Exhibit D – Research Project Requirement Template

Real-Time Transportation Origin-Destination Demand Estimation Using Multimodality Data

Recipient/Grant (Contract) Number: The University of Texas at Austin; University of Washington/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): Xuegang (Jeff) Ban

Project Partners: N/A

Research Project Funding: $60,000

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

Project Description: Real-time origin-destination (OD) demand estimation is essential for urban transportation management, enabling responsive traffic control, dynamic transit scheduling, e-hailing services, and emergency operations. Traditional OD estimation methods rely heavily on traffic sensor data and statistical modeling; but the limited coverage of sensors in most cities poses a significant challenge. Emerging data sources—such as mobile trajectories from smartphones and connected vehicles, and textual traffic information from reports or social media—offer promising alternatives for capturing real-time mobility patterns at scale and lower cost. However, current approaches often fail to integrate these heterogeneous data sources into a unified framework.

This project proposes a multimodal learning framework that fuses traffic time series data, mobile trajectory data, and transportation-related textual information to improve real-time OD demand estimation. Static OD matrices serve as a prior, which are dynamically adjusted based on real-time multimodal inputs. We leverage time series models for traffic counts, sequence and graph-based methods for trajectory data, and large language models to extract OD-relevant insights from text. Additionally, we aim to construct a hybrid dataset combining traffic counts, mobile trajectories, and text, derived from simulation or real-world sources, to support model development and benchmarking. Our work seeks to advance robust, scalable, and intelligent mobility solutions.

By integrating multimodal data sources in real-time OD estimation, our framework not only estimates OD demands but also provides deeper insights into travel behavior, particularly in destination and path selection. The fusion of trajectory patterns with contextual textual cues enables us to infer why travelers choose certain destinations—whether due to events, service availability, or disruptions. Similarly, sequence-based modeling of trajectories reveals preferred routes, shedding light on dynamic path choices under varying traffic conditions. This enriched understanding supports the development of more adaptive and human-centric transportation systems, informing planning decisions, optimizing route recommendations, and enhancing real-time traffic interventions based on actual travel motivations and behaviors.

US DOT Priorities: The project addresses the following priority areas:

1. Harness advanced data collection and data processing capabilities to create timely, accurate, credible, and accessible information to support transportation operations and decision-making.

2. Open data standards and accessible data portals enable shared use of anonymized data to support real-time operations, enhance data analysis and predictive analyses, and enable more responsive, data-driven municipal services.

Outputs: This project will develop novel methodologies for real-time OD estimation with traffic counts, mobile sensing data and text information. In addition to methodological contributions, we anticipate generating high-quality datasets that can support future research in travel behavior and OD analysis. This work is expected to contribute to both the transportation and computer science communities.

Outcomes/Impacts: Our new multimodal data fusion framework will provide a better strategy for real-time OD demand estimation, which is critical to elevate demand management, mitigate congestion, and reduce traffic incidents. This leads to improved real-time traffic management, policy and legislative enhancements prioritizing data-driven decision-making, and broader adoption of novel practices. Ultimately, this ongoing process fosters technological innovation, knowledge advancement, and policy reforms, culminating in a more efficient, safer, and sustainable transportation ecosystem.

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