (1) shared micro-mobility, (2) Transportation Networking Companies (TNCs) and (3) Connected and Autonomous Vehicles (CAVs). In total, 73 studies were summarized including 21 studies on shared micro-mobility, 27 studies on TNC and 25 studies related to CAV. Across the studies, the review provides information on the study region (for example state or city), the main variable of interest and the associated aggregation level, modelling approach employed, TDFM framework applicable (trip based/tour

based/activity based), TDFM components affected (such as trip generation/trip distribution/mode choice/traffic assignment) and if NMO was analyzed independently or within an integrated transportation system framework.

The update to TDFMs in response to NMOs will need to reflect the current state of practice in employing NMOs in TDFM modeling across transportation agencies in the US. The experience of stakeholders will play an important role in identifying the challenges in incorporating NMOs into TDFMs. The research team designed and disseminated an online survey to elicit responses from transportation professionals across the country. The survey questionnaire was organized into three different sections focusing questions on (a) current travel demand forecasting modeling tools, (b) potential changes already made or in consideration for new mobility options and (c) jurisdiction and respondent specific questions. In the first section, questions regarding operational TDFM, relevant components of the TDFM, frequency of TDFM update and challenges in updating TDFM were asked. In the second section, questions were focused along two different directions depending on whether NMO(s) is(are) considered or not. In the third section, questions were mainly focused on jurisdictions, demographics and respondents' role in the relevant agency. The survey analysis is conducted based on responses from 55 completed surveys. The survey analysis offered multiple insights. First, the survey results indicated that there is limited adoption of TDFM updates for NMOs. Second, the responses highlight interest among jurisdictions to adopt NMO impact within TDFMs. Third, the results showed that a large share of stakeholders are seeking resources to conduct TDFM updates. Thus, the main objective of the research project to *"develop a practitioners' guide for implementation of best practices for DOTs and MPOs looking to incorporate NMOs into TDFMs"* is timely and will be of value to stakeholders.

The research team prepared the guidebook based on the findings from preceding tasks to assist practitioners (at DOTs and MPOs) examining the impact of NMOs in their jurisdictions. The first part of the guidebook identifies different data-driven travel demand metrics that will allow the agencies to identify the direction and the potential magnitudes of NMO impacts on different components of the TDFM. The document provides practical approaches for agency personnel to conduct data driven evaluation of the impact of NMOs on travel demand in the jurisdiction. The demand metrics provided in the document will allow agency personnel to identify the potential TDFM components (if any) that are affected by NMOs. The second part of the guidebook focused on the approach to be employed for updating TDFM components. The document provides step-by-step instructions on how the different TDFM components can be updated. Using synthetic data, the guidebook illustrates the various updates necessary for TDFM components. As it is not feasible to illustrate changes to all TDFM components, the guidebook compiles use case examples for updating TDFMs in response to growing presence of NMOs. The three use case examples include: (a) vehicle ownership, (b) household trip rates and (c) mode choice. The use case examples are illustrated by using real world data for base scenario and simulated data for the NMO scenarios. The various datasets generated, the scripts employed for model re-estimation were included with a step-by-step tutorial for users. Given the significant professional and financial resources required to update TDFM obtaining an estimate of NMO impact can allow practitioners to make judicious decisions on TDFM updates. Agency personnel are encouraged to consider the data driven procedures provided along with their jurisdictional experience to finalize decisions on their TDFM update process. The overall tasks of this project were unique and challenging for several reasons:

- Real-world jurisdiction level data for evaluating the impact of NMO adoption is not readily available. This study made substantial efforts for collecting relevant data provided TDFM update procedure for three TDFM component as use case examples.
- The data for one TDFM are unlikely to include updates for multiple components. For example, only the mode choice model for the Triangle region TDFM was updated to include TNCs. So, this dataset will only be useful for one component.
- The small number of TDFM implementations do not allow us to develop a uniform template of TDFM updates with real world case studies. Even if we were able to develop models using real data, the data compilation process, scripts or model results cannot be directly used for other jurisdictions.

Recommendations for Implementation

Given the inherent challenges outlined above and the limited resources available to the team during the pursuit of the project, the current project is an ideal candidate for the NCHRP implementation program. The guidebook from the research provides a generic template for agency personnel to understand how NMOs can be incorporated within TDFMs. However, specific modifications for a jurisdiction-specific TDFM will need to be finalized in consultation with the agency using data from the jurisdiction. Due to the resource constraints, the research team could not work with agencies directly to build TDFM update implementations in our project. The research team proposes a plan to incorporate and implement these TDFM updates across multiple agencies in the US. As large urban regions are likely to have access to financial and technical resources to implement TDFM updates, the research team suggests working with three to five small and medium scale pilot projects for urban and rural regions to study the impact of NMOs in the TDFMs for these regions. The implementation team can compile data from these jurisdictions to employ the travel demand measures identified in the guidebook to examine potential changes in travel behavior. Subsequently, for TDFM components that are selected for update, the team can employ the necessary update strategy outlined in the guidebook (such a model re-estimation, or a model re-specification) to develop an enhanced TDFM framework. The team envisions a $80,000 per jurisdiction cost to evaluate and update the TDFM components.

The research team suggests the selection of agencies for the pilot projects based on panel member inputs and presentation of the project guidebook in TRB committee meetings (such as Travel Demand Forecasting (AEP50)). The project team will prepare a detailed PowerPoint style presentation that will illustrate the project results and how agencies will benefit from participating in the pilot project. The pilot project results and findings will offer several important outcomes including

- pilot projects will allow us to update the guidebook through practical implementation and allow us to further refine the metrics and update strategies
- TDFMs covered in pilot projects will broaden the scope of the guidebook and allow for wider applicability
- The implementation project can develop a lessons learned guide for practitioners on what are the most important challenges for NMO related TDFM update implementation process – a document of potentially great value for all agencies across the country based on real world TDFM update experience

The implementation team should work closely with the panel to identify candidate locations for pilot project implementation.