

## Exhibit D

### Research Project Requirement Template

#### How Complete are Your City's Streets? Evaluating the Completeness of Urban Streets Using Big Data and Computer Vision

**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):** Subhrajit Guhathakurta

**Project Partners:** N/A

**Research Project Funding:** \$213,472 (Federal + non-Federal funding)

**Project Start and End Date:** 9/1/2024 - 8/31/2025

**Project Description:** The main objectives of this project are: (1) development and validation of detection methods on the presence and width of individual elements of complete streets at street level, (2) development of a numeric index and typology to rate the completeness of streets, (3) curation of a publicly accessible database of various elements of complete street data in Atlanta metro; and (4) demonstration of how the rating/typology can be used to help users easily communicate and utilize the data in planning and policy decisions. Additionally, this project will provide an interactive map dashboard of non-residential urban streets in the Atlanta metropolitan region to visualize and communicate the data with the stakeholders. Understanding the current condition of complete street networks is an imperative first step in planning and policy interventions. The presence and the conditions of the eight elements of complete street segments, as reflected in the rating system, will offer critical information about which areas in the street network should be prioritized for complete street upgrades and what specific form these upgrades would entail. The knowledge of complete street elements will also help in assessing whether investing in complete street design and construction influence people's mode choices towards more active mobility and transit. While there are numerous elements that form the concept of complete streets such as public transit facilities, pedestrian and bicyclist accommodations, traffic calming, and streetscaping, this project focuses on the elements that determine the allocation of street space, such as sidewalks, bike lanes, and street parking, and save other non-surface objects for future studies, such as signboards, walk signals, and other fixtures.

This project plans to collect data on both the presence of complete streets elements and their cross-sectional width where applicable. This detection uses aerial and street view images together as one input. The primary data source for image data will be Google Street View and Google Maps API. By validating the detected result through the comparison with the well-established data, this project will test the potential of the methodology as a low-cost alternative to the existing data collection system. All data will be collected at the street segment level. The relationship between complete streets and travel behavior outcomes in terms of urban vitality and public health will be demonstrated by using urban vitality data (e.g., daily median spend for each POI from Safegraph) and mobility pattern (foot traffic data from ADVAN Research). All data will be collected at the street segment level.

**US DOT Priorities:** The proposed project aligns with several of the Research, Development and Technology Strategic Plan goals of US DOT. Most significantly, it addresses the goal of "advancing an integrated system of systems," through "...the development and implementation of policies and technologies that will enable an intelligent, safe, interconnected, and people-centered transportation system" (RD&T,

Page 51). The project will advance this goal by using data-driven insights from the application of data science and using data to provide strategic foresight. This project also supports the vision of “Putting People First - Smart Cities and Communities” by the application of open data portal on elements of complete street networks for routinely sharing data with the public. In addition, the project offers climate sustainability by improving the data and infrastructure for making walking and biking that are important active modes of transport, more pleasurable and safer. It also addresses the equity objective of the Strategic Plan given that walking and biking are the most universal and cost-effective modes of transport, if they can be made efficient, comfortable, and safe.

The technology transfer component is an essential part of this project. The aim is to provide the transportation planning authorities with operational models and data acquisition tools to classify “complete streets” and understand how well they serve the needs of all travelers using various modes of travel. This knowledge will identify potential conflicts among travel modes and point to mobility infrastructure that needs reinvestment and/or redesign. The technology transfer elements will include 1) tools to capture and process data from Google Streetview and aerial images; 2) analytical models that indicate the presence and quality of complete street infrastructure; 3) a scoring process for evaluating the “completeness” of “complete streets” and 4) an interactive web-based tool to examine the elements of complete streets spatially together with other data on mobility (congestion levels, safety, etc.).

**Outputs:** This project expects at least one publication and one conference presentation in a well-regarded journal and conference. Additionally, it will feature a publicly accessible web dashboard that offers a guide and visualizations of an open database. This database will contain quantified measures of street completeness, an interactive map showcasing the completeness of streets, and selected street view images used for street evaluation. This project will also provide a publicly accessible web dashboard. The developed methods will be packaged in a readily usable format and will be accessible to anyone through a public code-sharing repository with detailed tutorials (e.g., on Github). Lastly, a final report on the technical and policy implications will be provided. This project will construct one numeric index and one categorical typology of completeness of streets. The methods that will be tested for the construction of the numerical index include but not limited to, simple normalization followed by addition. This project will be one of the first attempts for developing an automated method for complete street measurements. It will serve as a benchmarking case on multiple aspects of the research framework, including the sampling strategy for image data, the design of computer vision architectures, protocols and a guideline for annotating the training dataset, and methods for constructing a complete street index and typology.

**Outcomes/Impacts:** We expect two outcomes from this project. First, the deliverables of this project can be used by stakeholders to prepare their first comprehensive database of complete streets. The database will provide needed information to assess the current condition as well as available spaces in the right-of-ways for future investment opportunities. Second, we expect follow-up studies that engage wider collaborations across the fields of urban design and planning, transportation, and computer science. Third, future stakeholders are also expected to expand to multi-city, multi-regional networks; the literature review showed that at least 32 states have policies on complete streets but suffer from the lack of data on the performance of complete streets. For short-term impacts, this project can dramatically reduce the cost of collecting data on the distribution of complete streets in all areas included in the project scope. This project can also increase the efficiency of fund allocation of transportation-related grant programs, such as the Livable Centers Initiative (LCI) by ARC by providing them an empirical basis on which to evaluate funding requests from municipalities. In the long term, the deliverables of this project can increase the public awareness of complete streets through the web dashboard and help municipalities make more efficient decisions on where to invest and maximize the return. Once implemented, complete streets projects can bring social, environmental, and public health benefits that can sometimes be greater than the cost of implementation.

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