SPR RESEARCH PROGRAM
SECOND-STAGE PROPOSAL SUMMARY

PROBLEM NUMBER AND TITLE

25-35 Benefit-Cost Analysis of Roundabouts to Support Long Range Investment Policy

PROBLEM SUMMARY

Despite significant investments and successful use of roundabouts throughout the state, Oregon currently lacks clear evaluation of the benefits and costs of roundabouts tailored to the state's needs. The states of New York and Virginia have adopted a "roundabout first" policy, identifying roundabouts as the preferred design for intersections where feasible because of benefits to lifecycle system cost, safety, and traffic flow with greenhouse gas emission reduction benefits. However, Oregon lacks a systematic evaluation including equity concerns to support policy development.

ODOT OBJECTIVES

1. Review existing studies and Oregon-specific data on benefits and costs of roundabouts for both new intersections and retrofitting of existing intersections.
2. Calculate the most cost-effective long-range investment decision that meets the broad range of ODOT goals and objectives, emphasizing safety, long-range costs, and return on investment to the agency and public.
3. Evaluate integration of the new information from this study to update the ODOT Traffic Roadway intersection control design tool, currently in beta development.

BENEFITS

This project will help ODOT address the contexts in which roundabouts can provide short and long-term benefits of improved safety, operational performance including delay and emissions, while evaluating costs for construction, operation, and maintenance. The information may help support seeking additional funding for construction of roundabouts. Results can be implemented into ODOT's traffic analysis tools currently under development and will provide guidance on when and where to get the most benefit for the least cost from implementing roundabouts in Oregon.

SCHEDULE, BUDGET AND AGENCY SUPPORT

Estimated Project Length: 18 months.
Estimated Project Budget: $157,500
ODOT Support:

Becky Knudson, Senior Transportation Economist

Chris Primm, State Traffic Operations Engineer

Greg Griffin, Research Coordinator

FOR MORE INFORMATION

For additional detail, please see the complete STAGE 2 RESEARCH PROBLEM STATEMENT online at:
https://www.oregon.gov/odot/Programs/ResearchDocuments/25-35.pdf

SPR RESEARCH PROGRAM
SECOND-STAGE PROBLEM STATEMENT
FY 2025

PROBLEM NUMBER AND TITLE

25-35 Benefit-Cost Analysis of Roundabouts to Support Long Range Investment Policy

RESEARCH PROBLEM STATEMENT

Traffic signals on the state highway system are crucial to the safety, operation, and management of the Oregon highway system. Oregon has 1,480 traffic signals, 84% are owned by ODOT. A large proportion are nearing the end of their life. Some signals are aging faster due to environmental issues, such as coastal salt air and weather. Signal operations are key to addressing safety, impacting autos, trucks, bikes and peds. As connected and autonomous vehicles (CAVs) are introduced into the Oregon fleet, ODOT will be working to develop communication capabilities between CAVs and signals, which will require expanded investment over time and increasing maintenance. As ODOT implements more roundabouts on the state system, we are seeing improvements in traffic performance, improved safety, and reduced maintenance costs over time. Other agencies across the USA are beginning to see evidence of reduced cost of long-range maintenance. This begs the question whether ODOT should establish a policy to move way from investing in signal replacement and establish a long-term strategy implementing roundabouts based on comprehensive lifecycle costs and benefits.

Lifecycle costs of intersection management vary by design. In general, signals are less expensive to put into place initially, require ongoing maintenance and replacement costs, and include severe-injuries to property-damage-only crash costs. Roundabouts cost more to put into place initially, require relatively low maintenance costs and involve fewer crashes and reduced severity. ODOT's forecast budget falls far short of meeting investment needs, especially for maintenance and preservation. This means more than ever we must be strategic in making investment decisions and consider comprehensive lifecycle costs when choosing projects that provide the best return on investment for the state transportation system. Reducing lifecycle costs would help ODOT make progress toward good stewardship of public resources.

Crash costs include an equity component. Lower income households operate older vehicles with fewer safety features, use transit and walk more often that higher income households. Reducing the incidence and severity of crashes would help ODOT make progress toward social equity goals. Reduced crash costs would also support progress toward meeting safety goals. Roundabouts are also known to improve system reliability and reduce delay; they do not require electricity or software updates to accommodate connected and autonomous vehicles. Smoother traffic flows on a reliable system contribute toward reduced GHG and toxic emissions as the fleet transitions toward electric vehicles.

In the past there has been very little information available for ODOT to adequately represent roundabouts in cost benefit analysis. However, more and more agencies across the nation are seeing results from roundabouts. For example, a recent white paper documenting the benefits of roundabouts in the state of Illinois provides a list of benefits, including reduced lifecycle costs and reduced crashes and severity (Burns & McDonnell, 2023). The paper noted that the states of New York and Virginia have adopted "roundabout first" policies identifying roundabouts the preferred design for intersections when feasible. Widespread implementation of roundabouts in Carmel, Indiana reduced injury crashes by 47% (Wang & Cicchino, 2022). A recent review of previous research suggests implementation of roundabouts significantly reduce fuel use and carbon dioxide emissions, reduce traffic delay and queuing, but that they may be less effective than signal-controlled intersections with higher traffic volumes (Claros, et al., 2021). Single-lane roundabouts can cost roughly $1-2 million, while multilane roundabouts cost more (ASCE, 2021). Replacing freeway ramp terminals with roundabouts can cost less than $1.9 million at stop-controlled ramps, and less than $5.1 million at signal-controlled terminals, using 2019 dollars (Claros, et al., 2021). However, there is no comprehensive review of benefits and costs of

roundabouts in Oregon.

RESEARCH OBJECTIVES

This research would result in data-driven decisions regarding long range plans for intersection control investment, including strong correlation with safety costs. The desired outcome of this proposals is to develop and apply the results of this research project by calculating the most cost-effective long-range investment decision that meets the broad range of ODOT goals and objectives, with an emphasis on improving safety outcomes, reducing long-range costs, and providing the best return on investment to the agency and the public. ODOT Traffic Roadway currently has a beta tool to evaluate intersection control design. Roundabouts are included in this tool, but the information representing costs and benefits is sparse. Representation of roundabouts based on real-world observed costs and benefits within this tool will support informed decision making and result in more complete and objectives analysis.

ODOT needs thorough in-depth research to obtain the data and develop engineering-grade analysis that can be integrated into tools we are currently developing in-house to meet our unique needs. The results of this research would be implemented quickly and provide benefits to the agency in a timely and effective manner.

WORK TASKS, COST ESTIMATE AND DURATION

Task 1: Current State of Intersection Control Investment Practices [4 months]

The objective of this task is to review and document current intersection control investment practices. The review will focus on current investment policies being implemented by other DOTs and whether emphasis is put on "Roundabout First." This will include identification of any strengths or limitations in intersection control investment practices, and a comparison of intersection control investment practices among DOTs. The review will also document agency consideration of connected and autonomous vehicles in their intersection control investment policies. Current methods and tools used as part of intersection control investment will be documented.

Task 2: Roundabout Benefit-Cost Assessments [3 months]

This task will build upon Task 1 by focusing on benefit-cost analyses regarding roundabouts. This assessment will identify if there are current practices being implemented to assess the benefit-cost of systemic roundabout implementation, particularly for agencies that have adopted a "Roundabout First" policy. The research team will assess strengths and limitations of roundabout benefit-costs analyses implemented by other agencies, while determining practices that may be beneficial to Oregon. Additional information assessed will be data inputs used for current roundabout benefit-cost analyses (e.g., maintenance costs, operational costs, environmental costs, safety costs, etc.), how the data was obtained, or what supplemental data is required to estimate such costs. The results from this task will help guide a benefit-cost analysis framework for Oregon in succeeding research tasks.

Task 3: Data Collection and Inventory [3 months]

Based on results obtained in Task 2 and an assessment of ODOT Traffic Roadway's beta tool for intersection control design, this task will consist of collecting and inventorying the necessary data to conduct a benefit-cost analysis for roundabouts. Data collected will include information related to initial implementation costs, maintenance costs, operations costs, environmental costs, safety costs, and other data inputs as identified in Task 2. The research team will conduct a descriptive analysis of the cost data collected and summarize all relevant costs to be considered in a roundabout benefit-cost analysis.

Task 4: Develop a Benefit-Cost Analysis Framework for Roundabouts [5 months]

Using the data collected in Task 3, a benefit-cost analysis framework for roundabouts will be developed. The framework will be developed such that a benefit-cost analysis can be conducted by ODOT personnel. The research team will also explore the ODOT Traffic Roadway beta tool to determine if the framework can be

implemented within existing intersection control design tools. As part of this task, the research team will assess the feasibility of updating the current tool versus the use of a tool developed through this research. The research team will also assess the feasibility of maintaining/obtaining the necessary data to allow for continued use of the roundabout benefit-cost analysis framework.

Task 5: Apply Benefit-Cost Analysis to Select Locations [3 months]
Through consultation with the TAC, the research team will take the benefit-cost framework developed in Task 4 and apply to select locations to illustrate its ability. The research team will compare results from the roundabout benefit-cost analysis to those obtained with ODOT Traffic Roadway's beta tool results for other intersection control design types.

Key Deliverables: This study will produce a final report *documenting the study process and findings, recommending approaches to implement cost-benefit analysis of roundabouts in ODOT Traffic Roadway's beta tool and appropriate project development guidance documents*.

Estimated Project Length: 18 months.
Estimated Project Budget: $157,500

IMPLEMENTATION

Close engagement of the project technical advisory committee (TAC) will be key for implementation of the project, to include the project champions and if funded, possibly Peter Schuytema who leads the ODOT Analysis Procedures Manual, and Scott Batson, Traffic Operations engineer for the Portland Bureau of Transportation. The TAC, along with ODOT Research Coordinator Greg Griffin, will work with ODOT staff to develop an implementation plan to include project findings across the agency, including Traffic Roadway's beta analysis tool, agency guidelines and manuals, and dissemination through the Northwest Transportation Conference and other venues.

POTENTIAL BENEFITS

This project directly addresses the safety research priority of the Oregon Research Advisory Committee, in addition to stewardship of public resources and sustainability and climate action. The information from this project could support seeking grants from external sources for implementation. Comprehensive evaluation of the benefits and costs of implementing roundabouts in Oregon has the strong potential, based on other jurisdictions, to save substantial lifecycle costs and save lives. If this study is not implemented, then the state will continue to make piecemeal decisions on appropriate intersection designs based on benefit and cost evaluation on a case-by-case basis, rather than a review of the pertinent information for ODOT. This research project provides a practical approach to saving Oregonians' money and lives through transportation design improvements.

PEOPLE

ODOT champion(s): Kevin Haas (ODOT State Traffic Standards Engineer), and Chris Primm (ODOT State Traffic Operations Engineer)

Problem Statement Contributors: Becky Knudson (ODOT Senior Transportation Economist), Jason Anderson (PSU Senior Research Associate, and Greg Griffin (ODOT Research Coordinator)

REFERENCES

ASCE. (2021). *Modern roundabouts boost traffic safety and efficiency*. https://www.asce.org/publications-and-news/civil-engineering-source/civil-engineering-magazine/issues/magazine-issue/article/2021/03/modern-roundabouts-boost-traffic-safety-and-efficiency

Burns & McDonnell. (2023). *Illinois, Let's Discuss Our Roundabouts*. https://info.burnsmcd.com/white-paper/roundabout-design-and-implementation

Claros, B., Burdett, B., Chitturi, M., Bill, A., & Noyce, D. A. (2021). Are roundabouts safe and economically viable replacing conventional diamond interchange ramp terminals?. *Transportation research record*, *2675*(9), 1557-1572.

Wang, J., & Cicchino, J. B. (2022). Safety effects of roundabout conversions in Carmel, Indiana, the Roundabout City. *Journal of safety research*, 82, 159-165.

STAFF REVIEW PAGE

Literature Check

TRID&RIP

☒ A review of TRID & RIP databases found no existing research that answers the research question

There are many current and recent projects evaluating aspects of roundabouts, but none comprehensively addressing benefits and costs for Oregon. The timing of this project can leverage these studies for appropriate proxy data for Oregon, when needed.

Technology & Data assessment

☐ No Identified T&D output

☒ At the end of this project, the implementing unit(s) within ODOT will need to coordinate the adoption of new technology or data in order to realize the full potential of this research.

Though not required for completion of the project, this study may be most impactful by coordinating with the ongoing development of ODOT's beta tool for intersection control design. At a minimum, this can include direct guidance for implementation of benefits and costs of roundabouts as this tool is further developed.

Cross-agency stakeholders

- List ODOT partners or impacted units.
    - Policy and Planning (Christopher Melson and Peter Schuytema)
    - Engineering and Technical Services (Angela Kargel and Christi McDaniel-Wilson)
    - Transportation Safety Office (Nicole Charlson and other regional safety coordinators)

- Identify any issues of concern raised by an ODOT partners. Note expected mitigation that addresses these concerns.
    - ODOT may need to review safety and project development policies based on results of this study, particularly because of its high potential for improving safety if implemented broadly.