

Exhibit D – Research Project Requirement Template

Household Vehicle Holdings and Composition: A Multi-Dimensional Analysis of Body and Fuel Type Choices

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): Chandra R. Bhat

Project Partners: N/A

Research Project Funding: \$75,000

Project Start and End Date: 06/01/2026 – 05/31/2027

Project Description: Household vehicle ownership is the foundation of personal mobility for the vast majority of American families. The number of vehicles a household owns, and the specific types of vehicles in its fleet, determine how household members access employment, healthcare, education, and services, and directly generate the travel demand that shapes roadway utilization, network performance, and infrastructure needs. Accurately representing how households make vehicle fleet decisions is therefore essential for travel demand forecasting, long-range transportation planning, and the design of policies that support reliable and efficient system operations.

While a substantial body of research has examined vehicle holdings, several important gaps remain. Most existing studies treat vehicle ownership as a single aggregate outcome, failing to jointly model the count of vehicles owned alongside the specific body-type and fuel-type composition of the household fleet. Even studies that examine fleet composition, often using the multiple discrete continuous extreme value (MDCEV) modeling approach (Bhat and Sen, 2006; Augustin et al., 2015; Chakraborty et al., 2023), identify only whether at least one vehicle of each type is present, rather than modeling the count of vehicles in each category. This is a meaningful limitation as many households own more than one vehicle of the same body type, and the specific count in each category has direct implications for household mobility capabilities and system-level demand generation. Further, existing studies do not allow for a direct effect of total fleet size on preferences for specific vehicle types. This is an important consideration because a household adding a second or third vehicle faces a fundamentally different choice context than one purchasing its first, and the body type preferred as a secondary addition to an existing fleet may differ substantially from a household's primary vehicle choice. Failing to account for these factors limits the accuracy of fleet-level demand forecasts and the ability of planners to anticipate how household vehicle availability translates into system demand.

This project addresses these gaps by developing a multivariate ordered-response probit (MORP) framework that jointly models household fleet size alongside the count of vehicles in each of twelve body-type and fuel-type combinations, including six body types (SUV, sedan, pickup truck, compact, minivan, and sports car) and two fuel types (internal combustion engine and electric). A key methodological contribution is the normalization of the likelihood function to ensure that the sum of vehicle counts across all body-type and fuel-type categories equals the total fleet count, eliminating infeasible outcome combinations while enabling direct estimation of the effect of total fleet size on preferences for specific vehicle types. The analysis uses data from the 2024 Transportation Heartbeat of America (THA) survey, a large national sample of households, supplemented with built environment data from the EPA Smart Location Database. The modeling framework also incorporates three latent attitudinal constructs capturing the degree to which individuals prioritize sustainability in transportation decisions, the extent to which

safety considerations shape personal travel choices, and the degree to which individuals view vehicles as social signals rather than functional assets. The inclusion of these attitudinal variables reveals the indirect pathways through which household demographics shape vehicle fleet composition, providing specific avenues for policy changes to influence vehicle holdings.

The results will enable metropolitan planning organizations and state DOTs to improve vehicle fleet representation in activity-based travel demand models, replacing aggregate ownership assumptions with behaviorally grounded estimates of fleet size and body-type composition that more accurately reflect how households generate travel demand. By quantifying how total fleet size directly influences body-type preferences, the project will improve the accuracy of vehicle availability estimates used in household-level travel demand analysis, supporting more reliable forecasts of trip generation, vehicle utilization, and peak-period demand. Together, these contributions will improve the reliability of transportation forecasting tools and support more effective, evidence-based decision-making for infrastructure investment and long-range system planning.

US DOT Priorities: This project directly supports the TBD Center's focus on advancing data modeling and analytic tools for understanding travel behavior and demand. It addresses a specific and consequential gap in how household vehicle fleet decisions are represented in transportation planning practice, with particular attention to the joint nature of fleet size and body-type composition decisions. In doing so, the project supports improved assessments of roadway capacity needs, parking demand, and travel demand management. This project will generate implementation-ready findings that can be used to support infrastructure improvements, transportation planning, and demand management policies that can yield tangible benefits for roadway users.

Outputs: Expected research outputs include a peer-reviewed journal publication and conference presentations to disseminate findings to research and practitioner audiences. These outputs will include a detailed modeling framework used for representing household vehicle holdings as well as tangible recommendations for improving vehicle fleet representation in activity-based travel demand models and other transportation forecasting tools. The project will also generate a guidebook for transportation agencies that translate model findings into improved planning practice, including specific recommendations for updating vehicle availability inputs, refining trip generation estimates by vehicle type, and improving the accuracy of long-range demand forecasts used in infrastructure investment decisions.

Outcomes/Impacts: The project will improve the ability of transportation agencies to represent household vehicle ownership behavior in travel demand models, leading to more accurate forecasts of trip generation, vehicle utilization, and peak-period network demand. Specifically, by providing quantified estimates of how fleet size and body-type composition vary across demographic and attitudinal segments, the research will support more reliable inputs for vehicle availability modeling, roadway capacity planning, and system utilization assessment. These improvements will enhance the quality of evidence available to metropolitan planning organizations and state DOTs when making infrastructure investment decisions and evaluating long-range transportation system performance.

More accurate fleet composition inputs will lead to better-calibrated assessments of roadway demand, aggregate vehicle mix, and system utilization, directly improving the quality of capacity planning, operations analysis, and long-range infrastructure investment decisions made by transportation agencies. For roadway users, these improvements can yield practical benefits, leading to reduced congestion, more reliable travel times, and more efficient system operations resulting from planning and investment decisions that are better calibrated to actual travel demand. Finally, by identifying how household demographics, attitudinal constructs, and built environment characteristics jointly shape vehicle ownership patterns, the research will also help agencies better anticipate where demand is concentrated and how it is likely to evolve, supporting investment decisions that more accurately reflect the mobility needs of all households and communities the transportation system serves.

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