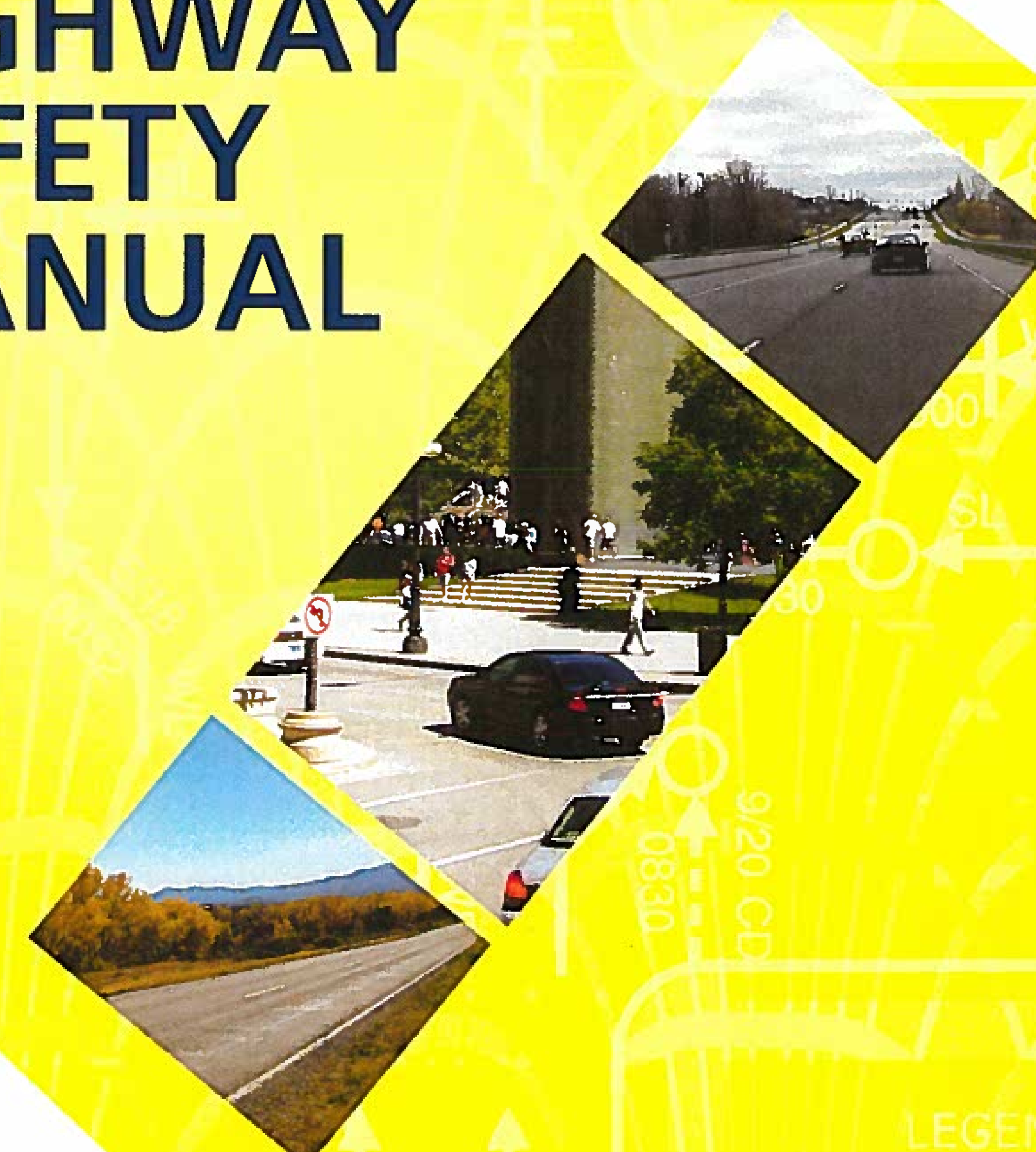
Houston District Design

An Introduction to the HIGHWAY SAFETY MANUAL



HSM
Highway Safety Manual

American Association of State Highway and Transportation Officials
AASHTO
The Voice of Transportation

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For more information, visit the *Highway Safety Manual* website:
www.highwaysafetymanual.org

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Table of Contents

Section 1: HSM Overview

What is the Highway Safety Manual?

The Highway Safety Manual (HSM) introduces a science-based technical approach that takes the guesswork out of safety analysis. The HSM provides tools to conduct quantitative safety analyses, allowing for safety to be quantitatively evaluated alongside other transportation performance measures such as traffic operations, environmental impacts, and construction costs.

For example, the HSM provides a method to quantify changes in crash frequency as a function of cross-sectional features. With this method, the expected change in crash frequency of different design alternatives can be compared with the operational benefits or environmental impacts of these same alternatives. As another example, the costs of constructing a left-turn lane on a two-lane rural road can be compared to the safety benefits in terms of reducing a certain number of crashes.

The HSM provides the following tools:

- Methods for developing an effective a roadway safety management program and evaluating their effects. A roadway safety management program is the overall process for identifying sites with potential for safety improvement, diagnosing conditions at the site, evaluating conditions and identifying potential treatments at the sites, prioritizing and programming treatments, and subsequently evaluating the effectiveness of reducing crashes of the programmed treatments. Many of the methods included in the HSM account for regression to the mean and can result in more effectively identifying improvements to achieve a quantifiable reduction in crash frequency or severity. Safety funds can then be used as efficiently as possible based on the identified locations.
- A predictive method to estimate crash frequency and severity. This method can be used to make informed decisions throughout the project development process, including: planning, design, operations, maintenance, and the roadway safety management process. Specific examples include screening potential locations for improvement and choosing alternative roadway designs.
- A catalog of crash modification factors (CMFs) for a variety of geometric and operational treatment types, backed by robust scientific evidence. The CMFs in the HSM have been developed using high-quality before/after studies that account for regression to the mean.

The HSM emphasizes the use of analytical methods to quantify the safety effects of decisions in planning, design, operations, and maintenance. The first edition does not address issues such as driver education, law enforcement, and vehicle safety, although these are important considerations within the broad topic of improving highway safety.

The HSM is written for practitioners at the state, county, metropolitan planning organization (MPO), or local level.

Regression to the mean is the natural variation in crash data. If regression to the mean is not accounted for, a site might be selected for study when the crashes are at a randomly high fluctuation, or overlooked from study when the site is at a randomly low fluctuation.

A Crash Modification Factor (CMF) is a factor estimating the potential changes in crash frequency or crash severity due to installing a particular treatment. The CMFs in the HSM have been developed based on a rigorous and reliable scientific process.

As an example, a 0.70 CMF corresponds to a 30 percent reduction in crashes. A 1.2 CMF corresponds to a 20 percent increase in crashes.

How is the HSM Applied?

The HSM provides an opportunity to consider safety quantitatively along with other typical transportation performance measures. The HSM outlines and provides examples of the following applications:

- Identifying sites with the most potential for crash frequency or severity reduction;
- Identifying factors contributing to crashes and associated potential countermeasures to address these issues;
- Conducting economic appraisals of potential improvements and prioritizing projects;
- Evaluating the crash reduction benefits of implemented treatments; and
- Estimating potential effects on crash frequency and severity of planning, design, operations, and policy decisions.

The HSM can be used for projects that are focused specifically on responding to safety-related questions. In addition, the HSM can be used to conduct quantitative safety analyses on projects that have not traditionally included this type of analysis, such as corridor studies to identify capacity improvements and intersection studies to identify alternative forms of traffic control. The HSM can also be used to add quantitative safety analyses to multidisciplinary transportation projects.

What is the Value of Using the HSM?

The HSM provides methods to integrate quantitative estimates of crash frequency and severity into planning, project alternatives analysis, and program development and evaluation, allowing safety to become a meaningful project performance measure. As the old adage says, "what gets measured gets done." By applying the HSM tools, improvements in safety will "get done."

Further, from a legislative perspective, the HSM will support states' progress toward federal, state and local safety goals to reduce fatalities and serious injuries. As public agencies work toward their safety goals, the quantitative methods in the HSM can be used to evaluate which programs and project improvements are achieving desired results; as a result, agencies can reallocate funds toward those that are having the greatest benefit.

The HSM methods can be applied to all transportation projects—not just those specifically focused on responding to safety needs.

Section 2: HSM Contents

The HSM is organized into four parts:

PART A Introduction, Human Factors, and Fundamentals

Part A describes the purpose and scope of the HSM, explaining the relationship of the HSM to planning, design, operations, and maintenance activities. Part A also includes fundamentals of the processes and tools described in the HSM. Chapter 3 (Fundamentals) provides background information needed to apply the predictive method, crash modification factors, and evaluation methods provided in Parts B, C, and D of the HSM.
The chapters in Part A are:

- Chapter 1 – Introduction and Overview
- Chapter 2 – Human Factors
- Chapter 3 – Fundamentals

PART B Roadway Safety Management Process

Part B presents suggested steps to monitor and reduce crash frequency and severity on existing roadway networks. It includes methods useful for identifying improvement sites, diagnosis, countermeasure selection, economic appraisal, project prioritization, and effectiveness evaluation. As shown in Figure 1, the chapters in Part B are:

- Chapter 4 – Network Screening
- Chapter 5 – Diagnosis
- Chapter 6 – Select Countermeasures
- Chapter 7 – Economic Appraisal
- Chapter 8 – Prioritize Projects
- Chapter 9 – Safety Effectiveness Evaluation

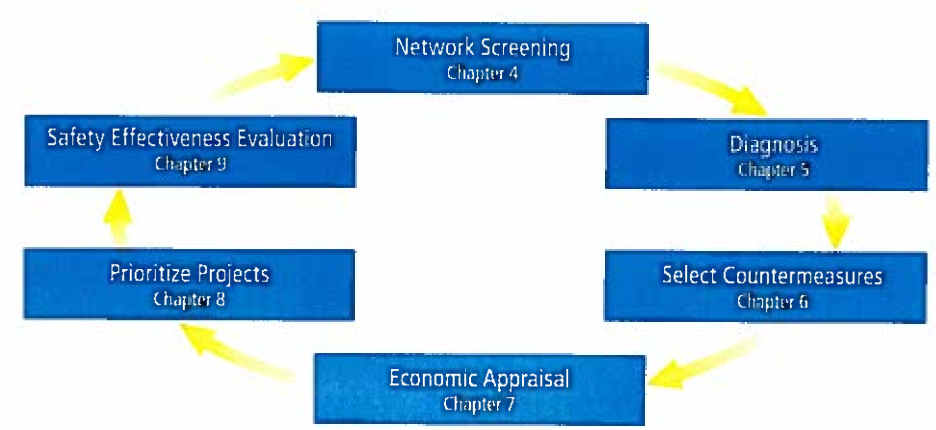


Figure 1 Chapters in Part B

Highlights of this part of the manual are advances in network screening methods and safety evaluation methods. In Chapter 4 (Network Screening), several new network screening performance measures are introduced to shift the safety analysis focus away from traditional crash rates. The major limitation associated with crash rate analysis is the incorrect assumption that a linear relationship exists between traffic volume and the frequency of crashes. As an alternative analysis tool, a focus on expected crash frequency can account for regression to the mean when developing performance measures for network screening. This analysis will provide a more stable list of locations that might respond to safety improvements than lists prepared with traditional methods. This, in turn, will result in a more effective spending of improvement funds.

Chapter 9 (Safety Effectiveness Evaluation) provides methods for evaluating the effectiveness of an individual treatment, a series of treatments, an overall program, and for calculating a crash modification factor (CMF). Evaluating safety investments is often an overlooked element of the roadway safety management process. The HSM brings a focus back to this step in the process.

PART C Predictive Method

Part C provides a predictive method for estimating expected average crash frequency of a network, facility or individual site, and it introduces the concept of safety performance functions (SPFs). As shown in Table 1, the chapters in Part C provide the predictive method for segments and intersections for the following facility types:

Safety Performance Functions (SPFs) are equations that estimate expected average crash frequency as a function of traffic volume and roadway characteristics (e.g., number of lanes, median type, intersection control, number of approach legs). Their use enables the correction of short-term crash counts.

- Chapter 10 – Rural Two-Lane, Two-Way Roads
- Chapter 11 – Rural Multilane Highways
- Chapter 12 – Urban and Suburban Arterials

Predicting expected average crash frequency as a function of traffic volume and roadway characteristics is a new approach that can be readily applied in a variety of ways, including design projects, corridor planning studies, and smaller intersections studies. The approach is applicable for both safety specific studies and as an element of a more traditional transportation study or environmental analysis.

Table 1 Facility Types with Safety Performance Functions

HSM Chapter	Undivided Roadway Segments	Divided Roadway Segments	Intersections: Stop Control on Minor Leg(s) 3-Leg	Intersections: Stop Control on Minor Leg(s) 4-Leg	Intersections: Signalized 3-Leg	Intersections: Signalized 4-Leg
10 Rural Two-Lane, Two-Way Roads	✔		✔	✔		✔
11 Rural Multilane Highways	✔	✔	✔	✔		✔
12 Urban and Suburban Arterials	✔	✔	✔	✔	✔	✔

PART D Crash Modification Factors

For each facility type, prediction models for set base conditions are found. CMFs quantify the change in expected average crash frequency as a result of geometric or operational modifications to a site that differs from set base conditions. As shown in Table 2, Part D provides a catalog of treatments organized by site type:

- Chapter 13 – Roadway Segments
- Chapter 14 – Intersections
- Chapter 15 – Interchanges
- Chapter 16 – Special Facilities
- Chapter 17 – Road Networks

The CMFs will be readily applicable to any design or evaluation process where optional treatments are being considered. The CMFs will also be a valuable addition to the documentation of design exceptions. Table 2 provides an example of a CMF.

The HSM provides a catalog of Crash Modification Factors for a variety of facility types.

Table 2 Sample Crash Modification Factors

Potential Crash Effects of Providing a Median on Multilane Roads

Treatment	Setting (Road Type)	Traffic Volume	Accident Type (Severity)	CMF	Std. Error
Provide a median	Urban (Arterial Multilane)	Unspecified	All types (Injury)	0.78	0.02
			All types (Non-injury)	1.09	0.02
	Rural (Multilane)		All types (Injury)	0.88	0.03
			All types (Non-injury)	0.82	0.03

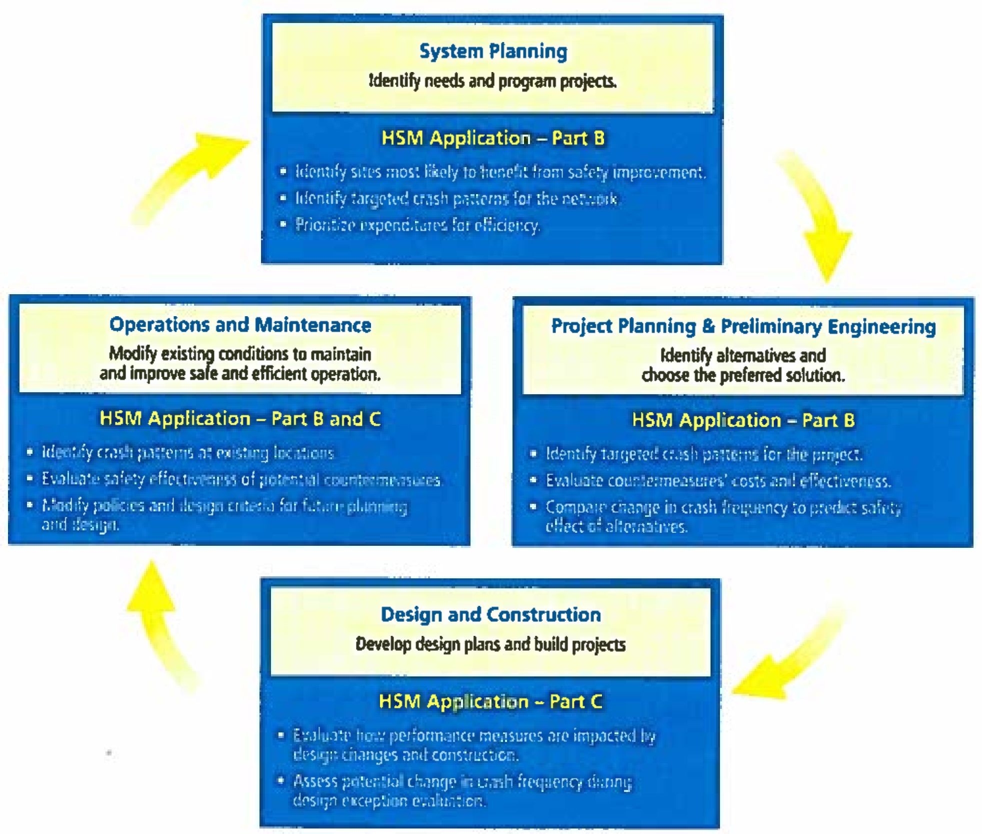
Base Condition: Absence of raised median

The HSM methods can be applied in each step of the project development process.

Section 3: Integrating the HSM with the Project Development Process

The project development process outlines the typical stages of a project from planning to post-construction operations and maintenance activities. The HSM can be applied in each step of the process. Figure 2 shows the relationship between a generalized project development process and the HSM.

Figure 2 Applications of the HSM in the Project Development Process



Section 4: Data Needs

In general, there are three categories of data needed to apply the HSM: crash data, traffic volume data, and roadway characteristics data. The crash data needs are limited to crash data by date (year), location, type, severity level, relationship to intersection (at-intersection, intersection related, not intersection related), and distance from the intersection. The traffic volume data requirement for roadway segments is the annual average daily traffic (AADT). For intersections, the traffic volume requirement is the major and minor street entering AADT.

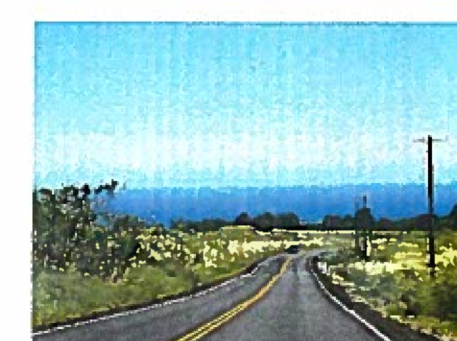
The roadway characteristics data requirements change as a function of the facility type (e.g., two-lane, two-way rural road, multilane rural highway, urban/suburban arterial) and whether an intersection or segment is under consideration. Table 3 provides a summary of the roadway characteristics data requirements.

Table 3 Site Characteristics and Traffic-Volume Variables Used in HSM Safety Predictions

Variables	Chapter 10 Rural Two-Lane, Two-Way Roads	Chapter 11 Rural Multilane Highways	Chapter 12 Urban and Suburban Arterials
Roadway Segments			
Area type (rural/suburban/urban)	✓	✓	✓
Annual average daily traffic volume	✓	✓	✓
Length of roadway segment	✓	✓	✓
Number of through lanes	✓	✓	✓
Lane width	✓	✓	
Shoulder width	✓	✓	
Shoulder type	✓	✓	
Presence of median (divided/undivided)		✓	✓
Median width		✓	
Presence of concrete median barrier		✓	
Presence of passing lane	✓		
Presence of short four-lane section	✓		
Presence of two-way left-turn lane	✓		✓
Driveway density	✓		
Number of major commercial driveways			✓
Number of minor commercial driveways			✓
Number of major residential driveways			✓
Number of minor residential driveways			✓
Number of major industrial/institutional driveways			✓
Number of minor industrial/institutional driveways			✓
Number of other driveways	✓		
Horizontal curve length	✓		
Horizontal curve radius	✓		
Horizontal curve superelevation	✓		
Presence of spiral transition	✓		
Grade	✓		
Roadside hazard rating	✓		
Roadside slope		✓	
Roadside fixed-object density			✓
Roadside fixed-object offset			✓
Percent of length with on-street parking			✓
Type of on-street parking			✓
Presence of lighting			✓
Intersections			
Area type (rural/suburban/urban)	✓	✓	✓
Major-road average daily traffic volume	✓	✓	✓
Minor-road average daily traffic volume	✓	✓	✓
Number of intersection legs	✓	✓	✓
Type of intersection traffic control	✓	✓	✓
Left-turn signal phasing (if signalized)			✓
Presence of right turn on red (if signalized)			✓
Presence of red-light cameras			✓
Presence of median on major road		✓	
Presence of major-road left-turn lane(s)	✓	✓	✓
Presence of major-road right-turn lane(s)	✓	✓	✓
Presence of minor-road left-turn lane(s)		✓	
Presence of minor-road right-turn lane(s)		✓	
Intersection skew angle	✓	✓	
Intersection sight distance	✓	✓	
Terrain (flat vs. level or rolling)		✓	
Presence of lighting		✓	✓

NCHRP Research Results Digest 329: HSM Data Needs Guide, 2008. Data requirements are for Part C only.

Data needs for applying the HSM methods change by the type of facility.



Network screening is the process of evaluating a network of facilities for sites likely to respond to safety improvements.

Section 5: Example Applications

PART B Network Screening Example (Chapter 4)

Chapter 4 of the *Highway Safety Manual* presents 13 optional performance measures for network screening. This sample application illustrates a network screening process for prioritizing spending at six intersections within a community using the Excess Expected Average Crash Frequency with Empirical Bayes (EB) Adjustment method. Network screening is the process of evaluating a network of facilities for sites likely to respond to safety improvements. The Excess Expected Average Crash Frequency with Empirical Bayes (EB) Adjustment performance measure combines predictive model crash estimates with historical crash data to obtain a more reliable estimate of crash frequency. This method also accounts for bias due to regression to the mean.

Data Requirements

The data required for the application of this method are:

- Historical crash data by severity and location
- Traffic volume (AADT for segments; AADT for major and minor roads for intersections)
- Basic site characteristics (e.g., roadway cross-section, intersection control)
- Calibrated Safety Performance Functions (SPFs) and over-dispersion parameters

Sample Application

The basis for the Excess Expected Average Crash Frequency with EB Adjustment performance measure is that each site is evaluated as a function of how much the predicted average crash frequency for the site differs from the long-term EB adjusted expected average crash frequency for the same site. This difference is referred to as the "Excess" value (see Table 4). Sites with a high "Excess" value are most likely to respond to safety improvements because they are theoretically experiencing more crashes than other similar sites. An advantage of this method is that it may be used as a performance measure to evaluate a mix of facility types and traffic volumes in a single ranking. The basic procedure is as follows:

1 For each site, calculate the Predicted Average Crash Frequency using the methods and predictive formulas presented in Part C of the HSM.

2 For each site, calculate the Expected Average Crash Frequency using the EB method presented in the Part C Appendix.

3 Estimate an "Excess" value using the following formula:

$$Excess_y = (N_{expected,\ n(PDO)} - N_{predicted,\ n(PDO)}) + (N_{expected,\ n(FI)} - N_{predicted,\ n(FI)})$$

$$Excess_{intersection\ 1} = (1.7 - 0.9) + (1.2 - 0.5) = 1.50$$

Where:

$Excess_y$ = Excess expected crashes for year

$N_{expected,\ n}$ = EB-adjusted expected average crash frequency for year

$N_{predicted,\ n}$ = SPF predicted average crash frequency for year

Table 4 Predicted Average Crash Frequency

Int.	Int. Type	Major Street Volume (AADT)	Minor Street Volume (AADT)	Observed Average Crash Frequency (FI)	Observed Average Crash Frequency (PDO)	SPF Predicted Average Crash Frequency (FI)[1]	SPF Predicted Average Crash Frequency (PDO)[1]	EB-Adjusted Expected Average Crash Frequency (FI)	EB-Adjusted Expected Average Crash Frequency (PDO)	Excess $(N_{e} - N_{p})_{PDO} + (N_{e} - N_{p})_{FI}$
1	3-Leg Signal (Urban Arterial)	8,885	6,313	2.8	3.4	0.5	0.9	1.2	1.7	1.50
2	4-Leg Signal (Urban Arterial)	18,447	2,569	2.8	5.0	1.3	2.6	1.7	3.6	1.49
3	4-Leg Signal (Urban Arterial)	16,484	2,041	1.4	2.0	1.1	2.2	1.2	2.1	0.03
4	4-Leg Signal (Urban Arterial)	23,793	7,700	4.4	4.0	2.2	4.4	2.9	4.2	0.61
5	4-Leg Signal (Urban Arterial)	19,726	10,084	1.4	8.8	1.8	3.9	1.7	6.1	2.05
6	3-Leg Signal (Urban Arterial)	25,559	1,440	2.6	6.6	1.0	1.8	1.5	3.5	2.22

[1] In this example, the local geometric conditions are the same as the geometric conditions for the SPF; therefore, all CMFs = 1.0
AADT = Average Annual Daily Traffic
FI = Fatal-and-Injury Crashes
PDO = Property-Damage-Only Crashes

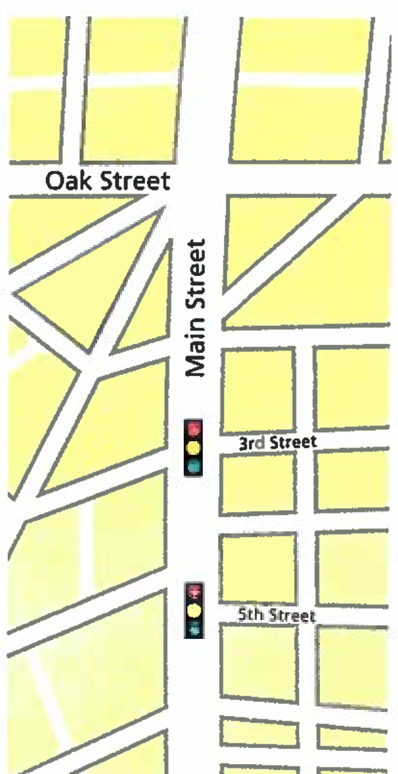
Results:

In this sample application, the final ranking of the intersections is determined based on the resulting "Excess" value (see Table 5). The intersection most likely to benefit from safety improvements in this example is Intersection 6, which has an "Excess" value of 2.22. Diagnosis and selection of treatment will be required to establish the potential for such improvement.

Table 5 Ranking of "Excess" Value

Intersection	Excess
6	2.22
5	2.05
1	1.50
2	1.49
4	0.61
3	0.03

This predictive method example demonstrates the quantitative safety analysis of design alternatives.



PART C Predictive Method Example

Background, Issues, and Objectives

The Main Street corridor is 1.5 miles long, connecting residential and industrial uses across a river to the downtown business district. It is an important vehicle and bicycle commuter route. The average daily traffic volume along this route ranges from 20,000 to 25,000 vehicles per day. The corridor has received funding for major geometric improvements. This study was conducted to evaluate the traffic operations and safety impacts of various design alternatives for the entire corridor. Several options were considered as part of the project, including converting the 2- or 3-lane roadway to a 5-lane road, or converting the roadway to a 3-lane road. Each case would include a mix of traffic signals and roundabouts at the intersections. This project example demonstrates the quantitative safety analysis of two alternatives on a small portion of the corridor.

Data Requirements

Segments

- Segment Length (miles)
- Through Lanes (number)
- Median Type (divided/undivided)
- Median Width (feet)
- On-Street Parking (yes/no)
- Fixed Object Density (obj/mile)
- Average Offset of Fixed Objects (feet)
- Roadway Lighting (yes/no)
- Speed Limit (mph)
- Traffic Volume (veh/day)
- Number/Types of Driveways

Intersections

- Number of Intersection Legs
- Traffic Control (signal, stop, roundabout)
- Left-Turn Lanes and Phasing (protected, permitted, protected/permitted)
- Right-Turn Lanes and Control of Right Turn (permitted on red, prohibited on red)
- Lighting (yes/no)
- Maximum Number of Traffic Lanes Crossed by Pedestrians (number)
- Nearby Bus Stops, Schools, and Alcohol Sales Establishments (number)
- Entering Traffic Volumes (veh/day)
- Pedestrian Activity (yes/no)

Analysis Methodology Overview

The crash frequency for each segment and intersection is predicted using an iterative 18-step method in Chapter 12, "Urban and Suburban Arterials." In summary, this method consists of initially calculating multiple- and single-vehicle fatal-and-injury and property-damage-only crashes; these values are added to obtain base predicted vehicle crashes. The next step is to adjust the base predicted vehicle crashes with crash modification factors (CMFs) based on the roadway characteristics. Finally, this value is added to predicted bicycle and pedestrian crashes. If a calibration factor was available, or historical data was available to apply the Empirical Bayes method, these two steps would be included. A sample calculation using the base equation for predicted average crash frequency is shown below, Equation 1 illustrates the base equation. Sample calculations are shown for the Main Street/3rd Street intersection no-build conditions.

Equation 1

$$N_{bi} = N_{spf\ int} \times (CMF_{1i} \times CMF_{2i} \times \ldots \times CMF_{6i}) \times C$$

$$N_{bi} = 12.97 \times (.066 \times 0.96 \times 0.88 \times 1.00 \times 0.91 \times 1.00) \times 1.00 = 6.63 \text{ crashes/year}$$

Where:

N_{bi} = Predicted average crash frequency for an intersection

$N_{spf\ int}$ = Predicted average crash frequency for base conditions ($N_{spf\ int}$ = 12.97, see below)

$CMF_{1i} \ldots CMF_{6i}$ = Crash modification factors for left-turn lanes (CMF_{1i} = 0.66), left-turn phasing (CMF_{2i} = 0.96), right-turn lanes (CMF_{3i} = 0.88), right turn on red (CMF_{4i} = 1.00), lighting (CMF_{5i} = 0.91), and red-light camera (CMF_{6i} = 1.00).

C = Calibration factor (C = 1.00)

Note, as this is a multi-step process there are multiple equations that are used to calculate $N_{spf\ int}$, (e.g., by crash severity, by mode), these steps are not detailed in this example. An interim equation used in that process for the Main Street/3rd Street intersection no-build condition is illustrated as Equation 2.

Equation 2

$$N'_{bimv(FI)} = exp(a + b \times ln(AADT_{maj}) + c \times ln(AADT_{min}))$$

$$N'_{bimv(FI)} = exp(-13.14 + 1.18 \times ln(33{,}910) + 0.22 \times ln(25{,}790)) = 4.07 \text{ crashes/year}$$

Where:

$N'_{bimv(FI)}$ = Multiple vehicle intersection fatal/injury crashes

a, b, and c = Regression coefficients (−13.14, 1.18, and 0.22 for 4-leg signalized intersections)

$AADT_{maj}$ = Annual average daily traffic on major road (33,910)

$AADT_{min}$ = Annual average daily traffic on minor road (25,790)

Table 6 Forecast Crash Frequency

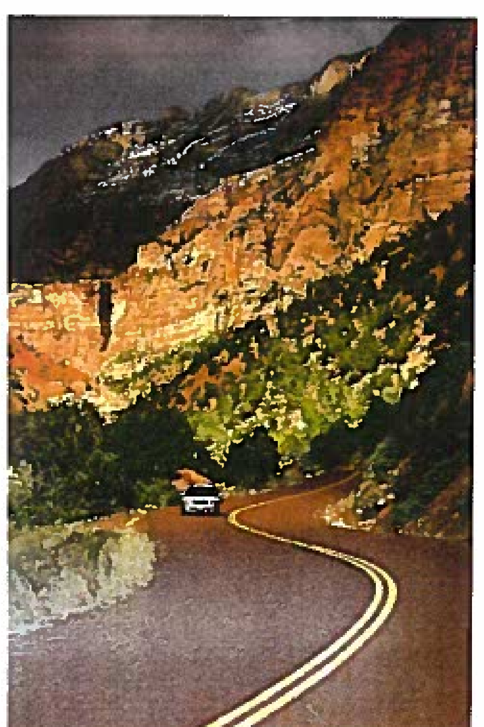
	2035 Forecast Crash Frequency (Crashes/Year)								
	No-Build			Alternative 1 (Mix 3- and 5-Lane)			Alternative 2 (5-Lane)		
Intersection/Segment[1]	Facility	AADT[2]	Crashes/Year	Facility	AADT[2]	Crashes/Year	Facility	AADT[2]	Crashes/Year
Int: Main & Oak	Stop	35,730/ 3,650	3.26	Roundabout	35,730/ 3,650	1.67	Signal	39,080/ 5,280	6.93
Seg: Oak to 3rd St.	3-Lane	34,580	8.30	3-Lane	34,580	5.74	5-Lane	38,150	9.32
Int: Main & 3rd	Signal	33,910/ 25,790	6.63	Roundabout	33,910/ 25,790	3.43	Roundabout	36,900/ 29,400	3.86
Seg: 3rd to 5th	5-Lane	33,270	5.05	5-Lane	33,270	1.51	5-Lane	37,310	1.74
Int: Main & 5th	Signal	33,200/ 5,940	6.40	Roundabout	33,200/ 5,940	3.32	Roundabout	37,860/ 7,230	3.99
Total Prediction	29.6 crashes/year			15.7 crashes/year			25.8 crashes/year		
Change Relative to No-Build				47% Decrease			13% Decrease[3]		

[1] For the purposes of presenting the results, crashes estimated for minor street intersections along the two segments (Oak St. to 3rd St. and 3rd St. to 5th St.) were added into the segment crash totals.
[2] Major Street AADT/Minor Street AADT for intersections.
[3] Under the 5-lane scenario, the corridor has more capacity; therefore more regional traffic is drawn to this corridor. The decrease shown is for overall crashes, so a normalized analysis would show a slightly greater decrease

Results (see Table 6):

- Changes in crash frequencies are quantified and compared to the no-build scenario. The resulting forecast crash frequencies for Alternatives 1 and 2, 15.7 and 25.8 crashes respectively, are compared to the no-build crash frequency, 29.6. The difference is quantified as a percentage.
- The change in crash frequency can now be considered as one of the trade-offs similar to traffic operations, environmental impacts and pedestrian and bicycle mobility.

Agencies can take these steps to begin using the HSM.



Section 6: Getting Started

Highway agencies interested in using the HSM methodologies in their safety management and project development processes should consider taking the following next steps toward implementation.

Purchase the HSM

The HSM is currently available for purchase from AASHTO for $325 for AASHTO members and $390 for non-members. Discounts are available for those states taking HSM training. Both hard copy and electronic versions are available. To purchase, visit http://bookstore.transportation.org and search under code HSM-1.

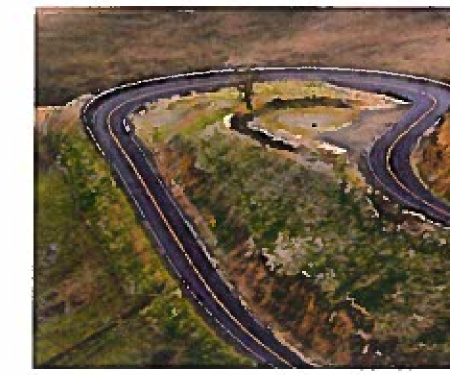
Develop an Agency Training Plan

The HSM methodologies may necessitate some changes in the way highway agencies analyze data, screen their network, and review alternatives for projects. In order to fully understand the methods of the HSM, it will be important for agency personnel to pursue training. NCHRP Project 17-38 is currently underway to develop an HSM overview training course (NHI 380106). In addition, a number of training opportunities available through the National Highway Institute (NHI) are identified in Section 7. The NHI courses can assist agencies in understanding how to apply the HSM methods to the agency's program and in using the safety analysis tools that execute HSM methodology.

Review Software Tools

A number of software programs have been developed to support practitioners' use of the HSM methodologies.

- ***SafetyAnalyst*** provides a set of software tools used by State and local highway agencies for highway safety management. It incorporates state-of-the-art safety management approaches into computerized analytical tools for guiding the decision-making process to identify safety improvement needs and develop a systemwide program of site-specific improvement projects. *SafetyAnalyst* is applicable to Part B of the HSM. The *SafetyAnalyst* software is available through AASHTO, and additional information can be found at www.safetyanalyst.org.
- The ***Interactive Highway Safety Design Model (IHSDM)*** is a suite of software analysis tools for evaluating safety and operational effects of geometric design decisions on highways. It checks existing or proposed highway designs against relevant design policy values and provides estimates of a design's expected safety and operational performance. The IHSDM performs the predictive method for the facilities in Part C of the first edition of the HSM (i.e., two-lane, two-way rural roads, rural multilane highways, and urban and suburban arterials) The IHSDM website summarizes the capabilities and applications of the evaluation modules and provides a library of the research reports documenting their development. Information is available at the public software website, www.ihsdm.org, where users can register and download the latest release of IHSDM.
- The ***Crash Modification Factors Clearinghouse*** houses a web-based database of CMFs along with supporting documentation to help transportation engineers identify the most appropriate countermeasure for their safety needs. Using this site at www.cmfclearinghouse.org, users are able to search for existing CMFs or submit their own CMFs to be included in the clearinghouse.



Develop an Agency HSM Implementation Plan

Incorporating the HSM into an agency's processes will take a concerted effort that should begin with a plan of action. A number of State DOTs have begun planning for the HSM by developing agency-specific training programs, and incorporation of the software tools previously discussed. The Federal Highway Administration (FHWA) is developing an HSM Implementation Plan Guide for State Highway Agencies to be released in late 2010. It will provide strategies to assist with HSM deployment activities at the State level.

Assess Crash Data

An agency should assess its crash data to see if assistance is needed to prepare it for the rigors of HSM analysis. FHWA will provide technical assistance and support to States in evaluating their data systems against data requirements in Part B of the Manual. A technical support staff with intimate knowledge of Part C is also available to answer questions through the FHWA Geometric Design Lab.

Stay Updated

The most up-to-date information on training, technical support, and marketing materials will be available at AASHTO's Highway Safety Manual website, www.highwaysafetymanual.org.

Section 7: Resources

- Highway Safety Manual website: www.highwaysafetymanual.org
- Purchase the HSM: http://bookstore.transportation.org. Search under code HSM-1.
  - Cost: $325 (Members), $390 (Non-members)
  - Discounts are available for those states taking HSM training
- IHSDM website: http://www.tfhrc.gov/safety/ihsdm/ihsdm.htm
- SafetyAnalyst website: http://www.safetyanalyst.org
- Crash Modification Factors Clearinghouse: http://www.cmfclearinghouse.org
- NCHRP Research Results Digest 329: www.trb.org/Publications/Blurbs/Highway_Safety_Manual_ Data_Needs_Guide_159984.aspx
- Training courses available at http://nhi.fhwa.dot.gov
  - New Approaches to Highway Safety Analysis (NHI-380075)
  - HSM Practitioners Guide to Two-Lane Rural Roads (NHI-380070A)
  - HSM Practitioners Guide to Multilane Urban/Suburban Highways (NHI-380070B)
  - HSM Application to Intersections (NHI-380105*)
  - HSM Workshop (NHI-380106*)
  - Application of Crash Reduction Factors (NHI-380093)
  - Science of Crash Reduction Factors (NHI-380094)
  - Interactive Highway Safety Design Model (IHSDM) (NHI-380071, NHI-380100* web-based)

*Course under development