

# Ohio Department of Transportation Research Project Fact Sheet



## Design of an Alternative Work Zone Attenuator Device

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Agency	Transportation Research Center Inc.
Report Date	February 2022
Project Number	111462

### The Problem

ODOT’s research indicates that mobile attenuators are currently attached to state-owned dump trucks and are operated by highway workers as positive protection devices (shadow vehicles) against a motor vehicle crash in Work Zone. When used in work zones as shadow vehicles in months leading up to winter, these dump trucks may become damaged, which may render them unavailable to support snow-and-ice operations. It is important to assess the use of a dump truck as a sacrificial shadow vehicle in work zone operations. Additionally, such assessment must also consider factors such as shadow vehicle operator safety, safety of Work Zone workers, and that of the errant motorist. This makes the decision for use of dump trucks in a Work Zone, non-trivial in nature. The objective of this research is to perform this assessment, and develop specifications for an Alternative Work Zone Attenuator Device.



### Research Approach

In order to develop functional specifications for an Alternative Device, the research staff devised a categorical approach that focused on identifying ODOT’s needs, performing an interim assessment of market options, and developing functional specifications that are refined by market feedback.



In Task 1, the research focused on identifying ODOT’s needs. The role performed by dump trucks in different phases of a Work Zone’s life-cycle was reviewed. In special focus was the role performed in an active Work Zone operation. The research was also informed by field study, discussions with ODOT’s staff, and Work Zone Crash Data Analysis.

In Task 2, the research focused on activities that led to design and development of concepts for an Alternative Device. The proposed concepts included features that satisfy ODOT’s needs and includes desirable features that may improve Work Zone safety. Finally, the research staff performed an Interim Market Review to identify candidate vendors that may provide feedback on the proposed concepts.

In Task 3, the research staff developed functional specifications for two concepts of the Alternative Device. These functional specifications were refined with vendor feedback received via the Request for Information (RFI) mechanism. The feedback was also used to identify technological feasibility and challenges of proposed requirements, and identify any technology and concept preferences.

### Findings

Key functions identified for the Alternative Device are divided into roles such as - carrying payload, facilitating mobile attenuator deployment, providing positive protection, and carrying electronic systems in a Work Zone. Typical characteristics of crashes relevant to TMA use on Interstates in Ohio’s Work Zones were obtained

Characteristics of crashes relevant to TMA use on Interstates, in Ohio’s Work Zones [2016-2020]

- Straight Roadway Geometry
- Twice as frequent in Stationary Work Zone over a Moving Work Zone
- High Risk Activities - Static Lane Closure, Working in Shoulder/Median

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This research was sponsored by the Ohio Department of Transportation and the Federal Highway Administration.

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from an analysis of data between 2016-2020. Field study and discussions with ODOT’s Highway Technicians revealed the preferred and not-so-preferred characteristics of dump-trucks when used as shadow vehicles in a Work Zone. The staff appeared to be open and curious to explore the feasibility of an alternative device, if adequate positive protection could be offered to the safety operator and workers in a Work Zone during a crash event. This analysis helped understand the expected operational domain of the Alternative Device. In Task 2, two concepts for an Alternative Device were proposed.

### Characteristics of Dump Truck use in Work Zones

- Ease of Use
- Familiarity
- Versatility
- Perception of Safety
- Blind spots
- Difficult to maneuver in tight spaces
- Difficult to back-in

<h3 style="text-align: center;">Concept C1 - Upgraded Mobile Vehicle</h3> <p style="text-align: center; font-size: small;">Upgraded Mobile Vehicle + Towable Attenuator</p> <p style="text-align: center; font-size: small;">An operator would drive the vehicle to the worksite, and once it is stationed correctly, the device is imagined to work without the need for a driver in Work Zones</p>	<h3 style="text-align: center;">Concept C2 - Mobile Remote Platform</h3> <p style="text-align: center; font-size: small;">MRP Device + Payload + Integrated Attenuator</p> <p style="text-align: center; font-size: small;">This device would be driven/towed to the Work Zone, and then it is expected to be maneuvered within a Work Zone, with an attached attenuator, by a remote operator.</p>
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In Task 3, specifications that outline functional requirements that define the expected behavior of the Alternative Device were developed for both concepts. The requirements were functional in nature to encourage a variety of potential technological implementations, market competition, and innovation to achieve ODOT’s needs. Finally, the research staff received responses from vendors on the proposed functional specifications via the RFI mechanism. Most vendor responses proposed technologies that will facilitate implementation of Concept C1 over Concept C2. A Cost-Benefit Analysis performed on one use-case indicates that the use of such a device over a New Dump Truck may be economically feasible. However, such an analysis is sensitive to the inputs and underlying assumptions.

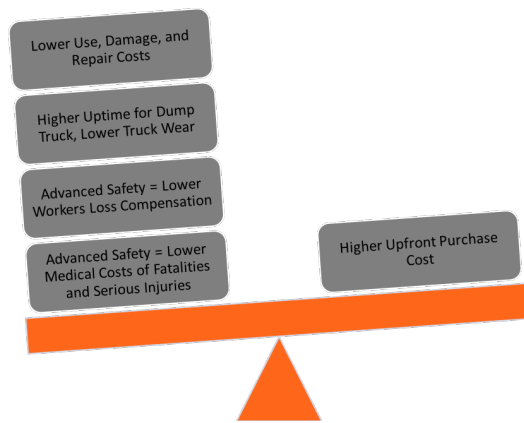
## Recommendations

The research suggests that an implementation of scope-limited Driving Automation System using advanced sensors such as LiDAR, RADAR, Ultrasonic, and communication that is fine-tuned for the prescribed Work Zone Operational Design Domain has the potential to act as a dump-truck replacement device. Vendor feedback also identified key challenges such as the need for ease-of-use, low maintenance, cyber-security, system reliability, and redundancy, which need to be considered in an implementation. In summary, the replacement of a dump-truck with a well-defined Alternative Device has the potential to; provide adequate positive protection to exposed workers, remove the safety operator from a motor vehicle crash event, and provide crash protection to the errant motorist vehicle using an appropriate crash attenuator.

### Categories of proposed functional requirements

- Positive Protection
- Operation & Maneuver
- Crash Prevention, Sensing, and Protection

<h4 style="background-color: orange; color: white; padding: 2px; margin: -5px -5px 5px -5px;">Dump-Trucks</h4> <ul style="list-style-type: none"> <li>• Human Driven</li> <li>• Safety Operator in-cab during crash</li> <li>• No advanced motorist crash sensing and response</li> <li>• Damage leads to downtime and expensive repairs</li> </ul>	<h4 style="background-color: orange; color: white; padding: 2px; margin: -5px -5px 5px -5px;">Alternative Device</h4> <ul style="list-style-type: none"> <li>• Limited In-Work Zone Autonomy</li> <li>• Safety Operator monitors remotely</li> <li>• Advanced crash sensing and response features</li> <li>• Easier repairs, lower and non-mission critical downtime</li> </ul>
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