SPR RESEARCH PROGRAM
SECOND-STAGE PROPOSAL SUMMARY

PROBLEM NUMBER AND TITLE

24-69 Understanding Vehicle Design and Crash Injury and Consumer Preference

PROBLEM SUMMARY

Fatal and severe traffic injuries have been steadily increasing in Oregon with pedestrian injuries making up an increasing share of the overall injuries. Many transportation agencies including the USDOT are increasingly emphasizing a Safe System Approach to reducing traffic injuries which means along with roadway design and operation agencies consider other important contributors such as vehicle design. The design of vehicles has long been recognized as a factor in the severity of injury for traffic crashes and the passenger fleet on Oregon's roads has continued to evolve. With motor vehicle sizes growing larger each year, there is a self-reinforcing push among vehicle-buyers to purchase larger vehicles for the safety benefits they confer to their occupants, particularly in collisions with other large vehicles. However, it is not clear that vehicle buyers understand the increased social cost of larger vehicles, including the increased risk of fatal and severe injury for other road users. This project seeks to first use existing crash data to assess how vehicle design influences crash outcomes in Oregon communities, and then test potential messaging and outreach policies to promote smaller vehicle sizes and safer travel for those who drive large vehicles. Another outcome is the potential to contribute to the national research and conversation happening around this topic, including via the Safe System approach.

ODOT OBJECTIVES

In addition to the final report, this research will develop a policy brief outlining the findings related to safety implications of vehicle design in Oregon, including the social cost of larger vehicle fleets. The brief will also include input from key research objectives, including findings from crash behavior models, consumer perception and decisions regarding larger vehicles, and driver perception and decisions as regards safety and larger vehicles.

BENEFITS

In order to address the rise in traffic injuries in Oregon a Safe Systems approach is necessary which required us to understand how all the major inputs, including vehicle design, are impacting crash outcomes. This research would provide information about the role of vehicle design in increasing injury outcomes as well as actionable information for how we might use education, marketing, and pricing strategies to influence consumer habits. The Strategic Action Plan's top priority of equity can be addressed by this research due to large vehicles primarily posing a risk to people outside of the vehicle. People with lower incomes are more likely to not own a vehicle and rely on walking and/or public transit for transportation. Recent ODOT research identified the overrepresentation of BIPOC and low-income communities in fatal and serious pedestrian injury collisions and fatalities ODOT 2021. Understanding the equity implications of vehicle size is an important need. In addition, measuring the safety impact of larger vehicles and developing communication strategies of those impacts to potential buyers could shift consumer habits towards smaller, more efficient vehicles, which would also help Oregon achieve its greenhouse gas emissions reduction goals. This research could support a fleet transition by highlighting the safety costs associated with larger vehicles and help ODOT reach the Strategic Action Plan's goal of building a Modern Transportation System.

SCHEDULE, BUDGET AND AGENCY SUPPORT

Estimated Project Length: 20 months.

Estimated Project Budget: $155,000

ODOT Support: Amy Joyce, ODOT Driver and Motor Vehicle Services Administrator, Suzanne Carlson, ODOT Climate Office Manager

FOR MORE INFORMATION

For additional detail, please see the complete STAGE 2 RESEARCH PROBLEM STATEMENT online at:
https://www.oregon.gov/odot/Programs/ResearchDocuments/24-69.pdf

SPR RESEARCH PROGRAM
SECOND-STAGE PROBLEM STATEMENT
FY 2024

PROBLEM NUMBER AND TITLE
24-69 Understanding Vehicle Design and Crash Injury and Consumer Preference

RESEARCH PROBLEM STATEMENT
Fatal and severe traffic injuries have been steadily increasing in Oregon with pedestrian injuries making up an increasing share of the overall injuries. The design of the vehicles has long been recognized as a factor in the severity of injury for traffic crashes and the passenger fleet on Oregon's roads has continued to evolve. Since 1988, the average weight of personal vehicles has increased by 26% with the proportion of the fleet represented by light-duty trucks and SUVs increasing from 20% in 1990 to greater than 66% currently (EPA, 2021). Vehicle size and weight can be factors for both crash injury severity and crash frequency for both vehicle occupants and non-motorized roadway users. For example, people in passenger vehicles that collide with pickup trucks are more than twice as likely to be injured (Desapriya et al, 2004). Pedestrians struck by a light truck or van (including SUVs) have been found to be two to three times more likely to die than when struck by passenger vehicles (Roudsari et al., 2004; Lefler and Gabler, 2004). When children are struck by an SUV, they are eight times more likely to die than if struck by a passenger vehicle (Edwards and Leonard, 2022). There is also evidence that people in larger vehicles may feel more protected and therefore take greater risks while driving (Claus & Warlop, 2022), which could further degrade safety. Despite the known safety impact of large vehicles, the passenger vehicle fleet is getting larger. Meanwhile, the safety impacts to people in smaller vehicles or on-foot are getting worse. Between 1986 and 2016 the proportion of pedestrian fatalities involving pickups or SUVs has increased from 22% to 44%. (Schneider, 2020). Further, as the average weight of vehicles has increased, areas of the U.S. with the highest growth in large vehicles have seen the highest increases in pedestrian fatalities (Tyndall, 2021). SUVs have been involved in excess of 1,100 pedestrian deaths since 2000 (Tyndall, 2021).

With motor vehicle sizes growing larger each year, there is a self-reinforcing push among vehicle-buyers to purchase larger vehicles for the safety benefits they confer to their occupants, particularly in collisions with other large vehicles. However, it is not clear that vehicle buyers understand the increased risk of fatal and severe injury they are placing on non-vehicle users of the road. Smaller vehicles would improve safety conditions for pedestrians, and for vehicle occupants overall if more buyers opted, or were directed by policy or market availability, to shift to smaller vehicles. Greenhouse gas policy objectives also exist that require a smaller percentage of the fleet to be made up of light-duty pickups and SUVs though no tools have been identified to help meet those goals (ODOT 2013).

There is a need to better understand the safety impacts of vehicle size in communities in Oregon, as well as how people are using large vehicles and messaging that could promote safer vehicle behavior and choices, including the adoption of smaller vehicles, both at the individual consumer level and at the policy level. This project seeks to first use existing crash data to assess how vehicle size and weight is influencing crash outcomes in Oregon communities, and then through data collected from an Oregon driver survey and focus groups, explore the potential for messaging and policy options to promote smaller vehicle sizes and safer travel for those who drive large vehicles.

RESEARCH OBJECTIVES
This research will conduct a comprehensive crash data analysis to determine the effects of vehicle size on crash injury severity and crash frequency in Oregon communities. This research seeks to determine how elastic car buyers preferences are for vehicles with known dangerous design elements by testing public messaging, marketing, education and pricing strategies options through surveys and focus groups. The research objectives will provide insight on the risk that larger vehicles pose on transportation safety in Oregon and the willingness of Oregon drivers to consider driving or purchasing smaller vehicles. This will be accomplished through the following:

- Identify measures being taken by State and Federal agencies to promote the use of smaller vehicles.
- Collect Oregon crash records and vehicle characteristic data to describe crash trends.
- Conduct a comprehensive descriptive analysis to identify large vehicle crash trends in terms of severity and frequency.
- Develop disaggregate crash injury severity and crash frequency models to identify significant factors in large vs. small vehicle crashes.
- Develop a survey instrument and focus group strategy for Oregon drivers to assess factors associated with vehicle buying decisions. The survey will also seek to uncover driver perceptions on safety messages and potential policy levers regarding larger vehicles.

The ultimate objective will be to better understand and document the social costs incurred by larger vehicles, including marginal costs of different vehicle buying choices, along with the potential of various messaging or pricing approaches to convey the risk and cost of larger vehicles.

WORK TASKS, COST ESTIMATE AND DURATION

Task 1. Collect, Review, and Analyze Current Literature on Vehicle Design and Safety *[3 months]*: The objective of this task is to conduct a comprehensive literature review of studies looking at factors related to vehicle design and safety, including vehicle size and weight, and resultant impacts on driver visibility, behavior, and crash outcomes. The review will also look at policies and initiatives undertaken by local, state, and/or federal agencies, and successful paradigms and lessons learned by other agencies in regard to reducing social costs related to these factors.

Task 2. Data Collection and Inventory *[5 months]*: The objective of this task is to collect and inventory all relevant data related to vehicle size and safety. This will include historical crash data, traffic and speed data, and other relevant data. The research team may explore the possibility of utilizing additional data sources, such as DMV records, to better capture vehicle-specific characteristics not included in Oregon crash data. The goal of this task is to collect and inventory all necessary data to complete the analyses in succeeding tasks.

Task 3. Data Mining, Fusion, and Descriptive Analysis *[3 months]*: This task will take the data collected and inventoried in Task 2 and apply data mining and fusion techniques to prepare the data for analysis. A comprehensive disaggregate data descriptive analysis will be conducted to highlight key trends in larger vehicle crashes. Disaggregation will consist of crash trends by time-of-day, lighting conditions, driver characteristics, number of vehicles involved, roadway classification, urban/rural, and other relevant crash characteristics. The analysis will identify key data characteristics to be considered in the crash behavior models as part of Task 4. Results from this task may also guide portions of the survey instrument.

Task 4. Crash Behavior Modeling *[4 months]*: Utilizing results from Task 2 and Task 3, a series of crash behavior models will be developed to identify contributory factors to crash frequency and injury severity for large-vehicle crashes. Crash frequency models will account for changes in exposure, while severity models are able to capture driver-specific characteristics. Results of this task will provide quantitative measures of the effects of crash, vehicle, and driver characteristics on larger vehicle crash frequency and injury severity. The results can highlight underlying explanatory and/or causal relationships between crash factors and crash frequency or injury severity.

Task 5. Oregon Driver Surveys and Focus Groups *[7 months]*: This task will consist of developing a survey instrument and focus group strategy to collect information from Oregon drivers about their vehicle buying preferences. The survey will seek to gather information on vehicle buying decisions, messaging relating to vehicle size and safety, and public perception on potential policy measures related to larger vehicles, such as how consumer habits would change when information on the risk to others is presented or due to pricing strategies like registration fees based on size and/or weight of the vehicle. Subtasks will include survey development, deployment, and analysis. Focus groups will follow the survey, and will seek to test messages relating to safety risks and societal costs associated with larger vehicles.

Task 6. Recommendations and Final Report *[4 months]*: The research team will prepare a research report that presents and details the findings of the research. Additionally, the research team will provide recommendations to ODOT for implementation in practice and whether further research is needed.

With some overlap of tasks, we anticipate an overall project timeline of 20 months:

	2023				2024												2025			
	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
Task 1. Literature Review																				
Task 2. Data Collection and Inventory																				
Task 3. Data Mining, Fusion, and Analysis																				
Task 4. Crash Behavior Modeling																				
Task 5. Oregon Driver Surveys and Focus Groups																				
Task 6. Recommendations and Final Report																				

Key Deliverables:
This research will document the relationship between vehicle design and injury severity and occurrence in Oregon while also developing information about potential intervention strategies policy and decision makers could implement reduce the number of fatal and severe injuries in Oregon.

Estimated Project Length: 20 months.
Estimated Project Budget: $155,000

IMPLEMENTATION
In addition to the final report, this research will develop a policy brief outlining the findings related to safety implications of vehicle size and design in Oregon, including the social cost of larger vehicle fleets. The brief will also include input from the Task 5 driver surveys and focus groups on which messages and approaches could be effective in reducing the safety and other costs associated with larger vehicles.

POTENTIAL BENEFITS
ODOT's mission statement and values both place safety at the top of ODOT's obligation to the people of Oregon. Evidence suggests that large vehicles increase safety risk of many roadway users and merits further understanding of the nuance of that risk, how the risk is distributed, and if there are steps that can be taken to adjust the fleet of vehicles in Oregon to improve roadway safety.

The Strategic Action Plan's top priority of equity can be addressed by this research in several ways. Large vehicles primarily pose a risk to people outside of the vehicle. Larger and heavier vehicles cost more to purchase, thereby placing them more within reach of wealthier Oregonians. Meanwhile, people with lower incomes are more likely to not own a vehicle and rely on walking and/or public transit for transportation. Understanding the equity implications of vehicle size is an important need.

Measuring the safety impact of these vehicles and developing communication strategies of those impacts to potential buyers could shift consumer habits towards smaller, more efficient vehicles, which would also help Oregon achieve its greenhouse gas emissions reduction goals. This research could support a fleet transition by highlighting the safety costs associated with larger vehicles and help ODOT reach the Strategic Action Plan's goal of building a Modern Transportation System.

PEOPLE
ODOT champion(s):
Amy Joyce, ODOT Driver and Motor Vehicle Services Administrator
Suzanne Carlson, ODOT Climate Office Manager

Problem Statement Contributors:

Heidi Manlove, Pedestrian and Bicycle Safety Program Manager
Tiana Tozer, ODOT Traffic Safety Coordinator Region 1
Josh Roll, Oregon DOT
Nathan McNeil, Portland State University
Jason C. Anderson, Portland State University

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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

Research exists documenting the role that vehicle design plays in injury severity but no research exists in Oregon and no research exists to explain how elastic consumer preference for vehicles with different design characteristics

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.

Cross-agency stakeholders

- List stakeholders or impacted units
- Identify any issues of concern raised by an ODOT stakeholder. Note expected mitigation