Research Stage 1 Problem Statement

PROPOSED TITLE: Exploring Data-driven Approaches to Traffic Signal Retiming Needs Identification and Solution Development

1. Concisely describe the transportation issue (including problems, improvements, or untested solutions) that Oregon needs to research.

Traffic signals operating at their intended performance levels are essential for supporting safe, efficient, and reliable travel for all users across Oregon's transportation network. And high-quality traffic signal operations require properly maintained and updated signal timing. ODOT currently identifies and implements signal timing updates through engineering studies conducted with discretion. These studies can be resource-intensive, requiring ad-hoc data collection and significant time and staff effort to determine when retiming is needed and to develop appropriate solutions, such as timing parameter adjustments or potential upgrades to traffic-responsive or adaptive traffic timing. At the same time, increasing travel demand and evolving multimodal patterns across Oregon have led to more frequent requests for diverse and time-critical signal retiming studies. This expanding workload strains current practices and contributes to a cycle that is difficult for ODOT to maintain sustainably.

Oregon now has access to a wide range of data sources, such as high-resolution historical and real-time traffic signal operations data (available through traffic signal central management software or automated traffic signal performance measures, ATSPM), probe travel-time data, safety records, multimodal traffic counts, and other performance measurement data. While these datasets offer substantial potential to facilitate current signal timing practice in a data-driven and cost-effective manner, there is currently no systematic and practical approach for integrating them into routine signal timing decision-making, implementation, and long-term maintenance.

Toward goals of agency cost savings and agency accountability measures, there is a need to explore scalable, data-driven methods that can detect signal timing needs reflected by performance degradation and support the development of improved timing plans. These methods can also help better justify when system upgrades, such as traffic-responsive or adaptive traffic signal timing, are warranted. This research would help ODOT and local partners cost-effectively maintain traffic signal performance, reduce engineering costs, and enhance safety, mobility, and reliability statewide.

2. What final product or information needs to be produced to enable this research to be implemented?

This research should deliver a set of implementable outcomes that enable agencies to incorporate data-driven methods into signal timing decision-making and long-term maintenance. Practical application scenarios include:

1. Using ODOT's existing data sources to identify traffic signal retiming needs across a range of operational circumstances, including varying data availability, facility types, and operational objectives. Scenario development should align with the *ODOT Traffic Signal Management Plan* (April 2020).

2. Supporting regular updates to signal timing parameters to enable timely, and potentially proactive, responses to changes in measures of effectiveness (MOEs). The methods developed should rely on available data and depart from conventional volume-driven timing optimization to achieve cost and effort savings.
3. Using designated MOEs to evaluate, document, and communicate the benefits of signal timing improvements.
4. Enhancing engineering studies and documentation to support requests for system upgrades, such as traffic-responsive or adaptive signal control. The research outcomes may support future supplements to the *ODOT Traffic Signal Policy and Guidelines* (July 2024).

In addition, the research should explore the feasibility of an automated, performance-data-driven approach to signal retiming based on ODOT's available data sources and provide a roadmap outlining the resources required and the potential benefits of establishing such an automated signal timing paradigm.

3. (Optional) Are there any individuals in Oregon who will be instrumental to the success of implementing any solution that is identified by this research? If so, please list them below.

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Mark Rahman	R1 Signal Manager	Mark.rahman@odot.oregon.gov	971-384-9767
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4. Other comments:

This research can serve as an expansion and enhancement of *ODOT Research Project 304-881: Using Automated Traffic Signal Performance Measures to Improve Signal Timings*.

Although prior efforts have produced valuable methodological insights supporting data-driven signal timing approaches, effective implementation within Oregon's specific context still requires a detailed examination of ODOT's data inventory and an assessment of viable, Oregon-specific use cases. In addition, MOEs and historical/real-time operational data of multimodal traffic signal users have not been well studied. This research would also focus on data reflecting pedestrians, bicycles, and transit to support comprehensive signal timing development.

This research emphasizes a **cost-effective approach** by leveraging existing data sources to address the practical challenges faced by ODOT's state traffic signal engineers in day-to-day operations. With numerous data dashboards and tools now available to signal practitioners, this project aims to bridge the gap between *"having data tools"* and *"using data tools effectively in practice."* The anticipated outcomes will help streamline project delivery, improve operational efficiency, and strengthen the return on research investments.

Emerging advances in machine learning and artificial intelligence also present opportunities to support ODOT's long-term interests in future technological development and procurement in terms of traffic signal management and overall traffic operations management. This research will review the current state of automated and AI-supported traffic signal timing approaches and evaluate their feasibility for

deployment within Oregon's operational, data, and policy environment. While some advanced methods may require data sources not yet available to ODOT, assessing these technologies now will provide valuable insight into their potential benefits, limitations, and readiness levels. The findings can help establish a roadmap that informs future investment decisions, guides technology adoption, and aligns Oregon's signal management practices with national trends in automation and intelligent transportation systems.

5. State of Oregon Decision Making Lenses

State decision making lenses are a part of the state of Oregon's policy structure. State policy and federal policy are not always aligned. The state will prioritize research according to state policy, however ODOT may be required to skip prioritized proposals based on constraints placed on the use of federal funds. If state funds are available ODOT will attempt to fund prioritized research that is deemed ineligible for federal funding.

Please complete the following three sections. Your answers to these questions will be applied on a programmatic basis to support agency decisions. Answering yes to the questions below is not required. Resolving a narrowly focused technical research problem may meet agency needs without answering yes to any of the following questions. The ODOT Research Section will seek a balanced portfolio some projects will answer yes to one of the three categories below (e.g. climate, equity, and/ or safety) and other projects in a different category.

We are looking for an overall program balance and no one project is expected to balance all categories. Generally, a research problem statement is expected to be able to answer yes with clear and verifiable information in only one of the three categories below, some projects may be able to answer yes in two or even three categories. Some projects (i.e. needs focused on specific elements of infrastructure design), may have no 'yes' answers but may still be a high value research need.

Climate

Oregon recognizes the climate crisis and makes systemic changes to reduce emissions caused by travel. To that end, we seek research that reduces carbon emissions from construction activities and materials, and from maintenance equipment and operations. Oregon envisions a transportation system that is resilient, this means a system that is durable in the face of seismic events and extreme weather to avoid negative impacts, withstand them or bounce back quickly to resume system function. We seek research that improves the ability of the transportation system to adapt or cope with more frequent and extreme weather events. This may include innovations in data and data sharing, construction materials and project design, communication, emergency planning and response, and more. Similarly, we seek research that avoids negative impacts on key habitats and ecosystems that can buffer or reduce damage to infrastructure and improve environmental conditions for wildlife and native vegetation. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan and Oregon Transportation Plan.

5a. Will addressing the transportation issue identified as a need in Question 1 develop, or **validate methods for the estimation, measurement, or monitoring** of transportation generated greenhouse gases (GHG)?

☐Yes ☐No ☒Unsure

5b. If climate or GHG is not the focus of this **transportation issue** identified in this problem statement, will the research apply a GHG analysis to transportation infrastructure, planning, operations, maintenance, or materials?

☐Yes ☐No ☒Unsure

5c. Will addressing the **transportation issue** include development or testing of construction practices, methods, or materials to establish potential reductions in greenhouse gas emissions?

☒Yes ☐No ☐Unsure

5d. Will solving the **transportation issue** in question 1 study or support the reduction of vehicle miles traveled and single occupancy vehicle travel or support transition to electric vehicles (or other types of zero emission vehicles) or low-carbon alternative fuels?

☐Yes ☒No ☐Unsure

5e. Will the solving the **transportation issue** in question 1 lead to work that will support, measure, or monitor, transportation system resilience in response to expected climate events, effects, or natural disasters in general?

☒Yes ☐No ☐Unsure

5f. Will solving the **transportation issue** in question 1 lead to work that may result in better environmental conditions for wildlife and native vegetation?

☐Yes ☐No ☒Unsure

5g. If you answered yes to any of the climate questions above or can provide alternative details related to climate, please provide additional information:

Data-driven approaches to signal retiming needs identification and solution development can produce indirect environmental and system resilience benefits:

- More timely and proactive timing adjustments. Cost-effective use of existing data resources enables agencies to identify performance changes earlier and implement signal timing improvements more quickly. Timely action can reduce unnecessary delays, stops, and idling along corridors, contributing to lower fuel consumption and reduced emissions.
- Enhanced monitoring and response to climate-related disruptions. Data-driven methods can broaden the range and speed of performance monitoring, helping agencies more quickly detect and respond to weather events, incidents, and other climate-impacted conditions. This capability supports the development of special traffic signal operations that improve the resilience of the transportation system.

Equity

Equity can have many dimensions and impacts relating to communities and transportation. It is important that problem statement proposals clearly explain the equity dimensions or impacts being examined. Oregon commits to social equity in the OTP, specifically to *improve access to safe and affordable transportation for all, recognizing the unmet mobility needs of people who have been systemically excluded and underserved. Create an equitable and transparent engagement and*

communications decision-making structure that builds public trust. We seek research that studies elements of this goal or applies analysis to specific transportation topics to ensure the resulting research recommendation is consistent with agency equity goals. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan and Oregon Transportation Plan.

5h. Is the **transportation issue** identified as a need in Question 1 specifically focused on transportation equity?

☐Yes ☐No ☒Unsure

5i. If the **transportation issue** is not focused on transportation equity, will the primary topic be assessed for equity benefits or impacts within the research project?

☐Yes ☐No ☒Unsure

5j. Is the implementation of potential findings from this research likely to directly involve participation from an identified group that would benefit from an equitable process or outcome?

☐Yes ☒No ☐Unsure

5k. Is the intended final product or information expected to support ODOT's equity efforts (Including but not limited to supporting one of the equity related objectives of the ODOT's Strategic Action Plan or Oregon Transportation Plan) ?

☐Yes ☐No ☒Unsure

5l. If you answered yes to any of the equity questions above or can provide alternative details related to equity, please provide additional information:

Data-driven approaches can improve decision-making transparency and support more effective public engagement for projects involving traffic signal timing adjustments or system upgrades. By clearly demonstrating how timing decisions are informed by measurable performance data, agencies can communicate benefits and trade-offs more openly with the public.

In addition, the anticipated outcomes of this research will consider the needs of multimodal users, including transit passengers and pedestrians. By supporting more equitable access and mobility across modes, the research may indirectly support ODOT's broader equity efforts.

Safety

Research outcomes may include interventions and countermeasures to prevent or reduce the frequency of crashes or other causes of transportation-related injury or death; or may include measures to reduce severity of injury (including prevention of death) after a crash or other injurious event. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan, Oregon Transportation Safety Action Plan and Oregon Transportation Plan.

5m. Will solving the **transportation issue** in question 1 support improving **safety culture** for either transportation workers or the traveling public?

☒Yes ☐No ☐Unsure

5n. Will the solving the **transportation issue** support improving safety through **healthy and livable communities**?

☐Yes ☐No ☒Unsure

5o. Will solving the **transportation issue** support improving safety through using **best available technologies**?

☐Yes ☐No ☒Unsure

5p. Will solving the **transportation issue** support improving safety through **communication and collaboration**?

☒Yes ☐No ☐Unsure

5q. Will solving the **transportation issue** support improving safety through **investing strategically**? 5r. If you answered yes to any of the safety questions above or can provide alternative details related to safety, please provide additional information:

Data-driven approaches can improve safety by enabling earlier detection of performance issues, such as unexpected queues, phase/cycle failures at signalized intersection, or increasing safety indicators (e.g., speeding during night times that can addressed by "rest-in-red" signal operations and red light running that can be mitigated by progression improvement.)

By identifying these issues timely and cost-effectively, agencies can adjust timing plans or operations, potentially reducing the likelihood of rear-end crashes, red-light running, and conflicts involving pedestrians and bicyclists. In this way, data-supported signal retiming contributes to a safer and more predictable operating environment for all users.

6. Corresponding Submitter's Contact Information:

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7. ODOT Sponsor Contact Information (Required if Submitter is not an ODOT employee)

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This form is not a grant application or contract document. Please do not include proprietary information on this form. Once this form is received ODOT may revise and publish the problem statement. If selected, ODOT will assign investigator(s) of the department's choosing to conduct research.