Joint Transportation Research Program

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Evaluation of Current Technologies for Training, Web Apps, and New Technologies

Introduction

Work zone safety has been a top concern for INDOT. This report outlines and explores technological opportunities surrounding INDOT's safety training. It focuses on some key aspects of improving safety training—what areas of a work zone affect safety, safety teaching practices currently in place, a quantified model of risks associated with works, and a cost-benefit analysis of training technologies.

This report first outlines a benchmarking process to understand the components of work zone safety by comparing states with similar accident rates to those in Indiana. Next, it breaks down the different components into attributes and defines a risk-attribute framework. In parallel, the report also explores the technological tools available that can help INDOT develop a better training model. To do this, this report provides a cost and attribute analysis of different tools—gamification, simulation, AR, and VR. This report also creates storyboard and training modules to use with the technological tools, which cover several training modules required by OSHA guidelines in 12 categories.

Finally, this report explores how these technological tools can best be distributed in different work zones to minimize cost while attaining risk reduction. To provide this final risk optimization, the report presents an optimization model that provides a suitable mix of training tools for different training modules.

Findings

- *Benchmarking:* The initial analysis of this report focuses on the benchmarking of INDOT's safety statistics with that of other state departments of transportation. The analysis suggests that five

Work zone area.

Image source: Uthe, D. (n.d.). Orange barrels, barricades, and signs blocking a road [Photograph]. Shutterstock. https://www.shutterstock.com/image-photo/orange-barrels-barricades-signs-blocking-road-1026980377

states share similar statistics with Indiana—Colorado, Delaware, California, Texas, and North Dakota. This provides a basis for understanding what parameters affect the safety of work zones at different DOTs.

- *Training Technologies:* The next part of this report focuses on different training technologies. The four different technologies focused on are gamification, simulation, AR, and VR. This phase of the project focused on extensive market research and reaching out to vendors. A holistic approach was taken to gather different cost components of these technologies. As a general bias, cost of training technologies grows with technological complexities; however, the findings suggest that, depending on training heads and the capital investment, risk may be significantly distributed to incur a reduced training cost per person for selected high-tech training tools.
- *Risk Attribute:* Another focus of this report is to find the attributes concerning the risk of a work zone. This analysis suggests that a work zone may have one or multiple attributes (e.g., working near an active roadway or working with power tools). A detailed analysis of the risk attributes is mentioned in this report. The analysis suggests that with valid data and supporting research papers, the risk of a work zone can be quantified. This leads to our findings and recommendations on how to customize the mix of training tools.
- *Storyboard:* The report also focuses on OSHA guidelines about what components should be considered in safety training. Several training modules were explored, and a set of modules created.

Implementation

The project develops a model that can, with proper data, evaluate what training tools can be deployed for specific training modules. The analysis rests on three basic findings (1) accident data (for this report taken from research paper on OSHA and NIOSH data), (2) risk framework, and (3) research on technological tools.

The accident data helps deploy a relative frequency for each risk attribute broken down on outcome of the accident. This ultimately measures the total risk index, which helps quantify the risks involved. In parallel, it is also required for a comparison of different training tools based on effectivity and cost. While cost can be obtained from market research, effectivity requires a firm understanding and research on retention rate and other factors. A separate metric was created to evaluate retention rate and compare the tools. It is assumed that training tools' effectiveness directly impacts the risk mitigation as far as mode of training is considered. Also, the effectivity varies for different training attributes.

The risk attributes are then classified according to training module so that a risk index can be attributed to each module, giving the modules a risk index to signify the modules' risk. Once this is done, the focus is to categorize training modules on what technology is best suited.

This formulation, which comes as a recommendation from this project, requires an optimization model involving effectivity and cost of tools for each attribute and type, training attribute involved with each training modules, and risks involved with each training module. The optimization model provides an optimum solution to reduce risk by a defined level (<25%) and provide the mix of training tools.

Recommended Citation for Report

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