Exhibit D – Research Project Requirement Template

Generative AI-based Framework for Modeling Longitudinal Travel Behavior Adaptation Under Transportation Interventions

Recipient/Grant (Contract) Number: The University of Texas at Austin/Grant # 69A3552344815 and 69A3552348320

Center Name: National Center for Understanding Future Travel Behavior and Demand (TBD)

Research Priority: Improving Mobility of People and Goods

Principal Investigator(s): Srinivas Peeta

Project Partners: N/A

Research Project Funding: $250,000 ($125,000 Federal + $125,000 matching funds)

Project Start and End Date: 6/1/2026 - 5/31/2027

Project Description: Transportation agencies deploy a wide range of interventions, including behavioral strategies, network modifications, pricing mechanisms, infrastructure improvements, and safety-focused measures (such as corridor redesigns and pedestrian signal retiming), to influence travel behavior and manage demand. While a broad range of approaches have been used to model travel behavior dynamics, such as discrete choice models, hidden Markov models, activity-based frameworks, and reinforcement learning approaches, modeling how behavioral responses manifest, strengthen, or decay over repeated exposure to transportation interventions remains relatively underexplored. This project will address this gap by developing a novel framework that integrates a Generative AI-powered behavioral simulation engine with a longitudinal stated preference (SP) study to model, calibrate, and validate the temporal evolution of travel behavior in response to transportation interventions. Leveraging large language models' capability to reason through open-ended behavioral scenarios using pre-trained human knowledge, the engine will construct heterogeneous traveler agents with persona profiles that vary across sociodemographic characteristics, mode preference, trip purpose, risk tolerance, and sensitivity to intervention type. These agents will simulate the full range of behavioral adaptation over time, capturing dynamics such as habit formation, inertia, and resistance to change. A longitudinal stated preference study, deploying scenario-based stimuli via Qualtrics to a panel recruited through Prolific, will provide the empirical basis for calibrating, fine-tuning where appropriate, and validating the engine against observed traveler responses. Safety-focused interventions will serve as the instantiation domain, chosen because they produce measurable, heterogeneous changes in travel behavior and demand that are well-documented. The resulting framework will be intervention-agnostic and transferable, providing transportation planners an evidence-based tool for evaluating long-term behavioral implications of interventions prior to their deployment in the real world.

US DOT Priorities: This project advances TBD's mission to understand evolving travel behavior and demand under technological, policy, and societal changes. It addresses the Center's "Understanding User Needs" thrust by modeling heterogeneous travelers as agents with distinct sociodemographic profiles, mode preferences, trip purposes, risk tolerances, and sensitivities to interventions, enabling analysis of who adapts, resists, or benefits in the short and long run. It also contributes to "Data Modeling and Analytic Tools" by developing a GenAI-powered longitudinal behavioral simulation engine, calibrated and validated with repeated stated-preference observations, to reveal behavioral evolution, habit formation, inertia, and decay in response to transportation interventions. Additionally, the longitudinal survey panel and scenario-based intervention stimuli support "Data Collection Mechanisms" by generating behavioral data under repeated intervention exposure. By linking empirical panel data with an intervention-agnostic simulation

framework, the project provides actionable evidence for evaluating transportation interventions before deployment.

Outputs: The anticipated project outputs are:

- A GenAI-powered behavioral simulation engine built on LLM-based agents configured with heterogeneous traveler persona profiles, capable of simulating how travel behavior evolves across repeated intervention exposure, capturing dynamics such as habit formation, gradual adoption, and resistance to change across heterogeneous traveler profiles, with a modular architecture designed for integration with established traffic simulation platforms.
- Behavioral models that capture dynamic adaptation processes, including habit formation, inertia, and resistance to change.
- A longitudinal panel dataset capturing individual-level behavioral trajectories across multiple survey waves, collected via Qualtrics and Prolific, documenting traveler responses to safety-focused intervention scenarios.
- A calibration and validation framework that links longitudinal stated preference data with simulated agent behavior to evaluate and improve model realism over time.
- Peer-reviewed publications, conference presentations, and publicly available resources including model code, analytical tools, and curated datasets to support replication and further research.

Outcomes/Impacts: The anticipated project outcomes are:

- Increased understanding of how travelers modify behaviors over repeated exposure to transportation interventions.
- Improved ability of researchers and practitioners to account for temporal behavioral processes, such as habit formation, inertia, and resistance to change, in transportation planning and analysis.
- A stronger empirical basis for assessing the behavioral effectiveness of transportation interventions before deployment, thereby supporting more informed planning, policy, and investment decisions.
- Advancement of travel behavior modeling practice through empirically calibrated and validated approaches that extend existing behavioral modeling frameworks in their representation of evolving traveler responses to transportation interventions.

The anticipated project impacts are:

- Improved transportation planning and policy evaluation through a validated behavioral simulation framework that enables agencies to assess potential long-term traveler responses to interventions before implementation, thereby supporting more robust and informed decision-making.
- Broader scientific contributions to transportation engineering and behavioral science through an intervention-agnostic behavioral simulation framework that can be extended across diverse transportation intervention types and planning contexts, reducing the need to develop new modeling infrastructure for each application.
- More effective design of transportation interventions by providing empirically grounded evidence on when and how behavioral responses manifest, persist, or diminish, enabling implemented strategies to more reliably achieve their intended objectives.
- Contribution to transportation workforce development through new research tools, datasets, and methodological foundations that can support training and future work in data-driven, behaviorally informed transportation analysis.

Final Research Report: A URL link to the final report will be provided upon completion of the project.