

Research Stage 1 Problem Statement

PROPOSED TITLE: EVALUATING SAFETY AND MOBILITY IMPACTS OF WORK ZONE DESIGN, SETUP, OPERATION, AND DEMOBILIZATION STRATEGIES

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

The design and implementation of work zone operations and traffic control are critical aspects of ensuring the safety of motorists and workers while maintaining mobility on ODOT roadways. Effective visualization tools that integrate both work zone design and expected traffic patterns can significantly improve decision-making regarding work zone traffic control design, setup, operation, and demobilization. Such tools that simulate traffic flow based on the design of the work zone can also provide an objective means of comparing alternatives and remove guesswork regarding their effectiveness for safety and mobility. Present operational resources and training tools cannot simulate and visualize the impact of work zones on traffic flows and do not provide an interactive means of testing work zone strategies before their real-world implementation. Thus, we propose the development and testing of a work zone traffic control simulation tool that provides immediate visual feedback on safety and mobility impacts of various work zone designs. This tool will aid in the selection and placement of traffic control devices and simulate and display their effectiveness based on expected traffic patterns for the duration of the project to provide safer work zones for workers and motorists.

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

Development of a work zone operations assessment tool, along with guidance to support its use in practice and for training, are required. The outputs needed from the study for application in practice are as follows:

1. **Factors and processes contributing to safety and mobility issues during work zone setup, active work operations, and removal:** An initial understanding of the key factors and decisions that contribute to safety and mobility issues during the setup, active work operations, and demobilization stages of work zones is needed. Secondly, an understanding of how ODOT staff envision using a work zone simulation tool is needed. The outcome of this initial scoping phase will identify the key factors that should be incorporated into traffic and construction operation simulation models to enable effective use of the tool and to calculate reliable safety and mobility performance metrics across alternative work zone strategies.
2. **Visualization and simulation tool based on safety and mobility KPIs of work zone strategies:** The second needed output is a functional work zone simulation tool. A prototype of a similar interactive work zone visualization and training tool has already been developed by OSU for illustrating, demonstrating, and planning work zone operations, as shown in Figure 1.

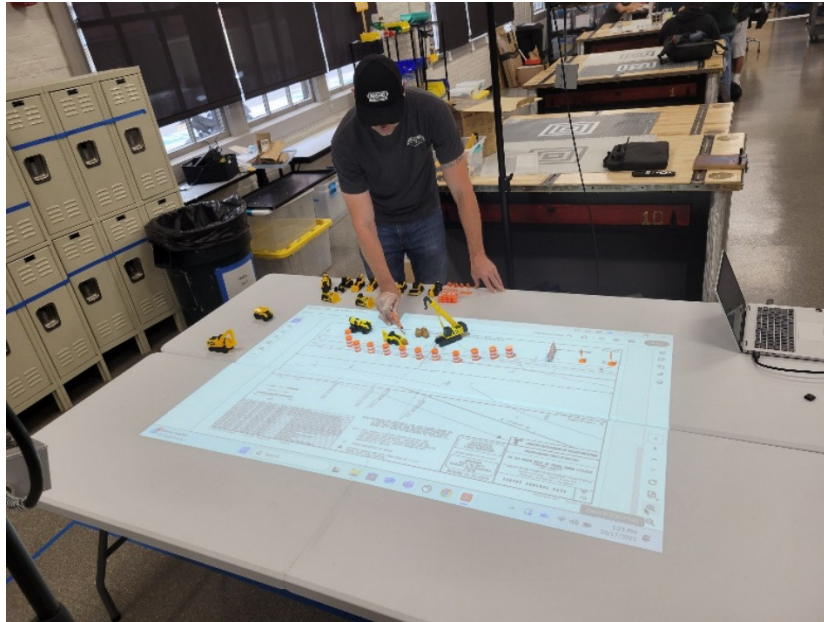


Figure 1. Interactive Video Display Training Table

We will extend this tool to simulate expected traffic flows and visualize mobility and safety based on work zone design by incorporating the factors from Step 1. The tool will include parameterized work-zone models that jointly simulate construction operations within the work zone and the traffic flow outside it to evaluate safety and mobility outcomes under various work zone design configurations. In addition to generating quantitative performance metrics, the integrated simulation will produce a dynamic and interactive visualization of both traffic flow and construction activity inside the work zone. This visualization will be responsive to changes in work zone inputs and configurations, enabling users to explore the impacts of alternative strategies in real time.

3. **Implementation modules for work zone simulation tool on ODOT projects:**

The last outputs needed are implementation modules that deploy the simulation results through a web/ desktop-based software application along with resources to support and train ODOT personnel. It is anticipated that the system would be accessible to all ODOT staff and trainees with the option of installing the interactive display table at select locations. The software application will require minimal IT support as it would be developed and hosted at OSU servers as needed. Using this system, ODOT staff will be able to upload project work zone plans and visualize simulated traffic and construction activities. Participants will also be able to modify the work zone layout using digital traffic control devices and immediately observe how those changes affect safety and mobility performance metrics. Implementation modules delivered to ODOT will include example simulations and instructions on performing the same type of analysis and visualization for new projects.

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.

Name	Title	Email	Phone
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Galen McGill	State Maintenance and Operations Engineer	Galen.E.McGill@odot.state.or.us	503-508-1881
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4. Other comments:

The investigators have considerable experience developing both traffic and construction simulations and this project aims to develop these simulations using the SUMO traffic-simulation package integrated with the ConStrobe discrete event simulation platform. Demonstration and validation of the tool through input from ODOT staff will be included. These can be deployed through a variety of ways including web-based, as a desktop application, and using a table-top visualization as shown in Figure 1.

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:

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:

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:

The National Work Zone Safety Information Clearinghouse (<https://workzonesafety.org/work-zone-data/worker-fatalities-and-injuries-at-road-construction-sites/>) reports that there were 10 work zone fatalities in Oregon in 2023. The number of work zone crash fatalities in all states typically represents a high percentage of the total number of crashes that occur in the states. The proposed research is directly related to the safety of ODOT workers who are operating equipment and working on the roadway, and the motorists who travel through maintenance and construction work zones. The ability to visual, foresee, and plan for the hazards that will exist in a work zone, while also optimizing mobility through the work zone, will aid in decision-making while planning and designing work zone operations.

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.