

Exhibit D

Research Project Requirement Template

The Reverse Side of Online Shopping: Examining Sociodemographic and Built-Environment Determinants of Delivery Returns

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): Chandra Bhat

Project Partners: N/A

Research Project Funding: \$150,000 (Federal + non-Federal funding)

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

Project Description: E-commerce growth has transformed retail, offering unparalleled convenience but causing a surge in product delivery returns. Industry reports show 30% of online purchases are returned, compared to 9% for brick-and-mortar stores, resulting in an \$817 billion financial burden in 2022, with online retail accounting for a quarter. The impacts extend beyond finances, straining logistics and transportation networks, increasing vehicle miles traveled, emissions, and urban truck traffic. Retailers may need to expand urban logistics infrastructure, but strategic planning is required to mitigate pressures on congested areas. Despite these implications, delivery returns remain under-researched, with studies focusing on product details or retailer policies rather than consumer-level factors driving return decisions, particularly in the U.S. market. This study aims to bridge this gap by examining how sociodemographic factors (e.g., age, gender, income) and built-environment characteristics (e.g., urbanity, access to return options) influence the frequency and channel choice for returning online purchases. We analyze responses from the NHTS 2022 survey regarding the frequency of returns through four channels: home pickup, post office/UPS/FedEx, Amazon drop-off center, and direct store returns.

The approach contributes to existing knowledge in four ways. First, we use a joint multivariate ordinal-response modeling approach, which is suited for this analysis as the data indicates that reported frequencies of returns per 30 days are generally less than 4 times for each channel. Second, through joint modeling, we can control for unobserved factors that lead to associations among the counts of the four return channels. For example, if an individual values convenience, they may be predisposed to selecting home pickup while also prioritizing returns at local mail carriers but be less likely to make dedicated trips to Amazon drop-off centers. Ignoring this correlation could lead to inaccurate estimates and inappropriate policy implications. Third, in addition to individual and household characteristics, we include zip code-level built-environment variables (including the density of residential location, land-use mix, number of mail carriers, and number of Amazon drop-off centers). Such built-environment factors reflect accessibility conditions that are important determinants of return choices. It is important to note that while factors such as return policies and shipping costs are critical in return decisions, the study design precludes their inclusion because we are analyzing aggregate counts of returns over a 30-day period rather than examining each return occasion individually. While we acknowledge the significant impact these factors have on return behavior, the methodology does not allow for their incorporation. Future research could potentially address this limitation. Fourth, we estimate the magnitude effects of variables that quantify how much increasing or decreasing a variable would actually affect the delivery return frequency by channel. This analysis allows

policymakers and industry stakeholders to quantify the potential impact of interventions or changes targeting specific variables.

US DOT Priorities: “Data-Driven Insight” (RD&T Plan, pp.58-59) is a key theme in this study, which utilizes NHTS data to contribute to studying return frequency and channel preferences. Through exploring this data and applying advanced models, we aim to assess and strategically plan for the changes that returns will bring to transportation systems.

The proposed work also aligns with "Sustainable and Resilient Infrastructure" objectives (RD&T Plan pp.44-49). By analyzing factors influencing returns, this study informs the development of strategies for reducing return rates and mitigating their adverse environmental impact, thereby informing more sustainable and resilient approaches to transportation planning.

Technology transfer efforts will encompass publishing findings in relevant transportation, e-commerce, and consumer behavior journals, presenting at conferences to reach industry professionals and policymakers, utilizing online professional networks (e.g., LinkedIn) to disseminate summaries to a wide audience, and establishing an open-access GitHub repository for data and models for community use and contribution. These efforts align with USDOT's priorities to make "R&D results [are made] widely available to other scientists, to the public to facilitate understanding and decisions, and to innovators and entrepreneurs who can translate them into the businesses and products that will improve all of our lives" (Page 64).

Outputs: The proposed research study shall result in a paper that will be submitted to a relevant journal. Also, the paper will be submitted to and presented at relevant conferences and meetings. The dataset compiled for this project as well as detailed formulations of the analytic models used will also be appropriately documented and made available for public use.

Outcomes/Impacts: The outputs of this project contribute to the body of knowledge by investigating how a host of sociodemographic and built-environment differences impact consumers' online returns. By identifying societal segments more likely to return products, and their preferred return channels, we are able to design targeted interventions that reduce return rates. Additionally, this information enhances awareness of logistical challenges and inefficiencies associated with high return volumes, allowing stakeholders to develop strategies that mitigate associated costs and adverse environmental impacts, contributing to optimizing transportation systems, reducing unnecessary travel, and encouraging sustainable consumer behaviors for an efficient and environmentally-friendly transportation network.

This research provides insights related to improving transportation, environmental, and urban planning practices. The findings on the sociodemographic and built-environment factors influencing return behaviors offer potential win-win scenarios for companies, consumers, and other sectors concerns. For instance, by identifying characteristics of frequent returners and their preferred channels, companies could strategically locate return facilities closer to these consumers. This could simultaneously reduce costs for businesses, enhance convenience for customers, and potentially decrease overall VMT and associated congestion and emissions. Such strategic planning also helps mitigate conflicts with other land-uses and enhance accessibility. However, the actual outcomes remain uncertain due to the multitude of variables at play in the e-commerce ecosystem.

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