Oregon Department of Transportation

Research Stage 1 Problem Statement

Number 26-13 – "Developing an Online GIS-Based Database to Store and Analyze Data from All Stages of the Pavement Life Cycle"

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

Roadways are continuously aging and deteriorating due to the increasing traffic volumes, increasing truck weights, and lack of enough funding to periodically maintain and rehabilitate aging roadway infrastructure (Coplantz, 2023). The reductions in funding in previous years have already started to show their effects as a decline in pavement network conditions for all five regions in Oregon (see Figure 9 in the 2022 ODOT Pavement Condition Report). Improving existing asset management practices by developing new tools and strategies has the potential to improve network-level pavement performance and create significant savings for the economy. More efficient maintenance and rehabilitation strategies are also expected to reduce the environmental impact of pavement life cycle stages.

Pavement asset management requires the collection, storage, and processing of datasets from different stages of the pavement life cycle, such as: *i)* pavement design outputs (material and structural design information); *ii)* paving material production and QA information (binder content, gradation, recycled asphalt pavement content, etc.); *iii)* as-built construction data (in-place densities, layer types, thicknesses, etc.); *iv)* pavement condition survey data collected during the use phase of the pavement; and *v)* roadway surface condition data collected by the ODOT's Pavements unit after maintenance activities (paving, chip sealing, etc.). Data from all those stages are needed to be able to identify pavement distress initiation and propagation mechanisms and develop strategies to combat those different distresses. Developing an online geographic information system (GIS) based database that integrates all pavement-related data in one system is crucial in developing a more efficient pavement management system (PMS) in Oregon. Although all the data listed above are collected by the different branches of ODOT at different stages of the pavement life cycle, there is currently no integrated data collection and storage system that can be accessed to store and download all the required historical information about different pavement sections. Connecting all the data in one platform and having an automated data processing system to cross-check the accuracy and validity of the data is crucial. The proposed online system will also have an automated internal statistical analysis platform where the most significant factors controlling the collected pavement performance parameters will be identified at the project and network levels. Using the outputs, the embedded intelligent algorithm will also provide pavement maintenance or rehabilitation suggestions.

The GIS-based data processing, storage, and visualization system (integrated into ODOT's current TransGIS) developed in this study will help ODOT improve the current pavement asset management system. The developed system will allow the integration of pavement data collected at different stages of the pavement life cycle. Integration of the pavement design, paving material production, construction, and maintenance data with the current PMS data under one platform will allow ODOT to determine the major reasons for the premature failure of some pavement sections in Oregon. The developed tool will help ODOT understand the most important factors controlling pavement longevity. Based on the findings, current

design, construction, material production, maintenance, and pavement management procedures will be improved.

The developed online GIS database will construct the beginnings of a network-level database application that will store all pavement-related data, such as mix design, material production, PMS, ground penetrating radar (GPR), FWD, core, dynamic cone penetrometer (DCP), other laboratory, maintenance, and field test data, etc., for the entire ODOT roadway network. Using the stored pavement information, the total worth of pavement assets and their contributions to the economy can be quantified.

This proposed research study addresses the "Economic and Community Vitality" and "Stewardship of Public Resources" goals of the Oregon Transportation Plan (OTP). It also directly addresses the "Process, material, or equipment improvements", "Cost reductions or savings to construction, operations, or asset maintenance", and "Innovative Technologies and Systems" research focus areas of ODOT.

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

This proposed research study will produce an online GIS-based data processing, storage, and visualization system (integrated into ODOT's current TransGIS) that integrates all data related to the pavements' life cycle under one platform. Using the online database, a user can enter post-miles, traffic directions, and other required highway information (or alternatively coordinates for the location) to access all the data collected for this particular section since the initial construction. The developed online system will also have embedded data visualization tools that will allow users to evaluate the data before downloading. The developed data processing tool with the automated statistical analysis component will also point out the most important factors controlling pavement performance for the selected location. The developed GIS database will also have bridge locations, connectors, ramps, route boundaries, and other important features of the roadway. ODOT personnel will be trained on the use of the developed online database (for future data visualization, processing, and entry).

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
Timothy Earnest	Assist. Materials Engineer	Timothy.Earnest@odot.oregon.gov	(503) 986-3079
Sean Parker	QA Training Coordinator	Sean.P.PARKER@odot.oregon.gov	(503) 986-6631
John Coplantz	State Pavement Management Engineer	John.S.COPLANTZ@odot.oregon.gov	(503) 986-3119

4. Decision making lenses

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 high value research need.

Climate

Oregon recognizes the climate crisis and makes systemic changes to reduce emissions caused by travel. Every mile driven in Oregon is powered by a clean source of fuel. We seek research that supports construction and maintenance operations are carbon neutral and investments in mobility that support travel by low and no emission modes. While every research project may not result in a reduction in emissions, transportation investments overall support emission reductions to achieve state goals. Oregon envisions a transportation system that is resilient in the face of seismic and climate events and impacts to the degradation of the natural environment are reduced. Our vision includes a transportation infrastructure is built in a way that avoids impacts on key habitat and results in better 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.

4f. 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 gasses (GHG)?

☐Yes ☒No ☐Unsure

4g. 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

4h. Will the 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

4i. Will the 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

4j. Will the solving the **transportation issue** in question 1 lead to work that will support, measure, monitor, transportation system resilience in response to expected climate events, effects, or natural disasters in general?

☐Yes ☒No ☐Unsure

4k. Will the 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

4l. 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 in what capacities are equity dimensions or impacts being examined within problem statements. It is a goal of the OTP 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". Proposed research may have the intent of studying elements of this goal or apply analysis to specific transportation topics to ensure the resulting research recommendations is consistent with our equity goals. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan and Oregon Transportation Plan.

4a Is the **transportation issue** identified as a need in Question 1 specifically focused on transportation equity?

☐Yes ☒No ☐Unsure

4b 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

4c 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

4d 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

4e 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.

4m. Will solving the **transportation issue** in question 1 support improving **safety culture** for either transportation workers or the traveling public?

☐Yes ☒No ☐Unsure

4n. Will the solving the **transportation issue** support improving safety through **healthy and livable communities**?

☐Yes ☒No ☐Unsure

4o. Will solving the **transportation issue** support improving safety through using **best available technologies**?

☐Yes ☒No ☐Unsure

4p. Will solving the **transportation issue** support improving safety through **communication and collaboration**?

☐Yes ☒No ☐Unsure

4q. Will the solving the **transportation issue** support improving safety through **investing strategically**?

☐Yes ☒No ☐Unsure

4r. If you answered yes to any of the safety questions above or can provide alternative details related to safety, please provide additional information:

5. Other comments:

REFERENCES:

1) Coplantz (2023) 2022 ODOT Pavement Condition Report. www.oregon.gov/odot/Construction/Documents/Pavement/2022_condition_report_maps.pdf

6. Corresponding Submitter's Contact Information:

Name:	Erdem Coleri
Title:	Associate Professor
Affiliation:	Oregon State University
Telephone:	541-737-0944
Email:	colerie@oregonstate.edu

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