**ARKANSAS DEPARTMENT OF TRANSPORTATION**
**SYSTEM INFORMATION AND RESEARCH DIVISION**
**FISCAL YEAR 2025**
**REQUEST FOR PROPOSAL**
**RESEARCH PROJECT NUMBER TRC2503**

## TITLE

TRC2503: Feasibility of Vehicle Probe Data for Origin-Destination Estimation

## ARDOT POLICY

All projects must conform to the rules, regulations, policies, and procedures issued by the Federal Highway Administration (FHWA), State of Arkansas regulations, and those of the Arkansas Department of Transportation (ARDOT). Questions on situations and circumstances not adequately addressed herein will be negotiated on a case-by-case basis and done in accordance with FHWA's 23 CFR Part 420, the Basic Agreement, the Research Manual, and all other Department guidelines and policies.

The contracting agency must enter into a Basic Agreement, if none exists, with ARDOT prior to the execution of any Project Agreement.

All research project contracts will be managed utilizing Infotech's Doc Express paperless contracting platform. The selected Principal Investigator (PI) and Co-Principal Investigator (Co-PI) must have access to Doc Express through their organization's account.

## PROBLEM STATEMENT

Origin-Destination (O-D) estimation is an important step for travel demand forecasting. Traditional approaches to estimating O-D rely on either a survey-based trip diary or traffic counts. Both methods are time-consuming and cost prohibitive. However, the emergence of third-party GPS and cell phone data provides a new source for O-D estimation as government agencies like ARDOT increasingly rely on these data sources for planning-level decision-making. However, vehicle probe data has limitations. The following illustrates potential scenarios and some questions that the research hopes to answer. The scenarios and questions are not all-inclusive.

- Long-distance trip representation may not distinguish between destination trips and pass-by trips:
    - *Example: Trips from Texarkana to Little Rock, AR, use Interstate 30 (I-30). Travelers may stop for lunch in Hope and gas in Benton. The trip origin is Texarkana, AR, and the destination is Little Rock, but the other stops represent pass-by trips, with the trip paths*

*diverging from and returning to I-30. Questions: Would probe data capture the interim stops as multiple origins and destinations? Could probe data identify the long-distance trip as the primary trip, with interim, or pass-by trips?*

- External location O-D into State:
    - *Example 1: Trips between Ft. Smith, Arkansas, and Joplin, Missouri, will have multiple route options and will likely stop once or twice. Questions: Would data purchased by Arkansas furnish specific destinations in another state? Could probe data identify alternate routes and their attractiveness based on trip type or vehicle type?*
    - *Example 2: Highway 65 between the Missouri State Line (e.g., Branson, MO) and Arkansas destinations. Gaps in probe data coverage may impact the O-D matrix. Questions: Do portions of the state exist where there is insufficient coverage of probe data to be useful for O-D matrix development? Can the research identify those locations, and offer projections of when market penetration would be sufficient to cover rural Arkansas?*
- The effects of urban trip O-D reporting with regards to trip-chaining is not clearly understood, which could lead to questionable O-D estimation patterns:
    - *Example: A Fayetteville automobile commuter travels in the morning from home to drop children off at school, then to work. In the evening, they travel from work to the grocery store, to daycare to pick up children, then return home. The trip type in a travel demand model is classified as a home-based-work tour that includes trip chaining, including five individual trips to intermediate stops. Question: Could probe data offer enhanced travel information beyond what is available through the U.S. Census, Center for Transportation Planning Products (CTPP) offerings, and travel demand models?*

The above scenarios are not all-inclusive. Specific case studies would be defined through the research study process with recommendations from the PI and concurrence from the Subcommittee.

Third-party O-D trip data attributes are not well-defined and may not be consistent across data sources:

- The third-party probe data accuracy (or bias) could be context-specific since it depends on sample data from the area of interest.

- Trip attributes such as vehicle type, vehicle occupancy, trip purpose, and mode of transport that may be gleaned from the data would be helpful, if available.
- Commercial vehicle and heavy freight data may be better represented by a data source different from that providing information on passenger vehicles.

Due to the unique characteristics of Arkansas' Interstate and National Highway System (NHS) routes, the accuracy of the probe data from other States may not apply to Arkansas. Nationally acquired data factors may not properly describe decision-making characteristics for Interstate and NHS long-distance trips. In this regard, it is essential to understand the opportunities and limitations of vehicle probe data for O-D estimation in the context of Arkansas. The research is intended to identify potential biases in vehicle probe data and recommend possible adjustments.

## OBJECTIVE AND SCOPE OF STUDY

This research aims to quantify the applicability of vehicle probe O-D data that can be purchased from third-party sources. The proposer should consider the following objectives, and may add to or clarify them as needed:

- Document, to the level possible, the ability of third-party data sources to accurately represent trip origins and destinations,
- Identify rural vs. urban data as it relates to third-party data source market penetration and gaps,
- Mobile phone data vs. connected vehicle data,
- Personal trip estimation vs. commercial trip estimation, and
- Identify and quantify significant variables that should be considered.

## METHOD OF STUDY

To examine the accuracy of O-D data obtained through third-party sources, the project will first conduct a comparative analysis using two to three case study areas for which both ground-truth and probe data are available or can be obtained. To evaluate whether the probe data has sampling biases, the research will compute trip O-D estimated from probe data and compare it with ground-truth data. Additionally, comparisons with the 2020 United States (U.S.) Census data, and/or Census Data for Transportation

Planning Products (CTPP) data might be considered. Finally, the study will develop a method to calculate the factors needed to adjust the biases in O-D estimation using probe data.

The Proposal should address the following:

- Methodology to compare third-party data with traditional O-D data sources. Traditional sources to consider may include the following:
    - Bluetooth data,
    - Sample survey,
    - License plate survey, or
    - Other O-D estimation methodologies.
- Third-party data sources and budget.
- Trip type or vehicle classification estimation at the following resolutions:
    - Personal trips, including trip-chaining, and
    - Commercial vehicle (truck) trips, including parking, deliveries, and intermodal transfers or off-loading.

The following specific tasks are anticipated. The Proposal should recommend revisions as appropriate to conduct the research most efficiently. Completion of each task should include Subcommittee involvement that is sufficient to document major decisions:

1. Literature and market review that supports O-D estimation and ground-truth methodology.
    a. Conduct a literature review.
    b. Conduct a market review of potential third-party O-D data sources and providers.
2. Develop O-D estimation parameters, including:
    a. Determine methodology for traditional O-D estimation, including assumptions for trip-chaining.
    b. Define specific case studies for analysis.
    c. Define when to include commercial vehicle (truck) data, particularly truck parking, if available.
    d. Determine rural and urban study areas in conjunction with the Subcommittee.

3. Data collection, including:
    a. Purchase and analyze O-D data, including vehicle type, distance, and mode, from third-party data sources. Assume that traffic count data will be provided by ARDOT and one or more additional data source(s) will be purchased through the research.
    b. Collect O-D data using traditional means or other method(s), including survey administration, review of other data sources, and fieldwork to install and remove equipment.
4. Compare results and document findings in the Final Report and recommend potential actions for successfully integrating the findings into ARDOT processes in the Implementation Report. Documentation should include:
    a. A decision tree to aid in determining the type of O-D data attributes, potential data quality, and bias, and
    b. Development of adjustment factors to use when applying data.

## POTENTIAL BENEFITS

TRC2503 research findings would provide guidance and calibration factors for use with third-party O-D data to use in planning studies and processes. Potentially, the research could be used with the following types of studies:

- Major corridor reconstruction or capacity improvement studies,
- New route location studies,
- Corridor management studies and needs assessments,
- Intersection turning-movement forecasts to evaluate traffic control devices,
- Interchange modification/justification reports, and
- Arkansas Statewide Travel Demand Model development, O-D output validation, or adjustment factors.

## TIME AND FUNDING OF STUDY

Work will begin no earlier than July 1, 2024, contingent upon acceptance of the Proposal and availability of research funds. The total length of the project should not exceed 27 months including the Publication Phase. A final report is to be drafted and presented to the Project Subcommittee on or before the Work Phase completion date. The Publication Phase will be of sufficient length to allow the proper review, comments, and revisions, and will contain funding to accomplish revisions and publication costs. The end

of the Publication Phase will be the formal completion date of the project. Up to 25 percent of the estimated project costs will be withheld pending final acceptance of the Final Report. Failure to deliver the required Final Report at the end of the project will result in the cancellation of the project, and the Department will retain 25 percent of the total project cost.

Plan for quarterly remote Subcommittee meetings with the PI, or more often based on current and upcoming tasks. Include travel funds and time for two in-person meetings with the Subcommittee at the ARDOT Headquarters, including one presentation or training for the Subcommittee at the time the Final Report is complete. The proposal should schedule for and include funding for any fieldwork needed to collect O-D ground-truth data. In lieu of fieldwork conducted by the PI, a contractor may be hired to collect field data, in consultation with the Subcommittee.

**REPORT REQUIREMENTS**

All reports must be in accordance with the most current Research Manual (available at https://www.ardot.gov/divisions/system-information-research/research/ or from the Research Section). All reports must be submitted through Doc Express. All final reports are required to be reviewed by a technical editor before submission to the Department.

Final reports must also be Section 508 compliant. Federally funded research with public-facing PDFs must be accessible as of March 23, 2018, according to the final federal rule for the Information and Communication Technology (ICT) refresh under Section 508. This ensures that federal employees with disabilities have comparable access to and use of information and data just like federal workers without disabilities. The law also ensures that members of the public with disabilities receive comparable access to publicly available information and services. All researchers should use the accessibility tracker in Microsoft Word before submitting final reports.

An oral report to the Transportation Research Committee may be required. In addition to reports, journal articles, and publications, the Department must be furnished one (1) copy of any master's thesis or doctoral

dissertation which is a result of any investigation or study on this project. The Department's written approval must be obtained before the publication or presentation of this project before its completion.

## PROJECT DELIVERABLES

The proposed research will provide ARDOT with the following documentation:

- **Quarterly Reports**,
    - Interim decision activity reports should be submitted in a Microsoft Word document with Quarterly Reports or more frequently on a Task Completion Basis,*
- **Benchmark Reports** should be submitted three months prior to project renewal (due by March 1, 2025, and March 1, 2026), and document all work done to date, where the project is behind, if applicable, and how the project will be made current, if applicable,
- **Draft Final Report** (due by June 30, 2026),
- **Draft Implementation Report** (due by June 30, 2026), and
- **Final Report** and **Implementation Report** with all comments addressed, and Subcommittee presentation, are due no later than September 30, 2026.

*The intent of this documentation is to allow for Subcommittee input and concurrence regarding methods and assumptions in a timely manner to allow for adjustments if needed.

## AUTHORIZATION TO BEGIN WORK

A letter authorizing the beginning of work will be transmitted through Doc Express initiating the project. Any cost incurred before the authorization letter is received will not be eligible for reimbursement. The project will begin work no earlier than July 1, 2024.

## EQUIPMENT

A complete physical verification of all software and equipment purchased or built for use on this project and the actual location of the equipment will be made each year. An Equipment Capitalization Notice is available from the Research Section for the reporting of software or equipment purchased during the project. All software developed on the project will be completed in an open-source format, and ARDOT must be provided a copy of

the source code. If non-expendable or special equipment is purchased with project funds, the equipment is owned by ARDOT, and disposition of the equipment will be determined by ARDOT at the project's closeout.

All rental rates must be approved by ARDOT before the approval of the proposals. Should a subcontract be part of the Proposal, ARDOT will not approve the purchase of any equipment in the Subcontract. Any equipment purchased through ARDOT's Transportation-Related Research & Workforce Development Grant Program or previous TRC projects is not eligible for rental rate charges.

All equipment must be purchased in accordance with the State of Arkansas purchasing laws and Arkansas Department of Transportation purchasing policies.

## PROPOSALS

Proposals must be submitted in a Word document utilizing the provided template to research@ardot.gov no later than the end of business on March 1, 2024. No proposals will be accepted after this date. All procedures must be in accordance with the most current Research Manual and Federal-Aid Policy Guide (FAPG). In the event of policy contradiction, the FAPG shall govern.

Upon approval of the Proposal by the Project Subcommittee, the Project Manager will initiate the process within Doc Express to acquire the appropriate electronic signatures from all parties.