UNITED STATES
DEPARTMENT OF TRANSPORTATION

Safety Impact Methodology

Mikio Yanagisawa
RITA / Volpe

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Safety Benefits – Basic Equations

$$\#\ Crashes\ Avoided = \#\ Target\ Crashes \times Application\ Effectiveness$$

$$Application\ Effectiveness = 1 - \boldsymbol{Exposure\ Ratio} \times \boldsymbol{Crash\ Prevention\ Ratio}$$

$$\boldsymbol{Exposure\ Ratio} = \frac{Exposure\ to\ Driving\ Conflicts\ \boldsymbol{with}\ V2V}{Exposure\ to\ Driving\ Conflicts\ \boldsymbol{without}\ V2V}$$

$$\boldsymbol{Crash\ Prevention\ Ratio} = \frac{Crash\ Probability\ in\ Driving\ Conflict\ \boldsymbol{with}\ V2V}{Crash\ Probability\ in\ Driving\ Conflict\ \boldsymbol{without}\ V2V}$$

Data Sources

- # Target Crashes: Crash databases (GES, FARS,…)
- **Exposure Ratio:** Field operational tests and controlled experiments
- **Crash Prevention Ratio:** Field tests, objective tests, controlled experiments, and computer simulation → ***Safety Impact Methodology (SIM) tool***

SIM Tool Overview

- SIM estimates effectiveness of individual scenarios
- SIM estimates are based on 100% system deployment

Rear-End Pre-Crash Simulation

VEHICLE

Host Vehicle State

Remote Vehicle State

DRIVER

Reaction Time

Braking Level

Control vs. Treatment

Rear-End
SIM
Simulation

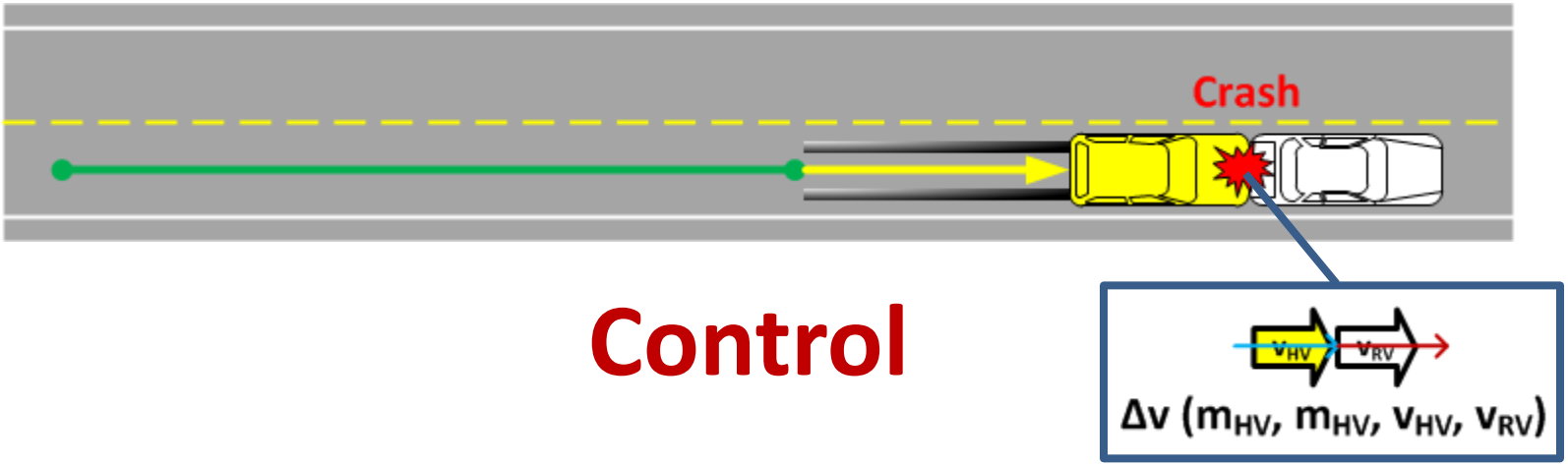
- Crashes
- Non-Crashes
- Impact Speed
- ΔV
- Effectiveness

SYSTEM

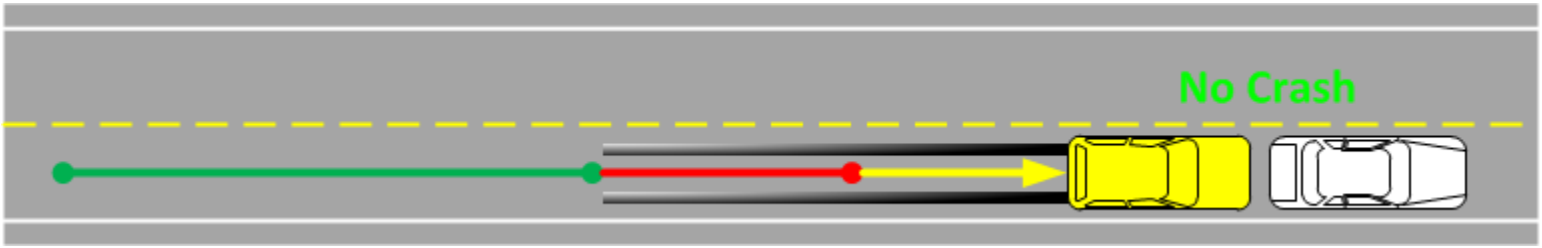
Time-to-Collision of Warning

Automatic System Activation

Rear-End Pre-Crash Walkthrough (LVS)

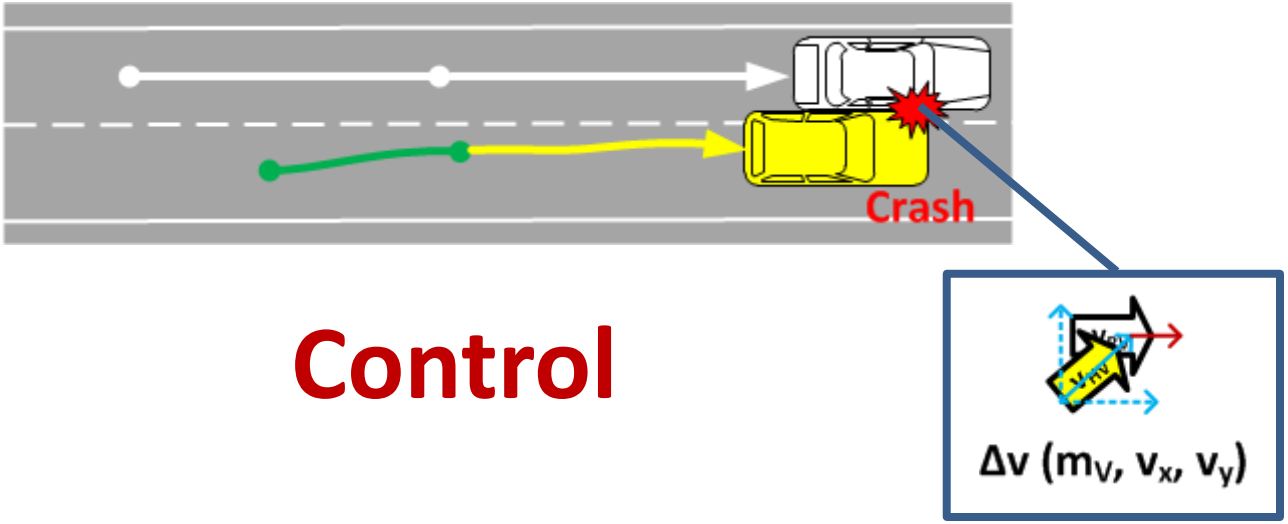


Control

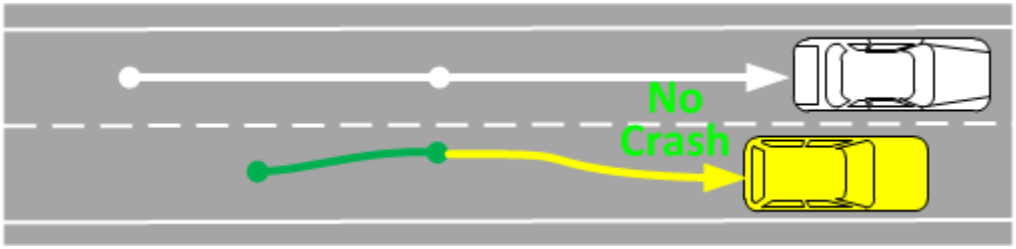


Treatment

Lane Change Pre-Crash Walkthrough

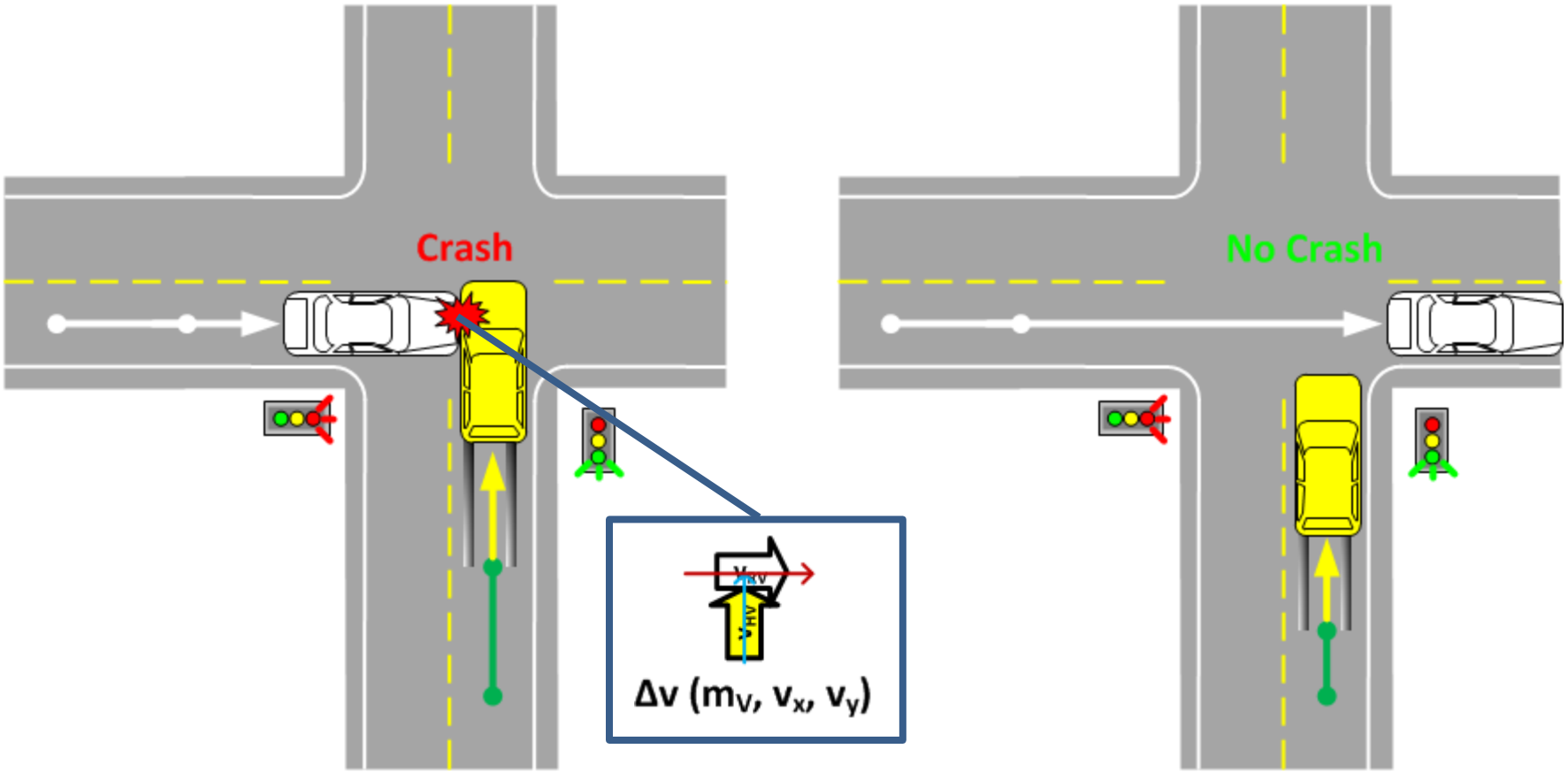


Control



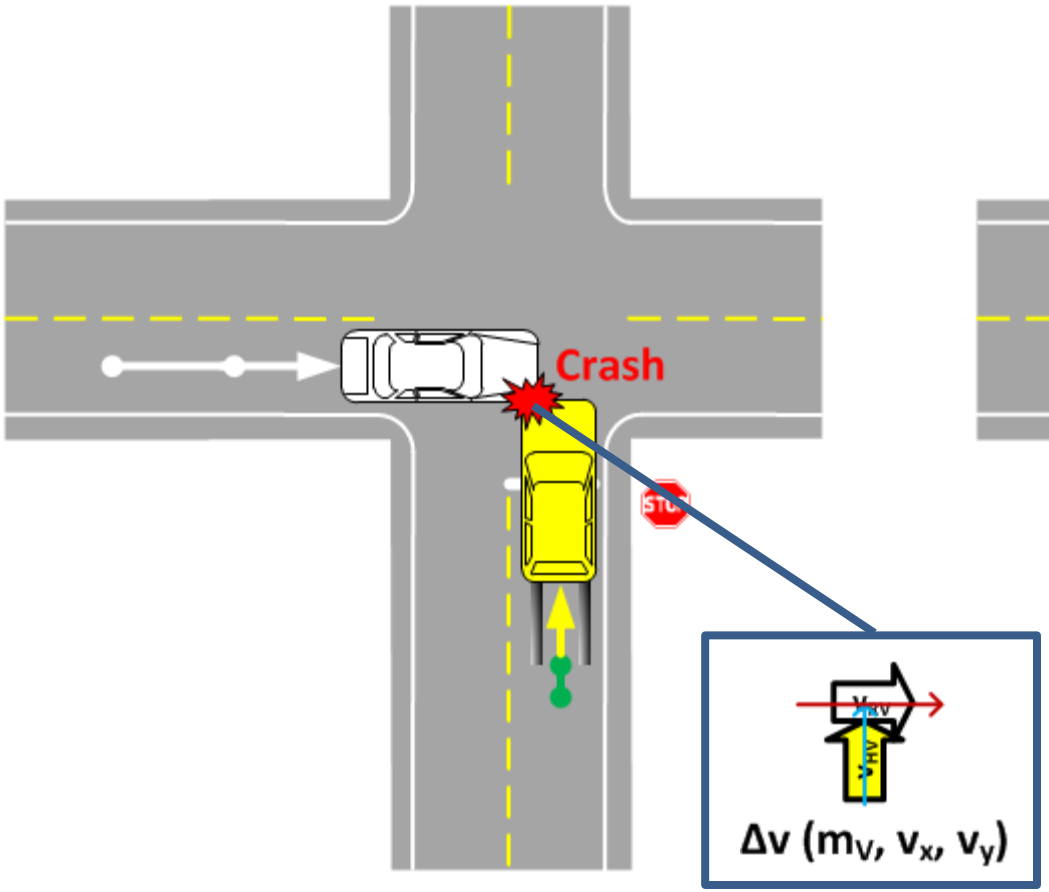
Treatment

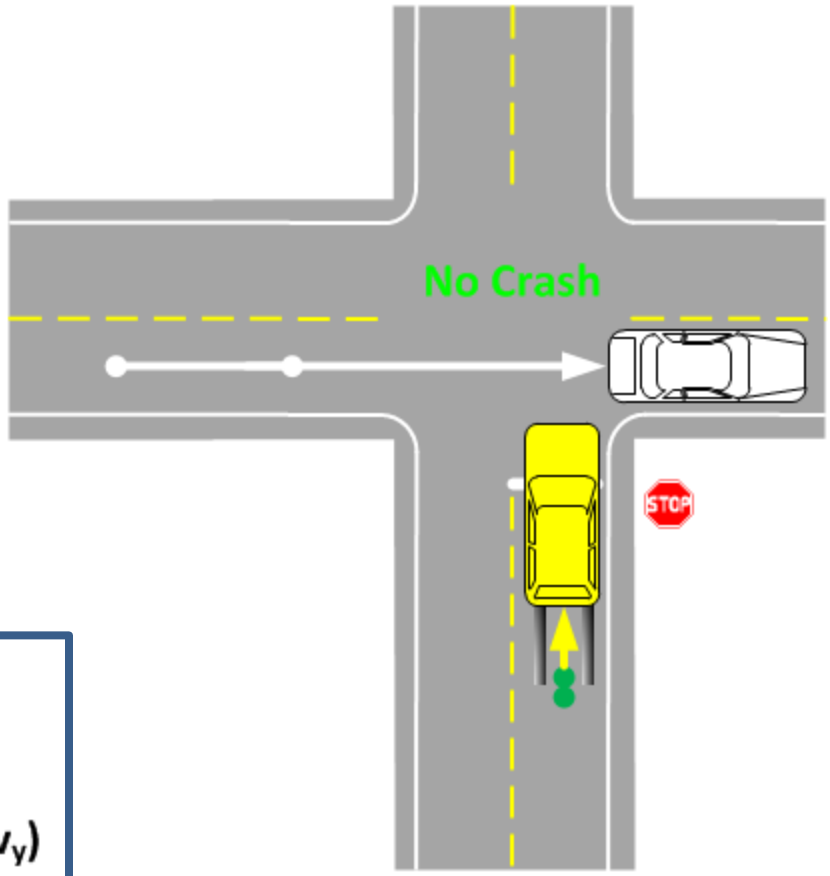
Straight Crossing Paths – Both Vehicles Moving



Control **Treatment**

Straight Crossing Paths – Stopped and Starting

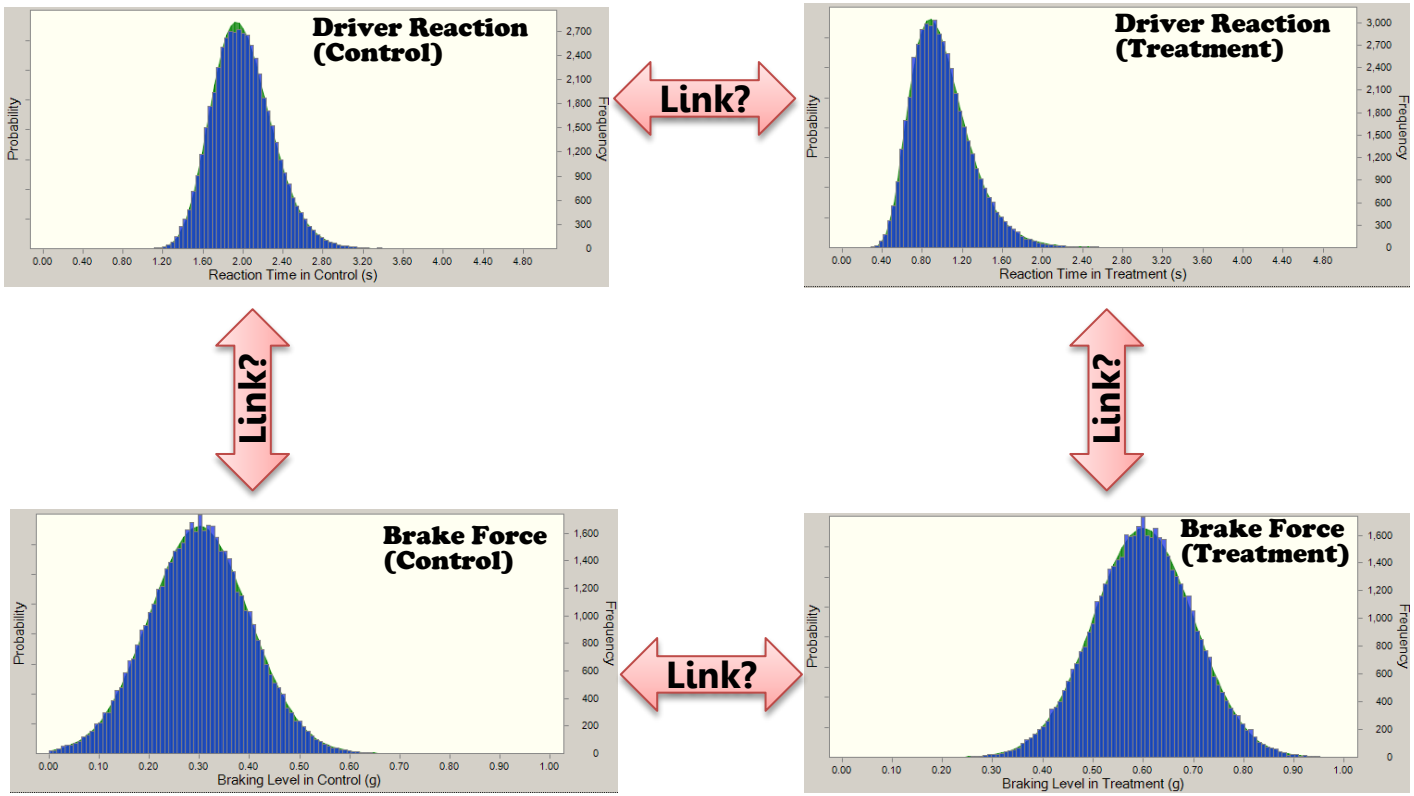




Control **Treatment**

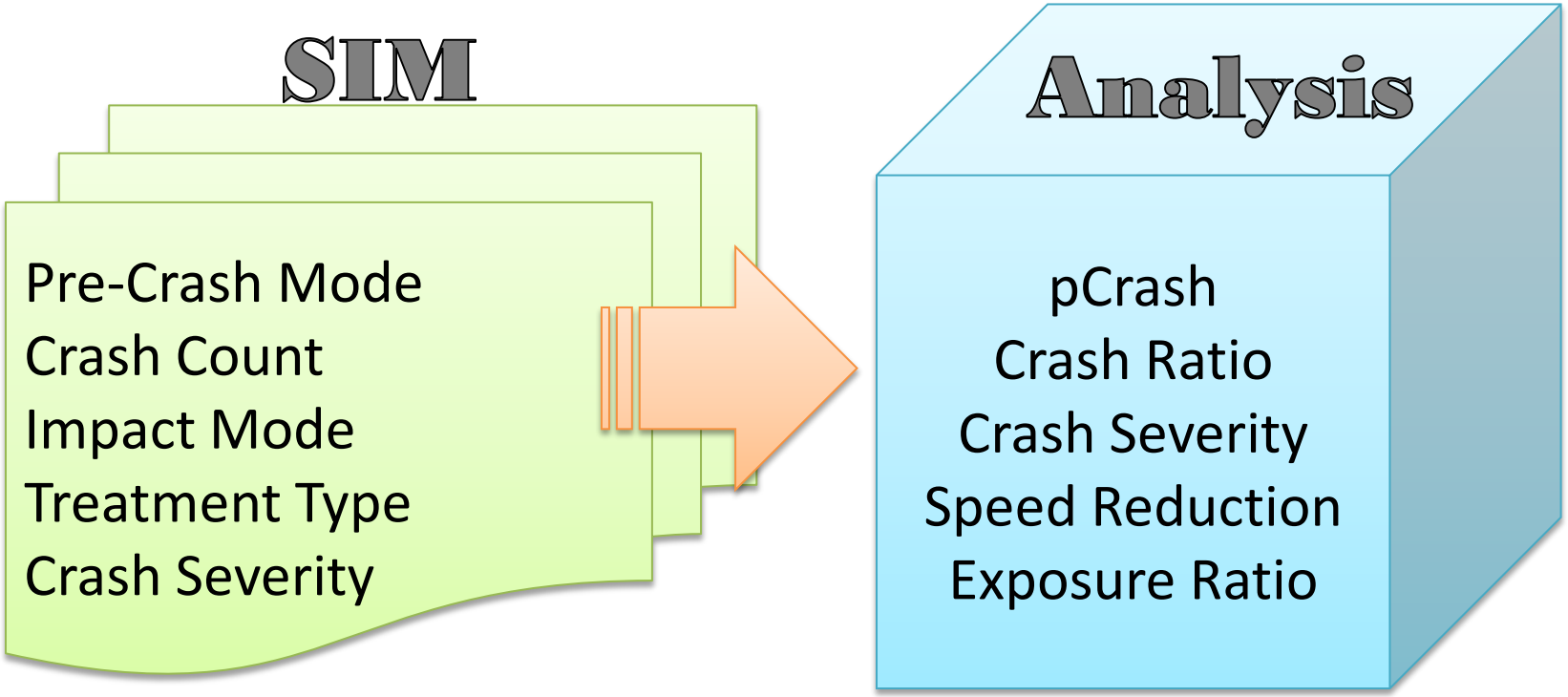
Input Parameters

*Example Mock Data



- Data
  - Field
  - Track
  - Experiment
  - Literature
- Relationships
- Dependencies
- Variable inputs

SIM Results and Analysis



- Results from SIM analyzed for effectiveness
- Applied to appropriate target population
- Pre-crash scenarios combined
- Effectiveness estimates lead to overall benefits