**Exhibit D**

**Research Project Requirement Template**

## Vehicle Edge Computing for Travel Behavior and Demand in Future Intelligent Transportation Systems (ITS)

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

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

**Research Priority:** Improving Mobility of People and Goods

**Principal Investigator(s):** Yunsheng Wang

**Project Partners:** N/A

**Research Project Funding:** $83,832 (Federal funding)

**Project Start and End Date:** 6/1/2024 - 5/31/2025

**Project Description:** Meeting the diverse needs of stakeholders such as passengers, drivers, and service providers is imperative. Modern travelers seek real-time updates and personalized journey experiences. Drivers need consolidated data for safety and punctuality (Chen et al., 2021), while service providers rely on data analytics to optimize resources and enhance reliability (Wang et al., 2020). Traditional centralized computing infrastructures struggle with the agility and responsiveness needed in the dynamic transportation landscape (Li et al., 2017). Edge computing emerges as a transformative solution by offloading computational tasks to roadside units. This enables swift processing for real-time applications, facilitating dynamic route optimization, congestion management, and resource allocation, thereby enhancing operational efficiency and reducing travel times. The project will investigate how edge computing impacts travel behavior. Field studies and simulations will measure travelers' responsiveness to real-time data and how it influences their travel choices and demand patterns. This ensures the research is relevant to travel behavior studies.

Edge computing not only enhances current transportation operations but is also crucial for autonomous vehicles. It allows real-time data processing and analysis for navigation, hazard detection, and collision avoidance. By leveraging edge computing, autonomous vehicles can offload computational tasks, alleviating the burden on onboard systems and ensuring seamless, responsive data processing without compromising safety or performance. The collaborative framework between autonomous vehicles and roadside units facilitates continuous learning and adaptation. Real-time access to advanced computing enables autonomous vehicles to use machine learning for predictive analysis, enhancing their ability to anticipate and respond to changing road conditions and traffic patterns. Integrating edge computing with autonomous vehicles creates a symbiotic relationship that enhances autonomous driving systems and accelerates the development of safer, more efficient transportation systems. This aligns the project with the theme of improving the mobility of people and goods, fitting the TBD center's priorities.

Work Plan:

1. Problem Definition: Clearly define the challenges in current travel behavior understanding and how real-time data processing via edge computing can address these.
2. Field Studies: Conduct studies in urban areas with heavy traffic to measure real-time responses of travelers.
3. Simulation Models: Develop simulation models to predict changes in travel demand based on different data scenarios.

4. Data Analysis: Analyze data from field studies and simulations to derive actionable insights.
5. Framework Development: Create a scalable framework for implementing edge computing in transportation systems.
6. Evaluation: Assess the scalability and cost-effectiveness of the proposed solutions.

**US DOT Priorities:** Research Priority: Data-Driven Insight: This project, focusing on Vehicle Edge Computing for Travel Behavior and Demand in Future Intelligent Transportation Systems (ITS), addresses the Data Science aspect of this priority. By utilizing advanced edge computing for real-time data processing, it aims to provide actionable insights for transportation decision-making. Through research, it develops tailored mobility data analytics methods and accessible tools for stakeholders.

Research Priority: New and Novel Technologies: Under the Automation aspect, the project advances edge computing in transportation. It establishes safety assessment frameworks, infrastructure, and methodologies for edge-based automated systems, ensuring responsible deployment. Additionally, it aligns with optimizing roadway infrastructure for digital and automated systems, emphasizing the integration of edge computing to support future transportation technology.

**Outputs:** The anticipated outputs for the proposed research include: 1) Edge Computing Framework: A developed framework for implementing edge computing solutions on roadside infrastructure to collect, process, and analyze transportation data in real-time within ITS environments; 2) Impact Analysis: Comprehensive analysis on the impact of edge computing applications on enhancing passenger satisfaction, safety, and operational efficiency, particularly for autonomous vehicles, providing valuable insights for policymakers and industry stakeholders; 3) Scalability Assessment: Evaluation of the scalability, reliability, and cost-effectiveness of vehicle edge computing infrastructure in large-scale transportation networks, offering guidance for future implementation and investment decisions, 4) Research Publications: Findings disseminated through publications in prestigious journals and presentations at key conferences, facilitating knowledge exchange and fostering collaboration within the research community.

**Outcomes/Impacts:** The anticipated outcomes of this research are manifold and have the potential to instigate transformative changes in the transportation sector: 1) The insights gained from this research could lead to the development of policies and regulations that promote the integration of edge computing into ITS, fostering innovation and enhancing the efficiency and safety of transportation networks; 2) By leveraging edge computing for real-time data processing, transportation agencies can improve operational efficiency, leading to reduced congestion, shorter travel times, and enhanced passenger experiences; 3) Edge computing applications could enable dynamic risk assessment and mitigation strategies, leading to improved safety protocols and a reduction in transportation-related accidents; 4) Optimized resource allocation facilitated by edge computing could result in cost savings for transportation agencies and improved overall economic performance of transportation systems. Overall, the research aims to catalyze the adoption of edge computing technologies in transportation, ushering in a new era of efficiency, safety, and sustainability in the sector.

The anticipated impacts of this research are substantial and wide-ranging: 1) By optimizing data processing through edge computing, the project aims to improve demand management, reduce congestion, and enhance operational efficiency within the transportation system; 2) Real-time insights generated by edge computing applications could lead to proactive safety measures, potentially reducing fatalities and injuries on roadways; 3) The adoption of edge computing technologies has the potential to decrease capital and operating costs for transportation agencies, allowing for more efficient resource allocation and infrastructure management, 4) The research outcomes will contribute to the body of scientific knowledge by exploring the effectiveness of edge computing in transportation, fostering innovation, and informing future research endeavors.

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