

SPR RESEARCH PROGRAM

SECOND-STAGE PROPOSAL SUMMARY

PROBLEM NUMBER AND TITLE

24-55 – Implementation Requirements for Work Zone Intrusion Technologies to Reduce Fatalities

PROBLEM SUMMARY

The latest information published by ODOT on fatal crashes shows alarming trends¹. In 2022, there were 605 fatalities, in 2021, 599, and in 2020, 460. These values represent three consecutive years of ODOT's highest recorded values, as reported over a 10 year period (Oregon DOT Crash Analysis Unit, 2020). Across the U.S., roadway workers on foot being struck by vehicles (both construction equipment and travelling public) was the most prevalent cause of highway worker fatalities (2017-2019) and accounted for 53% of worker fatalities in 2020 (ARTBA, 2022). Preventing intrusions, and protecting workers, is a high priority for both ODOT and contractors. ODOT has an immediate need to address this safety aspect, as identified by near misses in the month of February 2023 from Administrator Lynde's recent all-ODOT email (Lynde, 2023). This research will focus on work zone intrusion technologies, which may also have application in other areas of roadway safety.

ODOT OBJECTIVES

The goal of this research is to develop additional knowledge and practices related to the implementation of new work zone intrusion technologies to improve safety. The research plan will review current technologies (and other innovations) to compare with user needs and ease of implementation. The output will be a report comparing aspects of current leading technologies, presented as a list of attributes, and a guidance document for their implementation in practice. Data to compare these aspects will involve literature, user engagement, demonstrations, and to the extent possible, limited in-field experimentation. Improved safety with ease of implementation are primary motivations, however, other value-add aspects (e.g., cost, data logging/recording, availability, etc.) will be reviewed.

BENEFITS

ODOT's mission includes safety and economy as two of its core values. Focusing on work zone intrusions, including near misses, is important to help ODOT improve while delivering on safety, specifically focused for temporary work zones. Additionally, safety and mobility affect both ODOT's financial standing and the state's economy. The need to address work zone intrusions is especially important given the increase in work that will occur as a result of funding from the Transportation Investment Act.

SCHEDULE, BUDGET, AND AGENCY SUPPORT

Estimated Project Length: 24 months.

Estimated Project Budget: \$226,200

ODOT Support: Justin Moderie, P.E., G.E., State Construction and Materials Engineer, ODOT Construction Section; Kevin Haas P.E., State Traffic Standards Engineer; Justin King, P.E., State Work Zone 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/24-55.pdf>

¹ Years 2022 and 2021 are preliminary values, as advised by ODOT Crash Analysis Unit.

SPR RESEARCH PROGRAM

SECOND-STAGE PROBLEM STATEMENT

FY 2024

PROBLEM NUMBER AND TITLE

24-55 – Implementation Requirements for Work Zone Intrusion Technologies to Reduce Fatalities

RESEARCH PROBLEM STATEMENT

Vehicle intrusions into construction and maintenance work zones continue to occur and result in injuries, fatalities, and significant damage to ODOT equipment and roadway infrastructure. Prior ODOT research (SPR 790, 2017) provided a detailed assessment of three work zone intrusion technologies. Since that initial research, multiple new technologies have been developed that provide additional features for intrusion detection and intrusion alert. New, connected technologies can provide for real-time monitoring and recording of an intrusion incident. These technologies can be used for documenting near misses, law enforcement related to intrusions, and incident reporting and analysis for education and training. While the new technologies are quite promising to help reduce intrusions and change driver behavior, data and guidance is needed to determine how they can best be utilized and their actual benefits.

RESEARCH OBJECTIVES

The overall goal of this research is to develop additional knowledge and practices related to the implementation of new work zone intrusion technologies to improve driver and worker safety in temporary work zones. The research will focus on temporary construction and maintenance operations on multi-lane, high-speed roadways that involve one- or two-lane restrictions (e.g., repaving or restriping on Interstate 5) during daytime and nighttime conditions. Appropriate AADT levels for such cases will be reviewed with ODOT and considered within the research. To meet this goal, the proposed research focuses on the new, publicly available work zone intrusion alert technologies, especially those that have internet capability to record and communicate intrusion data. Specifically, the objectives of the research are to: (1) Collect information about new technologies that could be implemented to mitigate the impacts of work zone intrusions and assist with documenting, analyzing, and learning from intrusions when they occur; (2) Identify promising technologies for further evaluation and implementation in practice based on desired performance objectives; (3) Evaluate selected technologies to assess their effectiveness and determine guidance for practical implementation; and (4) Prepare implementation guidance and recommendations for use and reference by ODOT.

WORK TASKS, COST ESTIMATE AND DURATION

The proposed study will be conducted via multiple tasks intended to collect knowledge relevant to the topic, evaluate new intrusion technologies, and develop guidance for ODOT. The first phase of the study (Phase I) will consist of documenting currently available technologies, their capabilities, and ODOT's desired performance objectives for the technologies. Phase I will contain three tasks. Task 1 will consist of a comprehensive review of literature on the topic and intrusion technology websites to document the capabilities, implementation guidance, and expected performance of the technologies. Next, for Task 2, the researchers will reach out to ODOT and other state DOTs to collect experiential knowledge about work zone intrusion technology use and performance. Specifically, the researchers will meet with the TAC to identify desired performance objectives for the technologies, e.g., warn drivers when they have intruded into a work zone, warn workers of an intrusion, document the intrusion and its impacts on the site, and collect data needed for law enforcement related to the intrusion. Secondly, the researchers will conduct a survey of other state DOTs to identify their common practices and uses related to the desired performance objectives, including use of video to record work zone intrusions. The last task of Phase I (Task 3) will include an analysis of the work zone intrusions recorded in the Near Miss Reports collected by the ODOT Office of Employee

Safety and other databases containing data on intrusion incidents. The intent of the analysis is to identify the common characteristics of work zone intrusions and to map the capabilities of the technologies to the characteristics to fulfill the desired performance objectives. The output of Phase I will be an interim report (Task 4) that will inform the selection of work zone intrusion technologies to investigate further as part of Phase II of the study.

Starting with the intrusion technology information and performance objectives documented in Phase I, the next phase (Phase II) will focus on in-depth evaluation of one or two promising technologies. This phase will start with a TAC meeting to select the technologies for further evaluation (Task 5). Next, for Task 6, based on the TAC's selection and with the assistance of ODOT, the researchers will implement the selected technologies during a construction and/or maintenance operation for further evaluation. When implemented, the researchers will document the technology implementation, including ease of use, and record any safety concerns or other impacts to the work. If possible, without interrupting the work operations and creating a safety hazard, the researchers will conduct a trial of the technologies that includes a simulated intrusion. The simulated intrusion will enable collecting real-time data regarding the performance, capabilities, ease of use, and impacts. Finally, the researchers will interview the workers to gain their perspectives on the benefits & barriers of the technology use.

Phase III will involve discussion of the feasibility of deploying the technology and developing the guidance documents for implementation. The researchers will prepare a draft guide that describes the recommended practices and supports ODOT personnel when implementing the technologies on site (Task 7). The guide will be provided to ODOT for review, evaluation, and feedback. Lastly, Task 8 will entail the preparation, submittal, and presentation of a final research report that describes the study methods, results, conclusions, and recommendations for practical implementation of the results.

Key Deliverables: ODOT is in need of research regarding intrusion technologies in the form of a set of requirements. The requirements will be used to evaluate future technologies for their effectiveness in reducing fatalities, reducing near misses, and ease of implementation. Other factors will be examined for value-added benefits, including total costs to purchase, data collection/storage capabilities, and other factors which will be determined from stakeholders.

Estimated Project Length: 24 months.

Estimated Project Budget: \$226,200²

IMPLEMENTATION

Implementation of the expected research outputs requires detailed information related to the available work zone intrusion technologies. Specifically, information is needed regarding the features, capabilities, and performance of the technologies, the site conditions, and operations for which they are particularly useful, recommendations for how to implement the technologies, and the expected feasibility and impacts of implementation. The information needs to be provided to those ODOT construction and maintenance personnel who are in positions of determining what technologies and processes should be implemented during work operations on active roadways, and those personnel who conduct the work. An implementation guide that provides the information mentioned above would provide a useful final product for practical

²The estimated duration of the research study is 24 months, assuming a September 1, 2023 start date. Data collection over at least one construction season would be required in order to complete Task 6. The estimated budget includes PI salaries/benefits, travel to field sites for data collection, minor research equipment/supplies, and ODOT administration costs. The budget also includes an estimated amount of \$10,000 for acquiring (purchase or rental) intrusion technologies for Task 6. This equipment cost may vary depending on the specific technologies selected for evaluation in Task 5.

implementation of the research results. The outputs would be used by the ODOT Transportation Safety Division and the Transportation Safety Coordinators in each Region, as they plan and design traffic control for work zones. In addition, the results would be used by the Statewide Construction Office and implemented through communication and education of the Construction Project Managers statewide.

POTENTIAL BENEFITS

ODOT's mission includes providing safe and reliable transportation systems, and safety is one of ODOT's core values. Across the U.S., roadway workers on foot being struck by vehicles was the most prevalent cause of highway worker fatalities from 2017-2019 and accounted for 53% of worker fatalities in 2020 (ARTBA, 2022). Preventing intrusions from occurring, and protecting workers when an intrusion occurs, is a high priority for both ODOT and roadway contractors. Recent work zone intrusion incidents during ODOT construction and maintenance activities have reinforced the need to continue to look for ways to prevent and mitigate intrusions. Learning from intrusions that occur, including near miss intrusions, is also an important part of continuous improvement. The proposed research addresses driver behavior and safety in work zones, a driving environment that often creates additional risk to drivers and impacts mobility through the transportation network. Additionally, safety and mobility affect the economic efficiency of both ODOT and the state's economy. The need to address work zone intrusions is especially important given the increase in construction and maintenance work that will occur on roadways as a result of funding for ODOT from the Transportation Investment Act. Improving safety and mobility in work zones will lead to lower overall construction & maintenance costs and greater potential for ODOT to continue to support the state's economy.

PEOPLE

ODOT champion(s): Justin Moderie, P.E., G.E., State Construction and Materials Engineer, ODOT Construction Section; Kevin Haas, State Traffic Standards Engineer; Justin King, P.E., State Work Zone Engineer, ODOT

Problem Statement Contributors: Justin King, P.E., ODOT State Work Zone Engineer; Jon Lazarus, ODOT Research Coordinator; John Gambatese, PhD, Oregon State University

REFERENCES

(ARTBA, 2022) "Worker Fatalities and Injuries at Road Construction Sites." National Work Zone Safety Information Clearinghouse, American Road & Transportation Builders Association, <https://workzonesafety.org/work-zone-data/worker-fatalities-and-injuries-at-road-construction-sites/>.

(SPR 790, 2017) "Work Zone Intrusion Alert Technologies: Assessment and Practical Guidance." Final Report, SPR 790, ODOT, <https://workzonesafety.org/work-zone-data/worker-fatalities-and-injuries-at-road-construction-sites/>

(Lynde, 2023) "A Message of Gratitude" Email to all ODOT employees dated 3/2/2023

(Oregon DOT Crash Analysis Unit, 2020) "Count Crashes by Injury Severity by year", report# CDS330, https://www.oregon.gov/odot/Data/Documents/Crashes_Severity_Year.pdf

STAFF REVIEW PAGE

Literature Check

TRID & RIP

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

There are two active studies in the RIP database on this topic (from 2021). SPR-4629 study's scope and results (beyond the summary description) are not available at this time. RP2019-24 focuses on the evaluation and development of an intrusion detection system prototype developed by the researcher. The prototype is currently in development and not publicly-available. Our proposed study targets only those technologies that are currently publicly available and does not focus on just one technology. In addition, to these explanations, the states conducting these studies have slightly different standards for work zones in comparison to Oregon. Also, these studies are not focused on requirements gathering and ODOT user needs, unlike the ODOT proposal. I believe it is accurate to say that these studies will enhance the dataset and literature review portions of the ODOT proposed study and do not directly address ODOT's needs.

- **SPR-4629: Implementation and Assessment of Work Zone Intrusion Technologies. [Project]. Purdue University/Indiana Department of Transportation JHRP. Start date: 1 Jul. 2021.**
<https://rip.trb.org/view/1867289>
- **Technology Transfer for RP2019-24 - Work Zone Intrusion Alert System Technology Tests. [Project]. North Carolina Department of Transportation. Start date: 15 Apr. 2021.**
<https://rip.trb.org/view/1870699>

Prior ODOT research (SPR 790 Work Zone Intrusion Alert Technologies Assessment, 2017) is also a relevant study. However, ODOT customers learned from SPR790 that a set of requirements to be developed has more applicability for future use, as opposed to an evaluation of technology at any given moment.

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.

This research focuses on setting ODOT criteria and specifications for work zone intrusion technologies. The Research project alone will not result in the purchase or operational deployment of these technologies by ODOT. The final project objective of preparing implementation guidance and recommendations for use and reference by ODOT will hopefully serve as the business case documentation for any subsequent ODOT Tech and Data review and approvals.

Justin Moderie, State Construction & Materials Engineer and Justin King, State Traffic Work Zone Engineer or their successors will be responsible for initiating the tech and data approval process prior to operational implementation of this research.

Cross-agency stakeholders

- List stakeholders or impacted units

Maintenance Operations Branch (MOB) may possibly be affected if they agree to follow a change in temporary work zone standards. Policy and design standard changes will affect the contracting community.

- Identify any issues of concern raised by an ODOT stakeholder. Note expected mitigation

A concern was raised that the research product needs to relate technologies in terms of requirements, not only

products. This was address in the work product.

A concern was raised that ease of implementation be a major factor when evaluating technologies. This was addressed in the research plan and data development of stakeholders.