Exhibit D – Research Project Requirement Template

(Research project name) Leveraging Location-Based Services (LBS) Data and Video Analytics for Scalable Intersection Safety Assessment

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): Cynthia Chen and Xuegang Ban

Project Partners: N/A

Research Project Funding: $120,000

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

Project Description:

Intersections are high-risk locations where a significant share of severe crashes occur, particularly those involving pedestrians and other vulnerable road users. Traditional approaches to safety analysis rely on crash records, field observations, or fixed camera systems. While valuable, these methods are often costly, spatially limited, and retrospective, limiting their ability to support proactive, system-wide safety management. Transportation agencies increasingly require scalable, data-driven approaches to identify risky conditions and behaviors before crashes occur.

This project investigates whether anonymized Location-Based Services (LBS) data can be used to characterize and monitor safety-related conditions at urban intersections. LBS data provides large-scale coverage of mobility patterns but are inherently sparse and noisy. Rather than attempting event-level detection, this research focuses on whether LBS-derived movement indicators can capture safety-relevant conditions at the intersection level. The proposed approach leverages LBS data alongside complementary datasets, including video-detected safety events and crash records. The City of Seattle serves as the primary testbed due to the availability of processed traffic safety video data. These video data consist of event-triggered clips capturing safety-relevant interactions such as pedestrian signal violations, vehicle–pedestrian conflicts, and vehicles stopping within intersections. While limited in coverage, these data provide high-value examples of safety-critical behaviors.

A key component of the project is the systematic characterization of safety-related behaviors using video data. The video team will analyze a representative set of clips to refine and standardize behavior categories and develop a structured behavioral taxonomy. For each behavior type, key qualitative features will be identified, including temporal characteristics (e.g., timing and duration), movement characteristics (e.g., speed changes, trajectory deviations, stopping behavior), and interaction dynamics (e.g., number of agents and conflict interactions). These behavioral features will then be translated into measurable LBS-derived indicators, such as speed variability, trajectory density, spatial clustering, dwell time within intersections, and overlap of movement flows. This process will be conducted collaboratively to ensure that identified features are meaningful within the constraints of LBS data.

Due to the sampling and sparsity inherent in LBS data, individual events observed in video are unlikely to be directly captured in LBS trajectories. Therefore, the analysis does not attempt one-to-one event detection. Instead, the study evaluates whether LBS-derived indicators exhibit systematic variation across time periods and locations associated with differing levels of observed safety events. For example, locations or

periods with elevated levels of pedestrian violations or vehicle–pedestrian conflicts may exhibit distinct LBS-derived indicators, such as higher trajectory density, clustering, or speed variability.

Because the usefulness of these indicators depends on data quality, the project will explicitly assess the effects of sampling density, spatial accuracy, temporal coverage, and observation frequency on indicator reliability. Intersections and analysis periods will be screened using minimum data quality thresholds to ensure sufficient trajectory coverage. The study will also identify conditions under which LBS-derived indicators become unreliable, such as low sample penetration, insufficient observations, or highly heterogeneous movement environments. The resulting findings will inform an observability framework and practical guidance describing where and when LBS data can support intersection safety assessment and where supplemental data sources may be needed.

US DOT Priorities:

This project directly supports USDOT's priority of improving transportation safety, particularly for pedestrians and other vulnerable road users. By developing scalable methods to identify safety-related conditions at intersections before crashes occur, the research advances proactive and systemic safety management approaches that complement traditional crash-based analyses and support Vision Zero objectives. The project also aligns with USDOT's RD&T strategic goals by leveraging Location-Based Services (LBS) data alongside video-derived events, crash records, and speed data to develop new methods for assessing intersection safety at a network scale. The research is advanced and potentially transformative because it explores how large-scale mobility data can be used to infer safety-related conditions beyond the limitations of crash records, field observations, and fixed sensors. The resulting observability framework and safety indicators will support more scalable, data-driven approaches to transportation safety analysis and decision-making.

Outputs:

This project will produce: (1) a set of LBS-based indicators for characterizing intersection safety conditions; (2) an observability framework describing the extent to which different safety-related behaviors can be represented using LBS data; (3) analytical methods and documented workflows for coordinated analysis of LBS, video event, crash, and speed datasets; and (4) methodologies for multi-source assessment of safety-related conditions at intersections. The project will also generate processed and documented datasets, including behavioral taxonomies, event classifications, and aggregated safety indicators for study locations where permitted by data-sharing agreements. Additional outputs include software scripts, technical reports, practitioner guidance, journal publications, and conference presentations.

Outcomes/Impacts:

The project will enable transportation agencies to incorporate LBS-derived safety indicators and behavior-informed analytical methods into intersection safety assessment and prioritization processes. The resulting tools and guidance will help agencies identify high-risk locations, better understand safety-related behaviors, and complement traditional crash-based analyses with proactive, data-driven approaches. The research will also improve understanding of the capabilities and limitations of emerging mobility datasets for safety applications and support broader adoption of data-informed safety management practices.

The project has the potential to improve transportation safety by enabling more efficient identification of high-risk intersections and emerging safety concerns across large transportation networks. The resulting methods can help agencies prioritize investments, deploy resources more effectively, and improve protection for pedestrians and other vulnerable road users, contributing to safer, more reliable, and more equitable transportation systems.

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