Exhibit D – Research Project Requirement Template

Behavior-Aware Evaluation of Emerging Vehicular Technologies

Recipient/Grant (Contract) Number: The University of Texas at Austin; Arizona State University/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): Yanbing Wang

Project Partners: N/A

Research Project Funding: $50,000

Project Start and End Date: 06/01/2025 – 05/31/2026

Project Description: Emerging vehicular technologies such as vehicle-to-everything (V2X) and cooperative driving automation (CDA) have the potential to improve traffic operation and safety. However, their effectiveness hinges not only on technical performance but also on how users (mainly drivers) perceive, interpret, and respond to these systems. Past USDOT-sponsored pilot deployments have demonstrated promising benefits but also revealed critical challenges related to adoption, usability, and behavioral compliance. This project addresses these gaps by developing a behavior-aware, simulation-based digital testbed to evaluate the operational and safety impacts of these vehicular technologies under realistic traffic and behavioral conditions.

The core innovation of this testbed is its grounding in the Theory of Planned Behavior (TPB), a behavioral science framework that models user decision-making based on attitude, perceived norms, and perceived behavioral control. These elements are translated into probabilistic, agent-level responses to vehicular advisories such as speed guidance or queue warnings, to capture realistic and heterogeneous driver behavior across scenarios. The testbed will be calibrated using high-resolution traffic data and demonstrated through two real-world case studies: a freeway corridor in Tennessee and a signalized arterial in Chicago.

The final product will be an interactive, web-based dashboard that allows users to configure behavioral and technology adoption parameters, visualize outcomes, and evaluate system performance across key metrics such as delay, travel time, and surrogate safety indicators. This research supports more informed and behaviorally realistic deployment strategies for emerging vehicle technologies.

US DOT Priorities: This project aligns with USDOT's Transformation Priority Area by advancing innovative modeling and decision-support tools to guide the deployment of emerging vehicle technologies. It also supports key KPIs via AI-driven calibration (Novel Data/Technology Approaches) and an interactive dashboard for sharing insights (Digital Forum Development).

In addition, this project supports the "Intelligent, People-Centered Systems" priority (USDOT RD&T Plan, pp. 51–52). By embedding behavioral science into the evaluation of vehicular technologies, this study directly addresses the human factors dimension of future mobility systems. It also supports the "Data-Driven Insight" priority (pp. 58–59) by sharing an interactive dashboard

that enables stakeholders to analyze the combined impact of behavioral heterogeneity and technology penetration on operational performance.

Outputs: The anticipated outputs of this research project are three-fold. First, a web-based dashboard that showcases the insights from the behavior-aware digital testbed will be delivered. The underlying digital testbed integrates Theory of Planned Behavior modeling with calibrated traffic simulation. It enables transportation agencies and technology developers to evaluate V2X and CDA technologies under realistic human response scenarios. Second, the project will provide deployment strategy guidelines derived from case studies of the Tennessee freeway corridor and Chicago urban arterial and offer practical insights on technology implementation approaches that account for behavioral adoption factors across different operational contexts. Finally, the findings will be disseminated through academic publications and conference presentations to advance the knowledge base in human-technology interaction within transportation systems. These outputs collectively advance in how transportation technologies are evaluated and address a critical gap between technical capabilities and human adoption patterns that potentially impact the effective deployment of emerging vehicular technologies.

Outcomes/Impacts: This research will advance transportation technology evaluation by enabling behavior-aware assessment approaches. It aims to inform transportation agencies and developers to adopt more realistic testing protocols that account for human-technology interactions, leading to improved technologies that better align with user behaviors. Insights from this work will inform policy decisions and contribute to the development of standards for digital infrastructure, with the potential to influence regulatory frameworks for connected vehicle deployment. In the long term, the proposed framework may shape future evaluation protocols by establishing a new standard that centers human behavior in technology assessment and supports user-prioritized deployment strategies.

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