Research Problem Statement

ODOT Research Section
555 13th Street NE; Ste 2
Salem OR 97301-5192

Phone (503) 986-2700
Fax (503) 986-2844

I. TITLE

17-064 Understanding the Impacts of Household Budgets, On-demand and Shared Transportation Services (i.e., Zipcar), and Other Potentially Disruptive Shifts (i.e., CV/AV) on Future Mobility for Planning Decisions

II. PROBLEM

More so than at any other time in the last several decades, future projections for how people and goods will travel have become very uncertain. Over the past year and a half OSU, OSA, and ODOT have worked to better understand this uncertainty and its impacts to travel planning, performance measures, and policy decisions. This foundational work resulted in a cognitive map of how currently anticipated technologies and behavior shifts are connected and might influence one another. A fuzzy system dynamics modeler (FSDM) was developed and deployed to test the ranges of uncertainty that could exist around each technology and behavior.

From this research it was determined that several technologies and changes to the way transportation is provided stand to be some of the greatest potentially disruptive shifts in transportation. The research highlighted autonomous vehicles, mobile information technologies, transportation as a service, and light-weight electric vehicles, along with linkages to fixed route public transportation as deserving further exploration.

The previous research indicated that there was great uncertainty and great potential in these future aspects of transportation, however more research is required to better understand how these technologies could develop and impact future transportation performance measures and decisions. The previous research was only able to assess the potential for disruption at a very high level. A more refined purpose and approach is now needed to better understand potential implications. This was always the intent of the previous research: to serve as a guide for prioritizing more detailed research endeavors.

III. PROPOSED RESEARCH, DEVELOPMENT, OR TECHNICAL TRANSFER ACTIVITY

This research would set out to further investigate the potential impacts of household budgets, on-demand and shared transportation services, and other potentially disruptive shifts (i.e., connected and autonomous vehicles) and the impact this might have on household vehicle ownership (which is likely to decline as transportation as a service increases) and the relationship to public transportation and mobile information technology. The research would also incorporate the potential for light-weight automated and human powered vehicles to fulfill some of the travel needs, and potential safety aspects of an increased mix of autonomous, light-weight, and non-motorized vehicle travel.

It is currently envisioned that the Oregon Household Activity Survey (OHAS) records would be used to gain insight into how these future technologies might impact household travel decisions with budget constraints. The OHAS represents Oregonians' travel behavior captured in 2010. This research plans to use the travel behavior or needs of today to test how future technology might serve that need. In addition, it plans to test how changes in technology might alter the behavior seen today, given that the need can still be met or improved on using future technology; for example, a traveler might change a discretionary shopping trip destination if the speed at which they can travel would be significantly improved). Some of the specific research tasks include but are not limited to:

Task 1: *Literature Review:* A thorough literature review about the impacts of household budgets on travel decisions (i.e., families who spend 6% of household budget on mobility versus 19% for car owners), on-demand and shared mobility, and other potential disruptive technologies (i.e., connective vehicle (CV)/ autonomous vehicle (AV)) on the future of mobility.

Task 2: *Vehicle ownership and use modeling*: using the OHAS/CES and NHTS dataset: model vehicle ownership and fleet composition considering technology options/bundles and costs, on-demand mobility services and costs, willingness to share/pay under limited household budgets.
Task 3*: Evaluation of the adoption pace of emerging technologies* (i.e., internet and social media use, use of car-sharing or on-demand mobility services) and different scenarios on how emerging technologies will impact VMT. For example, this may replace a drive-alone trip with Uber + transit or other combo (solves transit's first- and last-mile problem). This may also eliminate a personally owned vehicle (separately), reducing unnecessary trips, and on-demand vehicles may generate additional VMT by cruising or deadheading.
Task 4: *Identification of CV and AV's impacts* on mobility and future VMT for varying market penetration through scenario simulations. For example, what is the net impact of AVs on transit and mobility opportunities for economically disadvantaged populations by addressing the first- and last-mile problems? This may displace a transit trip (not only increasing VMT, but undermining transit); this may replace one carpool trip with multiple single-ride AV trips; by making travel easier and cheaper AVs may encourage new trips to be generated. Furthermore, the time saved from using an increasingly efficient mode may further encourage additional trip generation.
Task 5: *Integration of vehicle fleet composition, usage, and evolution model system* to capture technology penetration time frames seeking to answer the question, will personal vehicle ownership become a relic of the past?
Task 6: *Final report:* considering the disruptive options/forces/technologies together in a holistic manner.

IV. POTENTIAL BENEFITS

Using OHAS to see how future technology could meet or exceed (and shift) current travel demand, needs, and desires will help provide better insight into how to incorporate and address these future technologies (such as lightweight electric vehicles and autonomous vehicles) in future transportation models, plans, and ultimately decisions.
These technologies have the potential to greatly impact transportation planning performance measures and decisions; however the generality of the previous research did not allow investigation of the mechanisms that would cause changes to occur. This further research and understanding would provide information needed to better understand the likelihood and the more detailed aspects of how the technologies could relate to one another and impact travel decisions. With this improved understanding, ODOT-TPAU would be positioned to incorporate these future technologies and potential behavior shifts into Oregon's travel demand modeling, forecasting, and planning, if deemed appropriate after the research. This would allow TPAU to provide better estimates of uncertainty and potential future outcomes to better assist planning efforts, and transportation project and funding decisions.

V. IMPLEMENTATION

Assuming that this research identified that the findings should be incorporated into risk assessment and planning around future uncertainty, the results from this work would be incorporated into ODOT-TPAU's travel demand models. Currently, TPAU is developing Activity Based Models (ABM) for Oregon MPOs. ABMs are a new platform for modeling travel behavior. The ABM platform is very flexible and better allows for testing the types of technology and behavior shifts currently scoped in this research. After the research is conducted and the shifts and levels of impact are better understood, those findings could be modeled in the ABM environment and could provide ranges of uncertainty around the assuming that technology and behavior remains very similar to today's. This range of uncertainty would better inform planning projects and decisions.

VI. LIST OF REFERENCES *(optional)*

Previous Research and their associated literature reviews:

1. Potential Changes to Travel Behavior/Patterns in the Next 20-40 Years Phase I: Cognitive Map
2. Potential Changes to Travel Behavior/Patterns in the Next 20-40 Years Phase II: Fuzzy Cognitive Map

VII. CONTACT INFORMATION

Your name: _Alex Bettinardi, Haizhong Wang, Brian Gregor Person Responsible for Implementation: Alex Bettinardi

Affiliation: ODOT-TPAU, OSU, OSA
Telephone: 503-986-4104/541-737-8538
Email: alexander.o.bettinardi@odot.state.or.us, Haizhong.Wang@oregonstate.edu, gregor@or-analytics.com

Affiliation: ODOT-TDD-Planning-TPAU
Telephone: 503-986-4104
Email: alexander.o.bettinardi@odot.state.or.us