MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 23-493 (project 550) | February 2023

Safety Support System for Highway Rail Grade Crossings

the ISSUE

Crashes at highway-rail grade crossings (HRGCs) often result in severe injuries and fatalities. Transportation decision makers and agencies need an efficient decision-making framework to predict crash occurrence and severity likelihoods and identify contributing factors to those crashes and quantify their effects. That framework should also quantify proposed geometric and countermeasures' safety improvement effectiveness, and rank the priorities for the crossings in terms of their safety improvement needs.

the RESEARCH

The research focused on providing tools and knowledge on the following four issues: 1) integrated grade-crossing crash frequency and severity prediction models, 2) marginal effectiveness of countermeasures, 3) geometric factors' contribution to crash frequency and severity, and 4) integrated hazard rankings of North Dakota grade crossings.

The research proposed an innovative statistical method, competing risk modeling (CRM), to identify the contributors, quantify marginal effects of geometric factors and control devices, and predict crash occurrence and severity simultaneously. Traffic exposure variables such as annual average daily traffic, day through-train, night through-train, train speed, and percentage of trucks are all significant contributors. Type of train services, commercial power availability, and train detection technologies are also identified as significant contributors. Moreover, the research also further quantified the four geometric contributors' effects and conducted detailed marginal effectiveness analysis for traffic control devices considering the pre-control conditions. The four geometric factors are: distance between a crossing and its nearest intersection, crossing angle as a continuous variable, number of lanes, and number of tracks. These geometric factors are spatially calculated with GIS software if they are not readily available. The research also investigated use of the effectiveness and prediction results to rank and prioritize crossings based on safety hazard.

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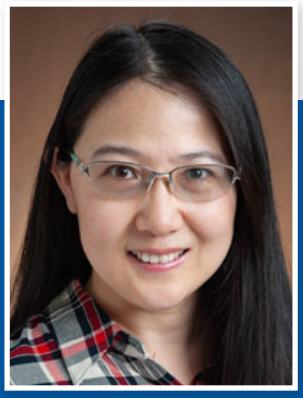

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Project Title

Safety Support System for Highway Rail Grade Crossings

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the **FINDINGS**

The applied approach suggests:

1. A hazard index should include both crash severity and crash occurrence likelihoods
2. A prediction model should be able to predict both crash severity and crash occurrence simultaneously to account for unmeasurable variance with the same set of predictors
3. Some contributors can be found significant to certain level of crashes but not significant to others
4. One contributor can have a positive impact on certain levels of crashes but a negative impact on others
5. The dependency between competing risks exists so the prediction model should consider such dependency. The independent censoring assumption could result in underestimated contributors' effects.
6. Marginal countermeasure effectiveness should be dependent on the pre-existing status.
7. Adding a traffic control device to a crossing does not always result in improved safety performance

   Adding a traffic control device to a crossing may result in positive improvement on a certain level of crashes but have a negative impact effect on others

the **IMPACT**

The research showed that an innovative computer modeling technique can help transportation agencies identify highway-rail grade crossings that are most likely to experience severe crashes. The modeling technique can also help identify contributing factors to crashes and identify and rank possible countermeasures. Results are being disseminated by the USDOT to help local agencies conduct analyses for making at-grade crossing safety improvement decisions.

For more information on this project, download the Main report at https://www.ugpti.org/resources/reports/details.php?id=1119

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.