Introduction

Contemporary road safety network screening methods rely on Safety Performance Functions (SPF) which are statistical models relating site characteristics to the number of crashes. SPFs are developed based on historical crash and traffic volume data and should be periodically redeveloped to accurately reflect changes in the underlying relationships that result from changes in the network, traffic behavior, operational performance of vehicles, rules of the road, and other contributing factors. This guideline, coupled with a spreadsheet tool, provides a practical method for determining whether SPF redevelopment is warranted. The data required for this method is either already available in municipalities which have locally developed SPFs or can be easily estimated. More details about the model developments can be found in our paper.

SPF Redevelopment Benefit Estimation Steps

The developed method attempts to estimate the monetary benefit of redeveloping SPFs based on the most recent data, which can then be compared against the cost. The benefit is captured through PPB (PSI Percentage Benefit) which shows how much more PSI units (potential for safety improvement) can be achieved through using redeveloped SPFs. PPB can be estimated through some trend measures which have shown to be correlated with PPB. The four-step process is as follows:

- **Step 1:** Estimate $(PSI) (i.e. the monetary value of one PSI unit)
    - $(PSI) is calculated as a weighted average of different crash types and their social costs:

$$\$(PSI) = \frac{N_{PDO} \times \$_{PDO} + N_{injury} \times \$_{injury} + N_{fatal} \times \$_{fatal}}{N_{PDO} + N_{injury} + N_{fatal}}$$

Where:

N_{PDO}	Number of PDO Crashes in R period
N_{injury}	Number of Injury Crashes in R period
N_{fatal}	Number of Fatal Crashes in R period
$(PDO)	Cost of PDO Crash in R period
$(Injury)	Cost of Injury Crash in R period
$(Fatal)	Cost of Fatal Crash in R period

Note that R period is the redevelopment period which is the most recent period that SPFs redevelopment can be based on.

- **Step 2:** Calculate Trend Measures
    - There are three types of information (number of crashes; traffic volumes; and time since SPFs were last redeveloped) that are readily available and can be used to describe the difference between two periods, as well as have a potential correlation with PPB. For each type of information, we define a trend measure that captures the absolute relative change between the base period and the current period:

$$\%Crash = \frac{|Crash_B - Crash_R|}{Crash_B}$$

$$\%AADT = \frac{|AADT_B - AADT_R|}{AADT_B}$$

$$\%Time = \frac{|N_{year}|}{P}$$

where subscript *B* represents the base period, *R* represents the redevelopment (current) period, *Crash* is the total number of crashes in the network, *AADT* is average of total AADT (or other exposure measure), N_{year} is the number of years between the current year and the base year (base year is the first year of the base period and current year is the last year of the development period), and *P* is the period length in year.

- **Step 3:** PPB estimation

  Given the trend measures, PPB is estimated as follows:

$$PPB = Slope_{TM} \times TM$$

  Where slope is the model parameter for each trend measure. If slopes are calibrated for the jurisdiction using the described methodology in the paper, they can be added in the spreadsheet. Otherwise, they can be estimated through our models given total AADT.

- **Step 4:** Monetary benefit estimation
  - Given the estimated PPB, the monetary benefit is calculated as follows:

$$Benefit(\$) = PPB \times \sum_{n\%} PSI \times \$(PSI)$$

  Where $\sum_{n\%} PSI$ is sum of the PSI unit from all top n% hotspots resulting from previous NS results.

  The benefit is estimated through three modes (crash, AADT, time models). Also the average of all three estimation is called CAT model which has been shown to perform better.

  These benefits now is compared with the cost of SPF redevelopment ($(RSPF)) to decide whether redevelopment is justified or not.