Exhibit D

Research Project Requirement Template

The Effect of Urban Infrastructure Change on Movement

Recipient/Grant (Contract) Number: The University of Texas at Austin; University of Washington /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): Cynthia Chen

Project Partners: N/A

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

Project Start and End Date: 12/1/2023 - 5/31/2025

Project Description: COVID is a crisis that is unanticipated both in its occurrence and also its length of impact. In the early days, many office employers implemented work-from-home policies while retail businesses shuttered, leading to deserted downtowns across the country. Yet crisis is also an opportunity, and municipalities and businesses innovated in response to the fears of infection. In particular, many cities changed transportation infrastructure, including permitting sidewalk cafes that accommodated outdoor dining, reallocating street space from travel or parking to outdoor dining, and redesigning streets to accommodate a wide variety of users etc. What are the effects of these urban infrastructure innovations? How well do they draw visitors and support businesses nearby? What are their effects on the region's traffic patterns? Are there spillover effects spatially? As cities emerge from COVID and re-imagine the future of our urban cores, answers to these questions are critical. Though the existing literature has a wealth of knowledge on the built environment effect on travel behavior, they are nearly exclusively at much larger scale (e.g., census tracts) and static (comparing different behavioral patterns between places with different built environment characteristics. There is little to no insight on how block-level urban infrastructure innovations lead to changes in visit patterns as well as nearby businesses. And yet, changes at this scale (block-level) are where local policy changes take place. This proposal is to answer these questions.

This research will leverage a variety of data sources to answer the above questions, including app-based GPS data, google street view data, business data, and satellite images etc. All data are longitudinal, covering several years from pre- to during and post-COVID (now). More specifically, app-based GPS data will allow us to quantify people's visit patterns as well as traffic flow patterns; Google Street View and satellite images will allow us to capture changes in urban infrastructure at the block level; and business data will capture business activities over time. The project will develop novel algorithms to clean and explore these data and address issues inherent to their collection, including biases, sparsity, and unrepresentativeness etic. When necessary, data fusion methods integrating different types of data will also be developed. The project will also develop methods and metrics to quantify changes in urban infrastructure. In addition to answering the questions raised above, project deliverables will also include: 1) open-source notebooks that can be used to process the various kinds of data; and 2) visualizations at selected locations to illustrate the changes from before to after.

The study site will be in the City of Seattle, a medium-large city in the Pacific Northwest that has implemented several innovations in urban infrastructure during COVID. Initial sites include Ballard and University District in Seattle. Both have a vibrant business district (though tailoring to different populations), a popular farmers' market and saw a surge of outdoor restaurants and cafes during the COVID period. In addition to these initial sites, we will also screen google street view datasets, satellite images, as

well as consult local cities for identification of additional sites in the region. The goal is to have a set of sites with contrasting characteristics in built environment and socio-demographic characteristics.

US DOT Priorities: "Data-Driven Insight" (DOT RD&T Plan, Page 58-59) is a key underlying theme in this study. This study will use a variety of novel data sources, including population-in-place data abstracted from cell phone records, Google Street View imagery, and municipal permitting data to understand how urban infrastructure changes lead to changes in people's visit patterns and business activities. Through the exploration of these data and the development of novel algorithms that harness insights from the data, the results of our research will provide valuable policy guidance to local jurisdictions.

The proposed work addresses several of the technology transfer (T2) and deployment goals within the RD&T Strategic Plan. It directly addresses the first priority of USDOT's T2 program "Launch research and technology programs whose outcome is targeted to technology transfer from the beginning of the project" (page 65). The proposed project is conceived to result in tools (open-source codes) that cities can use to evaluate the effects of their interventions (changes in urban infrastructure) on pedestrian flows, traffic patterns and business activities. It was also designed to generate insights that cities can directly use in future policies governing changes in urban infrastructure (e.g., cities can design urban infrastructure interventions in a way that support pedestrian flow, local businesses and yet have a minimal impact on the traffic patterns).

Outputs: We anticipate two categories of academic-oriented papers: (1) methodological papers that document the development of algorithms to process and analyze novel datasets, and (2) substantive paper detailing findings on how changes in urban infrastructure led to changes in people's visit patterns and business activities. We will also open-source all models and algorithms developed.

We will also generate visualization that illustrates the evolution in urban infrastructure and the associate changes in visit patterns and business activities. Outreach effort will include workshops with cities and local groups (e.g., U District Partnership) where the changes take place as well as conversations with colleagues at Seattle Department of Transportation.

Outcomes/Impacts: The proposed project will fill an important gap in the current built environment and travel behavior literature, which is to understand how block-level changes in our urban infrastructure can result in changes in people's visit patterns and business activities. This scale is directly at the policy level: when local officials (e.g., city planning) proposes changes, they must specify on what streets and for what purposes that street functions will change. In other words, the proposed project will generate outcomes that can directly influence how cities make policies on changing street configurations and furniture.

Intellectual impacts: 1) development of novel models and algorithms to process various kinds of data sources; 2) new insights on how changes in urban infrastructure will result in changes in people's visit patterns and business activities etc.

Societal impacts: 1) open-source models and algorithms to process various kinds of datasets; 2) policy guidance to cities whose policies on urban infrastructures directly affect residents' daily travels and local businesses; 3) better transportation demand management that supports walking and local businesses as well as minimize impacts on traffic patterns.

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