

SPR RESEARCH PROGRAM

SECOND-STAGE PROPOSAL SUMMARY

PROBLEM NUMBER AND TITLE

27-08: Enhancing Commercial Motor Vehicle Safety and Compliance: Evaluating the ARIES Pilot and Illegal Bypass Behavior in Oregon

PROBLEM SUMMARY

Illegal bypass of weigh stations and roadside inspection facilities poses a measurable safety and compliance risk within Oregon's commercial motor vehicle (CMV) system. When vehicles evade inspection, potential violations such as overweight operations, equipment deficiencies, and hours-of-service noncompliance may go undetected, increasing crash exposure and infrastructure damage risk. ODOT's Commerce and Compliance Division (CCD) currently lacks a standardized, integrated methodology to quantify illegal bypass behavior or link bypass events to inspection outcomes, crash involvement, and carrier safety history.

ODOT OBJECTIVES

This research will deliver to ODOT:

- A standardized and replicable data integration framework linking ARIES pilot data with CCD inspection, violation, crash, and carrier safety records.
- Measurable and trackable performance indicators to support ongoing internal monitoring of illegal bypass activity and automated enforcement effectiveness.
- Quantitative analysis of the magnitude, characteristics, and safety implications of illegal bypass behavior in Oregon.
- Evaluation of ARIES pilot impacts on compliance rates, inspection targeting efficiency, enforcement productivity, and CMV safety outcomes.
- Implementation guidance and best-practice recommendations to inform strategic investment decisions, future site deployments, and FMCSA Innovative Technology Deployment (ITD) funding applications.

BENEFITS

This research will strengthen ODOT's ability to detect and deter illegal bypass behavior, directly advancing Oregon's transportation safety goals. By integrating ARIES data with inspection and crash records, CCD will be able to target high-risk vehicles more effectively, reduce unnecessary inspections of compliant carriers, and improve enforcement productivity. The project supports ODOT priorities related to Safety, Innovative Technologies, Process Improvement, and Stewardship of Public Resources by providing measurable evidence to guide enforcement modernization.

SCHEDULE, BUDGET AND AGENCY SUPPORT

Estimated Project Length: 24-36 months

Estimated Project Budget: \$240,000-\$360,000

ODOT Support: Audrey Lawson, ITD Program Manager, CCD; Lloyd Pratt, Roadside Safety & Compliance Branch Manager, CCD; Calvin Brown, Motor Carrier Field Services Facility Analyst, CCD; Gian Olsen, Business Systems Analyst, CCD, & Carla Phelps, CCD Administrator

For additional detail, please see the complete STAGE 2 RESEARCH PROBLEM STATEMENT online at:

<https://www.oregon.gov/odot/Programs/ResearchDocuments/27-08.pdf>

SPR RESEARCH PROGRAM

SECOND-STAGE PROBLEM STATEMENT

FY 2027

PROBLEM NUMBER AND TITLE

27-08 Enhancing Commercial Motor Vehicle Safety and Compliance: Evaluating the ARIES Pilot and Illegal Bypass Behavior in Oregon

RESEARCH PROBLEM STATEMENT

Illegal bypasses of weigh stations and roadside inspection facilities present a measurable and growing risk to Oregon's commercial motor vehicle (CMV) safety program. When vehicles evade inspection, potential violations such as overweight operations, equipment deficiencies, and hours-of-service noncompliance may go undetected, increasing crash exposure for both freight operators and the traveling public. ODOT's Commerce and Compliance Division (CCD) currently lacks a standardized, integrated methodology to quantify illegal bypass activity or link those events to inspection outcomes, crash involvement, and carrier safety history. As identified in the Stage 1 problem statement, this limits Oregon's ability to allocate enforcement resources strategically, evaluate technology investments, and demonstrate performance improvements tied to federal Innovative Technology Deployment (ITD) funding.

Beginning in Summer 2026, CCD will deploy the Automated Roadside Information and Enforcement System (ARIES) pilot at the Bend Weigh Station, with long-term plans tied to Oregon's 21 weigh-in-motion (WIM) sites. ARIES introduces automated camera-based detection and digital enforcement capabilities designed to improve compliance monitoring and reduce illegal bypass behavior. While the technology represents a significant modernization effort, Oregon does not yet have an analytical framework to evaluate its effectiveness or to determine whether detected bypass behavior correlates with elevated safety risk. A rigorous, data-driven assessment is needed to validate ARIES performance, quantify compliance improvements, and inform decisions regarding statewide expansion.

Nationally, states have implemented a range of screening and bypass management strategies, including WIM-based pre-screening, transponder preclearance systems, and risk-based inspection targeting. For example, Kentucky has examined automated screening and enforcement efficiency within its commercial vehicle program, demonstrating operational gains from data-driven targeting; however, published work has not fully integrated illegal bypass detection with crash outcomes and telematics-derived behavioral indicators. More broadly, research using FMCSA inspection and carrier data confirms that risk-based enforcement improves safety outcomes, yet illegal bypass behavior remains underexamined in the literature. The emergence of freight telematics data, which captures speed patterns, route deviations, and braking behavior, creates new opportunities to evaluate bypass behavior in ways previously impossible.

This research will develop and validate a comprehensive framework that integrates ARIES data with CCD inspection records, crash databases, carrier histories, and telematics inputs to quantify illegal bypass activity and assess its relationship to safety outcomes. The study will establish measurable performance indicators for automated enforcement, evaluate the safety and operational impacts of the ARIES pilot, and provide evidence-based recommendations to guide technology deployment, enforcement strategy, and future ITD grant applications. By grounding enforcement modernization in transparent analytics, the project will strengthen safety, improve resource allocation, and position Oregon as a leader in data-driven commercial vehicle compliance systems.

RESEARCH OBJECTIVES

The overarching goal of this research is to develop and validate a comprehensive, data-driven framework that enables ODOT's Commerce and Compliance Division (CCD) to detect, quantify, and evaluate illegal weigh station bypass behavior and assess the safety and compliance impacts of the ARIES pilot deployment. The research will provide the analytical foundation necessary to support evidence-based enforcement strategies, performance monitoring, and informed decision-making regarding statewide expansion of automated enforcement technologies.

To achieve this goal, the project will pursue the following tasks and objectives:

- **Conduct a national literature review and state practice scan** to synthesize prior research, federal guidance, and state-level practices related to illegal bypass behavior, automated enforcement technologies, weigh-in-motion screening, and risk-based inspection targeting.
- **Develop a standardized data integration framework** that links ARIES pilot data with CCD inspection records, violation data, crash databases, carrier safety histories, and available telematics inputs, including consistent definitions of bypass events and compliance outcomes.
- **Quantify the magnitude and characteristics of illegal bypass behavior in Oregon**, including frequency, spatial distribution, temporal patterns, and high-risk operational contexts at the pilot site and comparable facilities.
- **Evaluate the relationship between bypass behavior and safety outcomes** by assessing whether vehicles or carriers associated with bypass events demonstrate higher violation rates, elevated crash involvement, or identifiable behavioral risk indicators.
- **Assess the operational and safety effectiveness of the ARIES pilot** by analyzing changes in compliance rates, inspection targeting efficiency, enforcement productivity, and safety-related metrics before and after deployment.
- **Develop performance measures and implementation guidance** to support ongoing monitoring of automated enforcement systems and provide evidence-based recommendations for CCD's strategic investments and potential statewide ARIES expansion.

WORK TASKS, COST ESTIMATE AND DURATION

The proposed research will be conducted over a 24-36-month period to allow sufficient time for ARIES pilot data collection, integration with CCD datasets, statistical modeling, and development of implementation guidance.

Task 1 – Project Initiation and Coordination (Months 1–2).

The project will begin with formal initiation activities, including a kickoff meeting with CCD leadership and ARIES technical staff to confirm scope, refine research questions, and establish communication protocols. During this phase, the research team will develop a detailed project management plan, finalize data access agreements, and establish data governance and confidentiality procedures to ensure secure handling of enforcement and crash records.

Task 2 – Literature Review and National State Practice Scan (Months 1–5).

The research team will conduct a comprehensive review of national research on illegal weigh-station bypass behavior, automated enforcement technologies, weigh-in-motion screening systems, and risk-based inspection targeting. This task will include examination of FMCSA guidance, ITD program documentation, and documented state practices and other jurisdictions. The outcome will be a synthesis of best practices, methodological gaps, and transferable strategies relevant to Oregon's enforcement modernization efforts.

Task 3 – Data Compilation and Integration Framework Development (Months 3–9).

This task will focus on compiling ARIES pilot data and integrating it with CCD inspection records, violation histories, crash databases, and carrier safety information. Where feasible, telematics inputs will also be

incorporated to provide behavioral context. The research team will develop standardized definitions of bypass events and compliance indicators, and construct a replicable data integration framework to support long-term monitoring beyond the pilot phase.

Task 4 – Quantification of Illegal Bypass Behavior (Months 7–14).

Using the integrated dataset, the research team will measure the frequency, spatial distribution, and temporal patterns of illegal bypass events. Analyses will identify operational conditions, carrier characteristics, and facility-level factors associated with higher bypass activity. This task will produce baseline performance metrics that describe the scope and characteristics of the issue in Oregon.

Task 5 – Safety and Operational Impact Analysis (Months 10–18).

This phase will evaluate whether bypass behavior is associated with elevated safety risk. Statistical modeling will assess relationships between bypass events, violation rates, crash involvement, and carrier risk indicators. Pre- and post-ARIES comparisons will be conducted to determine changes in compliance rates, inspection targeting efficiency, and enforcement productivity following deployment of automated detection technology.

Task 6 – Performance Measures and Implementation Guidance (Months 16–22).

Building on analytical findings, the research team will develop key performance indicators for automated enforcement effectiveness and define monitoring protocols for continued evaluation. Recommendations will be prepared to guide CCD's strategic investment decisions, inform potential statewide ARIES expansion, and strengthen future FMCSA Innovative Technology Deployment grant applications.

Task 7 – Final Reporting and Technology Transfer (Months 22–24 or 36).

The final phase will include preparing the Final Report, presenting findings to CCD leadership and partners, and delivering technical documentation, analytical templates, and executive summaries suitable for internal decision-making and external funding justification.

The **total estimated project budget** is approximately \$240,000-\$360,000 over a 24-36-month period. The primary cost component will be personnel, including the Principal Investigator, research staff, and graduate research assistants. Additional costs may include secure limited travel for site visits and coordination meetings, report preparation and dissemination, and university indirect costs consistent with ODOT requirements.

Key Deliverables:

The following key deliverables define the specific analytical tools, findings, and implementation guidance ODOT requires to evaluate the ARIES pilot and strengthen commercial motor vehicle safety and compliance statewide.

1. Measurable and trackable data for internal analysis (ongoing)
2. Literature review on illegal bypass behavior in Oregon and nationwide to determine the scope of the problem, the possible prevention methods, and the feasibility and impact of technology deployments on CMV safety.
3. Analysis on impact of ARIES pilot deployment on illegal bypass activity and CMV safety.
4. Analysis of the feasibility and best practices of future site deployments to ensure maximum return on investment.
5. Comprehensive research paper that details (1-4) above, along with recommendations for future activities including technology deployments, policy and procedural changes, data analysis, and research.

Estimated Project Length: 24-36 months.

Estimated Project Budget: \$240,000-\$360,000

EXPECTED ODOT IMPLEMENTATION ACTIONS

The following implementation actions describe how ODOT will apply the research findings to guide enforcement strategy, technology deployment decisions, and long-term commercial motor vehicle safety improvements across the state.

1. The analysis will provide ODOT with a methodology and rationale to assess the success and impact of the ARIES pilot.
2. Determine the location of future implementation/feasibility of additional sites to improve ROI.
3. The research will provide data and analysis on the impacts of this new technology deployment on CMV safety, allowing ODOT to pursue additional grant funding to support deployment.
4. Update enforcement and safety policies and procedures in accordance with the research recommendations.
5. Potential for additional research, analysis, and or policy or procedural efforts as ODOT obtains and evaluates new vehicle data previously unavailable to the Agency.

POTENTIAL BENEFITS

This research will generate significant safety, operational, and strategic benefits for ODOT's Commerce and Compliance Division and Oregon's transportation system. By developing a validated framework to detect and quantify illegal weigh-station bypass behavior and link it to crash risk and violation outcomes, the project directly advances the **Safety** focus area identified by the Oregon Research Advisory Committee and aligns with the Safety goal of the Oregon Transportation Plan. The integration of ARIES data with inspection, crash, and carrier safety records will allow CCD to target high-risk vehicles more effectively, reduce unnecessary inspections of compliant carriers, and improve overall enforcement productivity. This supports ODOT priorities related to **Innovative Technologies and Systems, Process improvements, and Stewardship of Public Resources**, as the research will provide measurable evidence to guide technology deployment and optimize enforcement investments. Over time, improved targeting and automation can reduce crash-related costs, enhance freight mobility for compliant carriers, and strengthen Oregon's competitiveness for future FMCSA Innovative Technology Deployment funding.

If this research is not conducted, ODOT risks implementing automated enforcement technologies without a defensible methodology to evaluate effectiveness or quantify safety returns. Illegal bypass activity may remain under-measured, limiting the agency's ability to allocate resources strategically or demonstrate measurable outcomes. Without integrated analytics, enforcement modernization efforts could lack transparency, consistency, and long-term performance tracking. Conducting this research ensures that ARIES deployment and future expansion decisions are grounded in evidence, supporting efficient operations, an improved safety culture, and data-driven policy decisions consistent with ODOT's Research Advisory Committee (RAC) priorities.

PEOPLE

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STAFF REVIEW PAGE

LITERATURE CHECK

TRID&RIP

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

ODOT DECISION LENSES

Climate: The ARIES pilot is not primarily a climate-focused initiative. However, it has indirect climate-related benefits through improved operational efficiency and infrastructure protection. By enhancing detection of illegal weigh station bypass behavior and improving risk-based inspection targeting, ARIES supports more efficient traffic flow through weigh facilities. Improved screening accuracy may reduce unnecessary stops and idling for compliant carriers which can modestly reduce fuel consumption and associated greenhouse gas emissions.

Additionally, enforcement of weight compliance helps protect pavement and bridge infrastructure from premature deterioration caused by overweight operations. Preserving infrastructure life reduces the frequency of major rehabilitation activities, which are resource and carbon intensive.

While this research will not include a formal greenhouse gas or emissions analysis, ARIES supports ODOT's broader climate stewardship goals.

Equity: The ARIES pilot promotes consistent and objective enforcement practices. Automated detection reduces reliance on discretionary roadside observation and supports uniform application of bypass criteria across facilities and regions. Clearly defined detection thresholds and standardized analytics promote transparency and reduce the potential for inconsistent treatment.

By improving inspection targeting accuracy, ARIES also reduces unnecessary stops of compliant carriers, supporting fair and equitable treatment across the freight industry. Any future expansion of ARIES will consider geographic distribution and operational impacts to ensure balanced and responsible deployment of enforcement technology.

Safety: Safety is the primary purpose of the ARIES pilot. Illegal bypass of weigh stations allows potentially unsafe vehicles to evade inspection, increasing crash exposure for commercial drivers and the traveling public. ARIES introduces automated camera-based detection and digital enforcement tools to identify and deter bypass behavior.

Through integration with inspection, violation, and crash data systems, ARIES supports risk-based targeting of high-risk vehicles and carriers. This improves inspection efficiency, strengthens enforcement consistency, and enhances ODOT's ability to prevent crashes before they occur. By modernizing detection and compliance monitoring, ARIES directly advances ODOT's shared responsibility for roadway safety.

TECHNOLOGY & DATA ASSESSMENT

While this research does not directly procure or implement new technology systems, it will generate data integration frameworks, analytical models, and performance metrics that may require operational adoption within ODOT to fully realize the project's benefits.

At project completion, the implementing unit(s) within CCD will need to coordinate with ODOT Information Systems, Data Governance, and Business Intelligence teams to operationalize integration of ARIES pilot data into long-term monitoring systems, incorporation of validated key performance indicators (KPIs) into CCD reporting dashboards, and alignment with enterprise data cataloging and metadata requirements.

The project may produce analytical templates, statistical models, and dashboard-ready metrics that require review through ODOT's technology and data governance processes prior to permanent operational deployment. If findings support statewide ARIES expansion, additional system configuration, data storage capacity, API integrations, or analytics platform adjustments may be necessary.

No external regulatory approvals are anticipated as part of the research phase though operational adoption of automated enforcement performance metrics or expanded integration with enterprise systems may require coordination beyond iCare, including security and privacy assessment, and coordination with FMCSA ITD reporting requirements.

Project leads will be responsible for initiating engagement with the Technology and Data process to ensure that research outputs transition from analytical findings to sustainable operational capability.

CROSS-AGENCY IMPACTS

- List ODOT partners or impacted units.
Although the ARIES research and pilot deployment are led by CCD, implementation of the project's findings has implications across multiple ODOT divisions. Though CCD will lead implementation, operationalizing the research outcomes will require coordination beyond roadside operations.

Within CCD, the Roadside Safety and Compliance Branch may need to adjust inspection practices and internal performance monitoring processes.

ODOT ISB and the Data Solutions Office will likely be engaged if the data integration structures are transitioned into production environments. Integration of ARIES pilot data into enterprise systems may require support to ensure appropriate long-term maintainability.

Expansion of ARIES to additional WIM sites could also involve Maintenance and Operations units responsible for facility infrastructure, equipment installation, and ongoing hardware support. Deployment decisions may necessitate site-level adjustments, operational planning, and resource allocation.

While the research itself does not require immediate business process changes outside of CCD, implementation of findings will require coordinated planning across ODOT to ensure that ARIES becomes an integrated component of Oregon's commercial vehicle safety strategy.

- Identify any issues of concern raised by any ODOT partners. At this time, no formal issues of concern have been raised by ODOT partners regarding the ARIES research project or pilot evaluation. Partners engaged to date have expressed general support for the framework and its focus on improving safety.