Texas A&M Transportation Institute

PROJECT SUMMARY

Texas Department of Transportation

0-7051: Develop a Real-Time Decision Support Tool for Rural Roadway Safety Improvements

Background

Current crash prediction methods—such as those in the AASHTO Highway Safety Manual (HSM)—consist of safety performance functions (SPF), crash modification factors (CMF), and severity distribution functions (SDF). While these models have statistical merit, they do not allow users to accurately predict crashes for short-term periods (i.e., months, weeks, days, hours, or peak periods for this research problem) and most of the models do not consider operational variables such as operating speed and weather condition.

Speeding-related crashes are one of the dominant types of crashes on rural roadways. As a result, the Texas Strategic Highway Safety Plan (SHSP) has identified speeding as one of the seven research emphasis areas for 2017-2022. Additionally, inclement weather plays a role in crash occurrences. There is a need to explore the development and functional forms of crash prediction methods using operational measures (i.e., operating speed and precipitation) to better account for these variables and to understand the impact of operational variable measures in highway safety performance. Additionally, an interactive web-based tool for safety prediction for rural roadways is needed.

What the Researchers Did

In this research project, researchers developed models for different rural roadway facilities (rural two-lane, rural multilane, and rural interstate roadways) for both the annual level and the daily level. First, researchers developed a database for the rural roadways of Texas by merging data from four major sources: 1) 5-minute interval operating speed data from the National Performance Management Research Data Set (NPMRDS), 2) traffic crash data from the Crash Records Information System (CRIS), 3) roadway information data from the Road-Highway Inventory Network Offload (RHiNO), and 4) 5-minute interval precipitation data from the Automated Surface Observing System (ASOS).

Second, researchers developed several speed measures (at both annual and daily levels) to account for the impact of operational speed on traffic crashes. After performing correlation analyses, two operational speed measures were selected for annual level analysis. Daily level analyses were used to determine suitable and most appropriate speed measures.

Third, the researchers developed SPFs at the annual level for different rural roadway facility types. Similarly, models were developed for daily level analysis.

Finally, researchers developed an interactive web-based decision support tool by using the SPFs developed for annual level analysis. This tool allows the analyst to select locations from several drop-down panels. After the selection of the

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locations, the analyst can visually inspect the roadway segments of interest. The safety scoring of the roadways is based on the expected number of crashes on the roadway segments.

What They Found

Annual level analysis: Geometric variables such as lane width, shoulder width, and median width show an association with the crash counts, and the association meets the conventional expectations. The truck proportion shows a positive association with FI crashes in rural freeways and rural multilane divided roadways. Increased variability in operational speed is associated with increased crashes for all four roadway facilities. In the absence of a posted speed limit, this study used reference speed as the surrogate for the posted speed limit. For rural freeways and rural multilane roadways, with an increase in operating speeds, the relative increase in crashes is greater on highways with higher reference speeds than highways with lower reference speeds. Average precipitation shows a positive association only for rural multilane undivided and rural two-lane roadways.

Daily level analysis: Geometric variables such as length and shoulder width show an association with the potential of day-level crash occurrences, and the association meets the conventional expectations. Truck proportion shows a positive association with the potential of day-level crash likelihood for all facilities. Increased variability in daily operational speed (the standard deviation of the daily average of 5-minute interval operation speeds) is associated with the likelihood of day-level crashes for all four roadway facilities. Average operating speed (the average of the daily average of 5-minute interval operation speeds) increases are associated with the potential of day-level crash occurrences. However, average operating speed is negatively associated with the potential of total crash occurrences on rural freeways. This finding for the rural freeway could be because of the high design standards for the freeways. This variable is not statistically significant for rural multilane undivided roadways. As daily average precipitation increases, the potential of a day-level crash occurrence increases for all facility types.

What This Means

One of the most significant limitations of the HSM—and quantitative safety performance research in general—is the omission of speed-related factors from nearly all aspects of safety predictive methods. Recent research has some progress in incorporating speed-related factors into crash predictive models. This study has shown that speed differentials between drivers affect the potential for and frequency of crashes. However, beyond these general relationships, there is minimal consistent, proven evidence for speeds (i.e., posted, average operating, or other) affecting annual crash frequency, although speed intuitively plays a major role in safety.

Researchers developed an interactive web-based decision support tool that assists practitioners in understanding safety scoring of roadway segments of interest with respect to not only roadway or traffic characteristics but also operating speed and weather conditions. Researchers recommend using the tool to take specific measures to mitigate significant safety issues. Additionally, researchers recommend potential revisions to the SPFs for rural roadways so that operating speed measures and weather can be included in the modeling framework. Similar tool for urban roadway facilities in Texas is recommended.

For More Information

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