Oregon Department of Transportation

Research Stage 1 Problem Statement

Number 26-55 – "Safety Evaluation of Driver Behavior at Roundabouts in Oregon"

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

Despite the well-known safety benefits of roundabouts, roundabout crashes in Oregon have been on an upward trend. Overall, roundabout crashes remained quite consistent from 2016 through 2019, hovering around 300 per year, followed by a steep decline in 2020 and a substantial increase in 2021 and 2022. From 2019 to 2022, there was a 29.3% increase in the number of roundabout crashes in Oregon. Although overall frequencies are low, there have also been slight increases in Vulnerable Road User crashes at roundabouts. These trends indicate a need to better understand safety behavior at roundabouts in Oregon to mitigate this upward trend. This research will identify crash-prone roundabouts and the factors contributing to the increase in roundabout crashes and severity outcomes. This research will also investigate driver compliance (see additional details in "Other Comments") and safety behavior at these roundabouts and provide recommendations for systemic efforts to reduce roundabout crashes, their severity, and improve driver compliance.

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

The final product of this research aims to offer ODOT a comprehensive analysis and report of safety behavior and driver compliance at roundabouts in Oregon. This research will first provide a summary of roundabout safety concerns and potential driver compliance issues for DOTs throughout the United States. This research will then conduct a comprehensive crash data analysis that will identify high-risk roundabout locations and the factors leading to the increase in roundabout crashes, the level of driver compliance with roundabout operations (e.g., appropriate use of turn signals), describe vehicle and vulnerable road user interactions at roundabouts, and provide recommendations for systemic roundabout crash mitigation efforts. The results of the analysis can help ODOT target public awareness campaigns and coordinate with DMV to emphasize appropriate driver requirements within roundabouts.

The analysis will consist of video data reduction, where this research aims to utilize computer-aided methods to reduce the video data. The method applied can be a tool that ODOT can use in the future for reducing video data in-house. The report intends to provide potential tools to improve driver compliance and overall safety at roundabouts. Key recommendations may consist of:

- **Driver Compliance at Roundabouts**: Potential strategies to improve awareness of roundabout procedures for drivers, such as targeted public awareness campaigns or public workshops.
- **Safety Behavior**: Options for addressing certain crash typologies at roundabouts. Provide potential strategies to reduce such crashes and/or their severity.
- **High-Risk Roundabout Locations**: Identification of high-risk roundabout locations in Oregon through a crash data analysis. Different location typologies (urban, rural) and roadway context for high-risk roundabout locations will be considered. Where appropriate, recommendations will be made to address transportation inequities if high-risk roundabout locations are found to be in locations that have high equity indices based on an equity matrix.

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. 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:

Climate is not the primary focus, though reducing the number of crashes relates to decreases in delay, idle time, and other factors that contribute to carbon emissions. Additionally, improving safety at high-risk roundabouts may lead to active transportation mode shifts, thus reducing vehicle miles traveled.

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:

This research aims to identify high-risk roundabout locations and assess driver compliance with roundabout operations. During analysis, results may indicate that high-risk roundabouts are in locations that meet equity considerations, including low-income areas and areas with a higher percentage of minority populations. Should areas such as these be identified, results and recommendations from this research can provide tools to improve roundabout safety considering equity.

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:

Safety is the primary focus of this research. By understanding the factors leading to increasing crash trends at roundabouts, appropriate mitigation strategies can be implemented by ODOT to support safety culture for the traveling public. The identification of driver compliance rates within roundabouts will further improve safety culture. Improving driver compliance in roundabouts may offer an opportunity to

increase vulnerable road user activity on routes that have roundabouts, leading to healthy and livable communities. This research will also consider recommendations to monitor or address driver compliance through new and emerging traffic monitoring technologies. It is anticipated that this research will offer an opportunity for ODOT to engage with the public and collaborate with DMV to ensure roundabout operating procedures are known to all, and the potential consequences of not abiding by these traffic laws. Through all of these recommendations, ODOT will be able to invest strategically and target their efforts to address both roundabout safety and driver compliance within roundabouts.

5. Other comments:

Recent studies on roundabout safety have suggested that roundabouts are expected to decrease the number of crashes, which is in stark contrast to the current trends in Oregon. Crash modification factors (CMF) for converting an intersection to a roundabout overwhelmingly indicate a reduction in crashes, where CMFs range (for all crash types, all injuries, and serious injuries) from 0.309 to 0.642 (Guin et al., 2019). Claros et al.(2022) had similar findings, but did note an increase in expected roundabout crashes when considering only no injury crashes. In addition, there are various studies dating back to as early as 2001 that suggest roundabouts, overall, are expected to decrease crash frequency.

In Oregon, drivers exiting a roundabout are expected to use their turn signal (Oregon Department of Transportation Driver and Motor Vehicle Servcies, 2024). Specifically, ORS 811.400 states that failure to use a turn signal when exiting a roundabout is a Class B traffic violation. For context, driving 21mi/h to 30 mi/h over the posted speed limit is also a Class B violation, which can be accompanied by driver license suspensions and/or a driving program. With this in mind, the leading cause of all crashes and injury crashes at roundabouts in Oregon is failing to yield the right-of-way. To address compliance issues that may be contributing to crash occurrences in roundabouts, research is limited. Some work has utilized survey data to classify and describe different driver behaviors (Al-Saleh and Bendak, 2012), while other work has used a combination of both field data and survey data to classify driver behavior under different scenarios (Belz et al., 2014; Chung et al., 2018; AlKheder et al., 2020; Hamad et al., 2024). AlKheder et al. (2020) found that about 3% of drivers had been cited for violating roundabout rules and Muley et al. (2022) found that about 18% of drivers exiting a roundabout use their turn signal. While this provides some insight, these studies were conducted internationally and may not reflect driver behavior or driver compliance in Oregon.

This research will examine roundabout safety in Oregon from different perspectives, thus complementing ODOT's ongoing commitment to transportation safety and transportation equity. This research will provide ODOT with valuable insights to strategically implement roundabout safety and driver compliance measures systemically.

References:

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