Research Stage 1 Problem Statement

PROPOSED TITLE: Automatic Classification of Injury Mechanism Using Biomechanical Modeling, Healthcare Metric and Transportation Data

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

Traffic accident injury is complex and can lead to different cost estimation and trauma triage. Delayed or misrepresented classification of injuries can be inconvenient and burdensome to the individuals and organizations involved. Accidents in traffic are caused by some kind of impact, i.e., the contact between some part of the vehicle and some part of the individual.   Even though there is health system information on the individual, the health condition on the part and the whole can vary over time. To develop a complete understanding of the impact, the consequences of the impact and the pre-conditions and post-conditions of the human, knowledge from biomechanical modeling, health system information and transportation accident report all need to be considered. Our project is to develop a system that automatically classifies the injuries to enhance existing accident reporting with comprehensive description of the mechanics of the impact and health system metrics.

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

Oregon Health Authority and Oregon hospitals have pertinent data related to the individuals; however, privacy and security concerns can prolong accessing the needed health data. On the other hand, anonymized accident information and generic biomechanical models can be developed to complete a database system, on which expertise of healthcare sectors can be integrated.   Currently, even though pedestrian death increased in 2022 in Oregon along with a reported 80% increase from 2013 to 2023 and cyclist fatality in accidents has not seen a decrease over the years, the specific injury mechanisms remain incomplete to ODOT crew and the emergency crew. There has been a growing effort worldwide to enable innovative vehicle designs and intelligent traffic rules for all motorists and pedestrians; in addition, biomechanical modeling and health system metrics are getting combined to enrich accident reporting for the transportation sectors. This enables an automatic classification system of the injuries that leverage knowledge of where the impact forces are, how the individual come to contact the vehicle part, the type of potential injury, the type of medical support and the damage to the vehicle.

With these quantitative details about each injury, categorizations will become more refined and objective. By verifying against existing health system metrics created by different medical groups over time, the classification process can be programmed. This automated approach will enable a system that contains more comprehensive descriptions of the injury mechanisms than the state-of-the-art accident reports, more accurate classifications of the severity and type of injury to reduce treatment delay and cost, and more transparent and repeatable data structures for fast technology updates in the future.

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

4. Other comments:

Existing traffic accident reports include where the collision occurs on the vehicle, e.g., frontal or lateral. This information can be used to establish further details such as information about geometry and material of the vehicle, physics of collision and health conditions of human. In turn, a more accurate injury mechanism can be derived, and a customized trauma triage can be applied to save costs for all parties involved. Health professionals use physiological, anatomic and mechanism-of-injury criteria to determine emergency support. Specifically, mechanism-of-injury includes high-level descriptions such as whether the injury is caused by ejection from the vehicle, rollover crash or high speed of vehicle. These mechanisms vary for different individuals with different health conditions. In addition, these mechanisms depend on whether the individuals are pedestrians, cyclists, e-cyclists, motorists or e-scooters. Classifications based on various input data need a system approach.

To establish a system that has databases from various domains will be our primary task. There are injury types that can be detected on site such as burns and bruises, and there are types such as bone fractures, internal bleeding, spinal cord or brain damage that need to be diagnosed. For the vehicles, there are different sizes, geometries and materials. The roadway characteristics can also be factors. After creating a comprehensive database of identified parameters in an accident, simulating how the injury is created is our next task. Biomechanical modeling enables understanding of damage caused by traumatic impact; however, these models are time-consuming to develop. Using transportation data on the costs of accidents, we foresee that some selected vehicle models, pedestrian types and road situations will become high priority to understand for ODOT.   This allows some representative simulations to be developed for these high priority cases. The biomechanical models can be adapted to describe more cases over the years. Based on these simulations, we can refine the categorizations of the injuries. With our system that is initially based on data from different domains and pertinent biomechanical simulations, inputs and evaluations from a group of medical experts can be incorporated back into the system.   To classify an injury, this system can be used as a reference manual to find matching conditions and decisions. Suggested classifications will be automatically generated by investigating these matches. On-site verifications can be achieved by consulting multiple experts who have access to the system.

During the development of the system, communications with ODOT, OHA and other hospital organizations will be on a monthly to quarterly basis. Literature research on injury mechanism published by transportation, physics, biology and medicine communities will be constantly performed. The entire project will be divided into stages that have concrete deliverables, i.e., constructions of the database system, creations of biomechanical simulations, and incorporation of inputs and evaluations from medical professionals.

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:

6. Corresponding Submitter's Contact Information:

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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.