ENHANCING ACTIVE WORK ZONE SAFETY WITH INTRUSION ALERT TECHNOLOGIES:

EMPIRICAL EVIDENCE ON EFFECTIVENESS AND IMPLICATIONS

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ABSTRACT

Highway workers are required to work close to moving traffic during road construction and maintenance activities, which exposes them to the risk of being struck by a distracted driver or intruding vehicle. In addition, work zones disturb the usual traffic flow and patterns due to changes in the existing geometric layout of a roadway, and this is also problematic for the drivers as they must navigate a layout of signs, barrels, and lane changes while keeping the vehicle in control. Moreover, late-night tasks, reckless driving, inconsistent work zones, drunk driving, and increased vehicle miles traveled are some of the additional causes of work zone incidents. Nationwide, around 40,000 accidents occur each year in highway work zones, and have steadily increased during the past ten years. The resulting fatalities, injuries, and property damage due to such incidents lead to significant expenses, prolonged travel delays, and potential damage to expensive products in transit.

While traditional safety precautions (e.g., truck-mounted attenuators, rumble strips, speed monitoring displays) can help enhance work zone safety, the number of intrusions calls for designing and implementing emerging intrusion alert technologies to warn drivers and workers when errant vehicles intrude into the work zone. Several state Departments of Transportation (DOTs) have begun examining the use of intrusion alert technologies to mitigate work zone intrusions. While previous studies examined the general effectiveness of these technologies, there are still significant research gaps in investigating how well these intrusion technologies alert the driver and workers, and no documented best practices are available for transportation agencies and DOTs interested in implementing them. In addition, these technologies have been through many improvements and modifications, and further research is imperative to ascertain their chances of acceptance by workers and contractors.

To address these gaps, this thesis focuses on (a) empirically examining the effectiveness, implications, and practices of four commercially available intrusion technologies in enhancing

work zone safety through various field tests and surveys, and (b) empirically investigate the effectiveness of these technologies considering drivers' cognitive processing (perception -reaction time) and responses in case of work zone intrusion. The findings of this research study provided detailed information on the identification and testing procedures of technologies, and offered guidelines and recommendations for adopting these technologies for practitioners and professionals in the highway construction sector. The proposed decision-making matrix and multi-criteria decision-making framework are based on the empirical data obtained from the various field experiments, literature review, and evaluation survey. This study also provided valuable insights into the overall effectiveness of commercially available intrusion technologies to incorporate required modifications in designing and implementing these technologies to enhance work zone safety. The long-term outcome of this study is to significantly reduce the injuries and fatalities in construction work zones in Indiana and across the country.