



Caltrans Division of Research,  
Innovation and System Information

# Research



# Results



Transportation  
Safety and  
Mobility

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**Project Title:**

Implementation of SPF methods to Identify High Collision Concentration Locations

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**Task Manager:**

Jerry Kwong,  
Transportation Engineer, Electrical  
jkwong@dot.ca.gov

## Implementation of SPF methods to Identify High Collision Concentration Locations

Develop California-specific Safety Performance Functions and a functional tool to conduct network screening on the California State Highway System

### WHAT WAS THE NEED?

As part of the efforts to improve safety, the California Department of Transportation is developing new safety network screening practices. This effort has two main components to it: (i) develop state-of-the-practice Safety Performance Functions (SPF); and (ii) develop a tool to implement a network screening method that utilizes these SPF's. Accomplishing both of these components would serve as the first phase towards implementation of such models. SPF's are statistical models that are used for high collision concentration locations (HCCLs) identification procedures, as described in the Highway Safety Manual. The mathematical equations can relate collision frequency to traffic volumes (Type 1 SPF) at a given location and may also include other site characteristics such as road geometry and intersection design (Type 2 SPF). The SPF that are currently described in the HSM are jurisdiction-specific and may not apply to jurisdictions without calibration. To overcome such challenges, California specific SPFs should be developed for all the three facilities based on the data availability in the Traffic Accident Surveillance and Analysis System –Transportation System Network (TASAS-TSN) for the State highway system. The developed SPFs will then be incorporated into a Excel macro based tool toward applying the desirable network screening methods to identify high crash concentration locations. The tool should have the ability to generate reports based on the needs of the Caltrans Traffic Safety Investigation team.

### WHAT WAS OUR GOAL?

The goal of this project was to develop a first version of an implementable tool utilizing the best-practice safety performance evaluation procedures for improving highway safety on the California state highway system.



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## WHAT DID WE DO?

Caltrans, in partnership with the University of California, Berkeley Safe Transportation Research and Education Center identified a set tasks and activities to accomplish this research. The activities included: (i) design and develop an MS excel macro spreadsheet tool that can be used for conducting SPF-based analyses and re-estimating the existing SPF's; (ii) incorporate all of the Caltrans-reviewed SPF's into the spreadsheet tool, so it can be used by select Caltrans traffic safety experts; and (iii) provide guidelines for developing additional SPFs, re-calibrating existing SPFs and a road-map for incorporating such SPF's into the tool. In order to better understand the current system in place, and the interactions between the entities, workflow between these entities and the sequence of work activities, we will develop process maps. Further, based on the SPF data need project and other related projects, a thorough data exploration was carried out including assessment of data availability in the TASAS-TSN. This helps identify the suitability of the most recent five years (2013-2017) for infrastructure and collision data for developing SPFs. Data was subject to go through cleaning process, which included checks for update consistency, attention to whether the facility type is open/closed during the analysis period and other considerations. Later, segmentation procedures, which are grouping of homogeneous segments, were incorporated. Trimming of intersection influence distances was also carried out. After data cleaning and segmentation, infrastructure data was then merged with the collision data including severity level. SPFs were developed for all the three facility types (segments, intersections, and ramps) and incorporated into the spreadsheet tool for network screening.

## WHAT WAS THE OUTCOME?

A functional tool that can conduct SPF-based network screening analyses for identifying HCCLs. More specifically, the outcome includes 17 segment SPFs, 3 intersection SPFs and one ramp

SPF were developed. SPFs were developed based on total collision, and combination of fatal, severe, and visible injury levels (FSV). Based on the performance measures, SPFs Type 2 for FSV were recommended over Type 2 SPFs for all collisions. An MS excel macro spreadsheet tool was then designed and developed incorporating all the Caltrans-reviewed SPF's. For network screening process of highway segment, two most common approaches; sliding window and peak searching, were incorporated in the tool. In addition, the tool will generate the output in two different formats: (i) Traffic Investigation Reports (TIRTS); and (ii) state-wide potential site for investigation list format.

## WHAT IS THE BENEFIT?

This research provides Caltrans with a testable version of a SPF-based highway safety assessment procedures using existing infrastructure data. Through this, Caltrans is closer to implementing more efficient resource allocation for identified HCCLs. The developed excel spreadsheet tool is simple and easy to operate. In addition, the research also provided guidelines for incorporating additional SPFs/re-calibrating existing SPFs for network screening based on the availability of geometric characteristics of roadway. Finally, different report generation options enable Caltrans experts to generate reports based on the described specifications. This can also further be led to optimizing the resources allocation across different highway safety related projects. In the long run, Caltrans would be able to use the SPF tool to identify high priority locations through network screening and will ultimately result in the reduction of traffic-related fatalities and injuries in California.

**IMAGE**

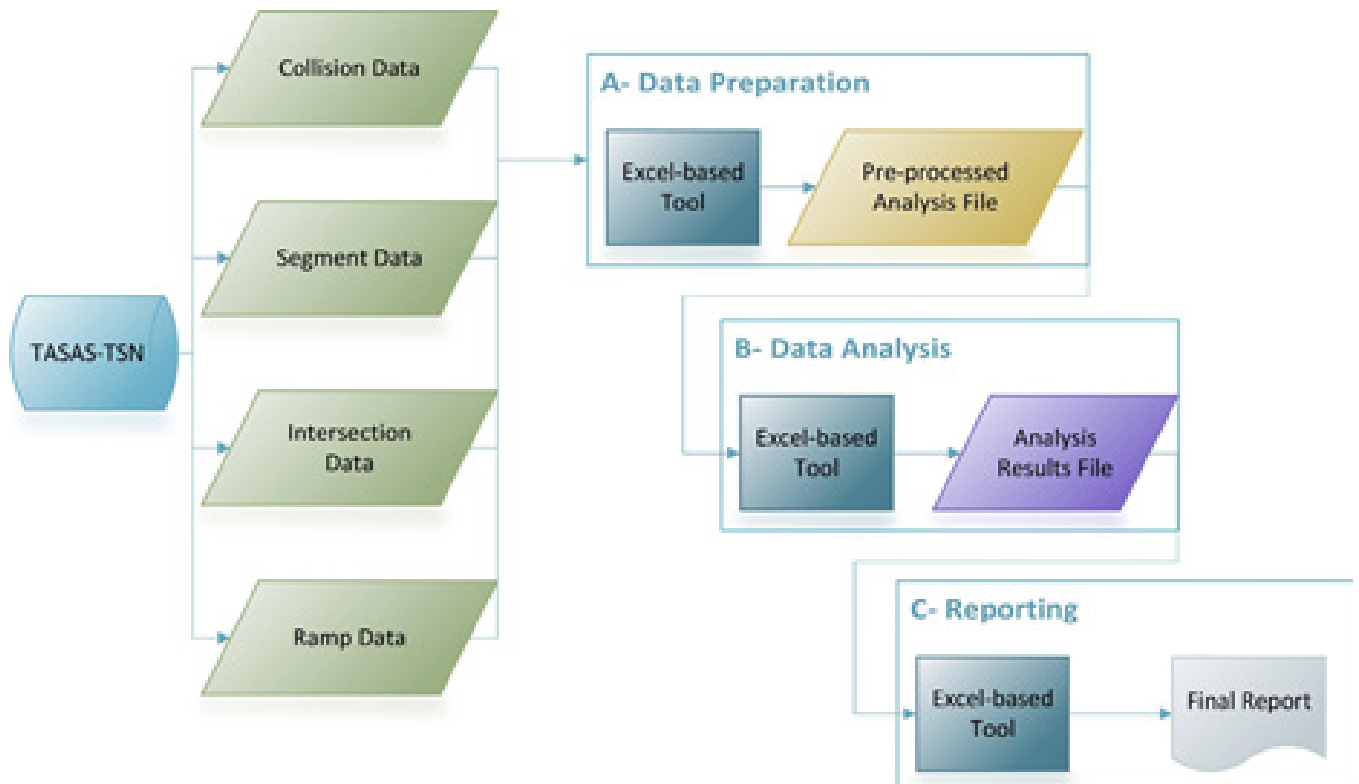


Image 1: Visualization of the scope of the project. This project seeks to develop a MS Excel spreadsheet tool for identifying high crash concentration location through network screening, which will eventually improve the safety of highway along SHS. The tool will incorporate California specific Safety Performance Functions (SPFs) developed with the recent infrastructure and collision data available within TASAS-TSN.