DRISI

CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

TRANSFORMING IDEAS INTO SOLUTIONS

Research Notes

Phase 3: Implementation of Safety Performance Functions for California

Develop tools to provide the California Department of Transportation (Caltrans) with the ability to implement Safety Performance Functions (SPF) techniques to efficiently target highway improvements and countermeasures at locations that demonstrate the greatest potential in reducing fatal and injury collisions.

Safety

May 2025

Project Title: Methods for Identifying High Collision Concentration Locations for Potential Safety Improvements

Task Number: 4058

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Completion Date: May 31, 2026

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WHAT IS THE NEED?

Identifying high-collision concentration locations is a major objective of many state and local transportation agencies. In recent years, significant progress has been made with respect to crash prediction models for identifying such locations. In addition to providing valuable information related to factors that can potentially contribute to an increase in the likelihood of traffic collisions, the Highway Safety Manual (HSM) explains how SPF (i.e., a mathematical relationship describing the collision frequency and explanatory variables) are used to estimate the expected number of collisions per year for a given location, which serves as a baseline for network screening techniques which play a major role in the transportation safety management process.

The first two phases of SPF Implementation project mainly focused on the SPF developed for the three functional components of highway, segment, intersection and ramp, with the recent data, and developing an Excel- Macro-based tool. This tool will help identify high collision concentration locations in the state highway system, even though the scope of this tool was limited. Whereas the second phase of the SPF Implementation project, the main focus will be towards deepening the support and rollout. Deepening the support will be made by assisting Caltrans in calibrating the Excel-Macro-based tool developed in earlier phases and enabling the tool for multiple users.

WHAT ARE WE DOING?

The techniques and tools developed in this study will help Caltrans to more efficiently target locations that will likely benefit from safety improvements and would result in the

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greatest reduction in fatal and injury collisions. To accomplish this, we will further develop the range and depth of the existing SPF along with enhancements to the MS Excel tool.

WHAT IS OUR GOAL?

This proposed phase includes two parts — updating the SPF with additional geometric data and updating/developing Crash Modification Factors (CMF) for California State Highway System (SHS). In the first part of the project, advanced California-specific SPF will be developed (or re-estimate/ calibrate all SPFs using the most recent five years of data) using additional infrastructure data – geometric data which could not include in phase 2 and explore any methodological enhancements. The second part mainly explores the existing California CMFs' and provides recommendations for updating/developing CMFs' to meet the safety expectations of California SHS. CMFs play a vital role in recommending countermeasures as part of safety investigations.

WHAT IS THE BENEFIT?

This project represents an effort to enhance pedestrian safety and to refine the capabilities and resources needed to address the imbalance between pedestrians and motorized roadway users in California. The improvements to the pedestrian exposure modeling will allow Caltrans to perform more advanced safety analyses involving risk. Pedestrian-specific SPFs will allow Caltrans to incorporate Empirical Bayes methods in evaluating pedestrian countermeasure effectiveness. The crash typology and risk-based High Collision Concentration Location (HCCL) identification and prioritization techniques are intended to more efficiently identify HCCLs with the greatest potential for safety improvements and reduce the number of false positives. Pedestrian corridor identification is meant to identify groups of contiguous segments or intersections with similar features and safety problems that can be addressed systematically.

WHAT IS THE PROGRESS TO DATE?

As part of Task 1, regular communication was maintained with Caltrans staff through biweekly status meetings, as well as additional meetings as needed, to discuss project progress, address any emerging issues, and ensure alignment with project goals.

In Task 4, significant updates were made to the existing spreadsheet-based tool, including enhancements to the embedded VBA macros, to improve functionality, user experience, and data processing efficiency.

For Task 5, the team thoroughly reviewed and responded to detailed comments and feedback provided by Caltrans on the technical work, which included a pilot Safety Performance Function (SPF) analysis conducted for a representative selection of districts. The revised technical documentation and results were finalized and submitted to Caltrans for further review and integration into the broader project framework.