ABSTRACT

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Title: Project-Oriented Safety Management of Rural Local Roads using a Probabilistic Framework to Estimate Crash Risk.
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Although rural areas make up 19% of the U.S. population and have 30% of the annual vehicle miles traveled (VMT), more than half of the annual U.S. traffic fatalities (in excess of 15,000) occur in rural areas, according to the National Highway Traffic Safety Administration. For higher-volume rural state roads with a considerable crash history, the effect of road geometry, infrastructure, traffic, and roadside features on safety has been studied extensively. However, more than 80% of rural roads in Indiana and other heavily agricultural states are local roads. Rural local roads have lower crash frequencies than rural state roads, but greater crash rates (when adjusted for VMT). Rural local roads are often maintained by counties and townships, have low-volumes, and may have obstructed sightlines, outdated geometrical designs, and roadside obstacles that make them dangerous to roadway users. The identification and mitigation of safety problems at high-crash locations with costly improvements, as is typically the case with rural state roads, is not suitable for rural local roads since safety problems are less apparent. There is a considerable risk of severe crashes at multiple locations, but it is not revealed with a high crash frequency at particular locations.

This dissertation describes a method for assessing the risk of crashes on rural local roads. A practical approach for obtaining geometry, roadway infrastructure, and roadside features is presented. Such data may be lacking or incomplete in existing local repositories. The collected road/roadside features, annual average daily traffic (AADT), and traffic crashes are used in estimating the bivariate ordered probit model, a statistical technique that is well suited to handling the lower crash counts often present on rural local roads. The model is applied in the context of Indiana local intersections to identify the road/roadside features influencing the risk of the fatal/injury (*FI*) and property damage only (*PDO*) crash types.

The results suggest that increases in the AADT on the major and minor roads increase the risk of *FI* and *PDO* crashes at rural local intersections. Furthermore, intersections with nearby

driveways located on the major road and intersections with trees/brush obstructing the sightlines have an increased risk of *FI* and *PDO* crashes, albeit with a lesser effect on the *FI* crash risk. Conversely, three-leg intersections and intersections where the major road is a four-lane divided highway have a decreased risk of both crash types.

Finally, this research describes a framework that shifts the focus of benefit-cost analysis from expensive safety improvements applied at individual locations to programs of low-cost improvements applied uniformly over many locations. Based on the findings from the statistical analysis, appropriate low-cost safety improvements were proposed with the aim of reducing the crash risk. The potential crash cost savings afforded by these improvements were found and utilized in a benefit-cost analysis to assess the feasibility. The presented methodology can allow agencies to better justify safety improvements on local roads that have experienced limited crashes but for which the potential consequences are severe if crashes occur.