SPR RESEARCH PROGRAM
SECOND-STAGE PROPOSAL SUMMARY

PROBLEM NUMBER AND TITLE

25-29 Evaluation of the relationship between near misses and crash outcomes at intersections in Oregon

PROBLEM SUMMARY

The overrepresentation of crashes at signalized intersections is a persistent problem in Oregon. Crash analysis is a useful tool for characterizing the safety of a system, then refining the system's design. However, assessing the safety of novel transportation designs or existing facilities using real crash data may not be feasible because of the long observational periods and low numbers of crashes. Typically, three years of before and after data is required to produce statistically significant quantities of data (e.g., Perkins & Harris, 1968; Glennon & Thorson, 1975). Significant advances have been made in our ability to characterize transportation system safety with tools such as the Highway Safety Manual (HSM) predictive methods, however these tools require that crash modification factors (CMFs) have been produced for the infrastructure treatments in question, and for those models to have been calibrated for use in Oregon.

ODOT OBJECTIVES

Surrogate Safety Measures (SSM), or leading indicators such as near miss events, allow for the comparison of safety-related events by acting as proxies for likely crash outcomes. Because they are based on observable events, they can often capture multiple safety-related issues rather than being limited to a single aspect and offer the opportunity to include important factors that can contribute to crashes and severe outcomes, yet are not included in current crash databases. The promise of leading indicator analysis, such as SSM, has yet to be robustly correlated with real crash data across a wide variety of crash topologies. Recently, multiple vendors have entered this space, driving down cost - both for one-off studies and ongoing installations – increasing our need for defensible guidance when using this data. What little work that has been done in this space has not been calibrated to an Oregon Context. This project will determine the efficacy of leading indicator analysis in Oregon.

BENEFITS

A central element of ODOT's mission is to provide a safe and reliable multimodal transportation system. The proportion of fatal and serious injury crashes in Oregon is trending towards year over year increases. By scientifically correlating leading indicators with common crash configurations in Oregon, these new measures will provide additional tools for transportation safety and operations engineers to proactively evaluate the performance of existing and novel design and operational solutions, thereby increasing the safety of surface transportation systems in Oregon. These tools will allow for better evaluations of cost / benefit analysis of mitigation implementation in Oregon.

SCHEDULE, BUDGET AND AGENCY SUPPORT

Estimated Project Length: 24 months.
Estimated Project Budget: $210,000
ODOT Support: Christi McDaniel-Wilson, ODOT State Traffic Safety Engineer; Ben Chaney, ODOT Transportation Analyst; Jiguang Zhao, ODOT Traffic Safety Engineer

FOR MORE INFORMATION

For additional detail, please see the complete STAGE 2 RESEARCH PROBLEM STATEMENT online at:
https://www.oregon.gov/odot/Programs/ResearchDocuments/25-29.pdf

SPR RESEARCH PROGRAM
SECOND-STAGE PROBLEM STATEMENT
FY 2025

PROBLEM NUMBER AND TITLE

25-29 Evaluation of the relationship between near misses and crash outcomes at intersections in Oregon

RESEARCH PROBLEM STATEMENT

One persistent challenge across surface transportation systems is the overrepresentation of crashes at signalized intersections, a problem Oregon is not immune to. Crash analysis is a useful tool for characterizing the safety of a system, then refining the system's design. However, assessing the safety of novel transportation designs or existing facilities using real crash data may not be feasible because of the long observational periods and low numbers of crashes, typically at least three years of before and after data, required to acquire statistically significant quantities of data (e.g., Perkins & Harris, 1968; Glennon & Thorson, 1975). Significant advances have been made in our ability to characterize transportation system safety with tools such as the HSM predictive methods, however these tools require that CMFs have been produced for the infrastructure treatments in question, and for those models to have been calibrated to local conditions.

Surrogate Safety Measures (SSM), or leading indicators such as near miss events, allow for the comparison of safety-related events by acting as proxies for likely crash outcomes. Because they are based on observable events, they can often capture multiple safety-related issues rather than being limited to a single aspect and offer the opportunity to include important factors that can contribute to crashes and severe outcomes yet are not included in current crash databases. In the absence of robust crash data, or calibrated CMFs, leading indicator analysis may provide a proactive approach to identify traffic safety problems and evaluate proven and novel solutions before crashes occur (e.g., Arun et al., 2021; Hyden, 1987; Perkins & Harris, 1968).

RESEARCH OBJECTIVES

For practical application, Tarko et al. (2009) identified two characteristics SSMs must have: (1) They "should be based on an observable non-crash event that is physically related in a predictable and reliable way to crashes, and (2) There exists a practical method for converting the non-crash events into a corresponding crash frequency and/or severity". Even if a 1:1 mapping cannot be achieved, ODOT would gain significant value in developing high/med/low risk levels for different leading interval tools.

The promise of leading indicator analysis (i.e., surrogate safety measures (SSM)) in the transportation domain has yet to be robustly correlated with real crash data across a wide variety of crash topologies in the United States. Recently multiple commercial vendors have entered this space, driving down the cost - both for one-off studies and ongoing installations - making it timelier to have defensible guidance for using this data. What little work that has been done in this space has not yet been calibrated to an Oregon Context. This project will determine the efficacy of leading indicator analysis in Oregon.

WORK TASKS, COST ESTIMATE AND DURATION

This study will include the following research tasks to achieve the stated research objectives:

Task 1: Briefly review the state of practice related to near miss leading indicators (e.g., post encroachment time) at intersections in transportation. Additionally, this review will consider how leading indicators have been used for supporting funding/programming requests.

Task 2: Produce a prioritized list of crash scenarios (e.g., overtaking, left turn across path) that would benefit from validated leading indicators
Task 3: Select test sites (e.g., 30) for video data collection
Task 4: Conduct video and crash data collection
Task 5: Conduct video data reduction and crash data preparation
Task 6: Perform robust data analysis on video and crash data
Task 7: Development of guidance and final report

Key Deliverables:

This study will produce guidance via a final report on the validity of applying leading indicator analysis in Oregon. Details about the relationships between leading indicators and real crash data will be produced in such a way that allows ODOT engineers to use, or not use, particular leading indicators with confidence in their work. The recommendations will be prepared in a form that will allow for ease of adoption in the appropriate ODOT Design Manuals.

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Estimated Project Budget: $210,000

IMPLEMENTATION

This research will produce statistical evidence proving the relationship between surrogate safety measures and actual crash outcomes for certain crash typologies in the state of Oregon allowing for wider adoption of leading indicator analysis in traffic safety assessments of novel and recently implemented infrastructure.

POTENTIAL BENEFITS

A central element of ODOT's mission is to provide for a safe and reliable multimodal transportation system. The proportion of fatal and serious injury crashes in Oregon is trending towards year over year increases as it is in the rest of the country. By scientifically correlating leading indicators with common crash configurations in Oregon these new measures will provide additional tools for transportation safety and operations engineers to proactively evaluate the performance of existing and novel design and operational solutions, thereby increasing the safety of surface transportation systems in Oregon. These tools will allow for better evaluations of cost / benefit analysis of implement mitigation in Oregon.

PEOPLE

ODOT champion(s): Angela Kargel, PE, ODOT State Traffic Services Engineer

Problem Statement Contributors: David Hurwitz, Professor at Oregon State University; Chris Monsere, Interim Vice Provost for Faculty Success & Professor at Portland State University; Sirisha Kothuri, Senior Research Associate at Portland State University; Greg Griffin, ODOT Research Coordinator

REFERENCES

Arun, A., Haque, M.M., Washington, S., Tarek, S., and Mannering, F. (2021). A systematic review of traffic conflict-based safety measures with a focus on application context. *Analytical Methods in Accident Research*, Vol. 32.

Glennon, J. C. and Thorson, B. A. (1975). *Evaluation of the Traffic Conflicts Technique*, Final Report.

Hydén, C. (1987). *The development of a method for traffic safety evaluation: The Swedish traffic conflict technique* (Doctoral thesis). Lund University.

Perkins, S., and Harris, J. (1968). *Traffic Conflict Characteristics - Accident Potential at Intersections, Highway Research Record*, No. 225, pp 35-43.

Tarko, A., Davis, G., Saunier, N., Sayed, T., Washington, S., 2009. *Surrogate measures of safety*. white paper. Transportation Research Board, Washington, DC.

STAFF REVIEW PAGE

Literature Check

TRID&RIP

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

There are no in-progress or completed projects determining the efficacy of surrogate safety measure analysis in Oregon. An Iowa-based study showed that among modern machine learning techniques, contrastive pessimistic likelihood estimation (CPLE) identified potential conflicts better than other approaches (Sharma, et al., 2019), but this study did not relate the surrogate measure to actual crash risks.

Reference

Anuj Sharma, Pranamesh Chakraborty, Neal Hawkins, & Skylar Knickerbocker. (2019). *Automating Near-Miss Crash Detection Using Existing Traffic Cameras Final Report* (17–619; p. 53). Iowa State University Center for Transportation Research and Education. https://intrans.iastate.edu/app/uploads/2019/09/near-miss_crash_detection_w_cameras_w_cvr.pdf

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.

Deliverables from this project include a report with guidance for possible incorporation in ODOT design manuals, but new technologies or data integration are not anticipated.

Cross-agency stakeholders

- List ODOT partners or impacted units.
    - Engineering and Technical Services (Angela Kargel, Christi McDaniel-Wilson, and Jiguang Zhao)
    - Transportation Safety Office (Nicole Charlson and other regional safety coordinators)
    - Policy and Planning (Ben Chaney)

- Identify any issues of concern raised by an ODOT partners. Note expected mitigation that addresses these concerns.
    - Comprehensiveness of crash contexts was raised as a concern, which could be mitigated by identifying sites covering diverse geographic and design contexts.
    - Statistical validity of having adequate near-miss data collection was also raised, which could be mitigated by prioritizing sites identified by ODOT staff as having near-miss scenarios such as intersections with high volume left turns and vulnerable road user traffic.