Exhibit D – Research Project Requirement Template

Integrating Microsimulation in a Multi-scale Local Freight Activity Model

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): Alison Conway, Michael Grossberg, and Camille Kamga

Project Partners: N/A

Research Project Funding: $200,000 ($100,000 Federal and $100,000 CCNY Match)

Project Start and End Date: 6/01/26 – 5/31/27

Project Description: This project builds on results from prior TBD Center projects to advance the development of a multi-scale, synthetic data-based simulation framework for evaluating urban freight policy and infrastructure interventions. In Phase 1, we conducted a comprehensive review of existing freight data sources and machine learning- and generative-AI based approaches to address persistent data gaps for local freight decision-making. In Phase 2, we are developing a novel simulation framework to synthesize detailed truck path segments at a traffic analysis zone (TAZ) scale, and testing the utility of this synthetic data for evaluating before-after implementation scenarios for urban freight policies. While this TAZ scale simulation enables us to represent the total activity within a zone – including time spent in specific vehicle states (e.g. moving, stopping, idling) – it does not yet represent location- or segment-specific activity within the zone. However, many urban freight interventions of interest to local cities - such as street design changes, lane or signal prioritization, parking and loading regulations, and segment-specific access controls - require this more detailed granularity. This Phase 3 study aims to address this gap.

Many recent freight microsimulation studies have used agent-based modeling approaches to simulate freight stakeholder decisions. Within the US, these are typically implemented at a national, state, or regional scale, and focus on individual decisions such as mode choice, route choice, or parking location choice. These studies rely on proxies like land use or industry to generate freight trips or commodity flows, which are then assigned using traditional traffic modeling approaches (e.g., user equilibrium) or statistics from literature or surveys, limiting adaptability to other decision types. Other studies assess city logistics interventions (e.g. vehicle electrification, consolidation center placement) using optimization-based approaches to fixed vehicle fleets, with objective functions minimizing logistics-related costs. Reinforcement learning appears frequently in the transportation literature but with limited freight applications. This approach could potentially be implemented to represent truck behavior as an agent that learns from repeated experience - choosing, at the segment-level, which street to traverse or where to stop, and receiving feedback based on travel or dwell time – with TAZ-scale synthetic activity defining how much activity occurs in a zone and the agent resolving where it occurs.

The aim of this project is to define a simulation framework that could integrate TAZ-scale vehicle activity inputs, be implemented within a TAZ at a population scale to simulate segment-level activities, and be adaptable to simulate multiple local decision types. This project phase has three objectives: (1) to identify best-available microsimulation approaches for evaluating micro-scale freight interventions; (2) to assess the utility of machine learning approaches – in particular reinforcement learning - to improve upon static decision-assignment processes within these simulations; and (3) to develop a scalable and adaptable framework for microsimulation of freight interventions that integrates TAZ-scale truck paths with highresolution segment-level activity. Key project tasks include: (1) a comprehensive synthesis of existing freight microsimulation studies, (2) feasibility analysis of reinforcement learning for freight operator route choice and behavioral modeling, (3) development of a proposed graph structure for simulating varied freight-related interventions within a traffic microsimulation model, and (4) evaluation of common simulation tools (e.g., VISSIM, SUMO) to assess their native capability to represent the proposed graph structure.

US DOT Priorities: This project addresses US DOT's key priorities of transformation and safety. The project aims to develop a framework for integrating emerging analytics approaches - including synthetic data generation and reinforcement learning for decisions-assignment processes - into practical traffic micro-simulation for analysis of local, segment-scale urban freight interventions. By improving the ability of agencies to simulate, rather than pilot, local policy and infrastructure changes, the project can help to both advance new urban freight management solutions that address traffic congestion and related externalities – including collision risk - and to avoid economic and safety risks associated with implementation in uncertain conditions.

Outputs: In addition to the project ***final report***, this project will produce two primary outputs. First, this project will define an implementable ***framework*** for simulating urban freight activity, and the impacts of urban freight-related interventions, at a segment level as part of a multi-scale simulation framework. The framework will be detailed in the project report. Second, this project will also produce a ***practical guide*** to assist freight and traffic modelers to more effectively represent detailed freight activities in traffic micro-simulations. The project will produce a comprehensive synthesis of micro-simulation and reinforcement learning approaches suitable for modeling local freight operator decisions, and will also provide an assessment of the suitability of existing freight microsimulation and traffic modeling tools to evaluate the impacts of specific freight-related interventions. Results will also be published in an academic journal and presented at relevant professional conferences.

Outcomes/Impacts: This project addresses a critical need in state and local agencies for adaptable tools for street level simulation and assessment of varied urban freight-related interventions. Currently, many state and local governments are interested to implement both city logistics strategies (e.g. consolidation centers, lockers, and micro-hubs) and street and curb management approaches (e.g. truck-only lanes, freight signal prioritization, priced or regulated loading zones) to manage the significant impacts of freight activities on local street networks while maintaining freight access for local businesses and residents. However, due to privacy-related data access barriers, they typically lack the data granularity and the freight-specific traffic simulation tools to evaluate the impacts of interventions. In the short term, this project will produce immediate guidance for agencies to improve the representation of freight activities in traffic micro-simulation. In the long term, the project will produce a multi-scale implementable framework for simulation of freight activities at different granularities for evaluation of varied freight-specific interventions.

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