Safety Analysis Methods for Planning and Project Development

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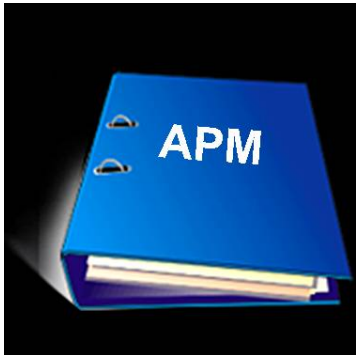
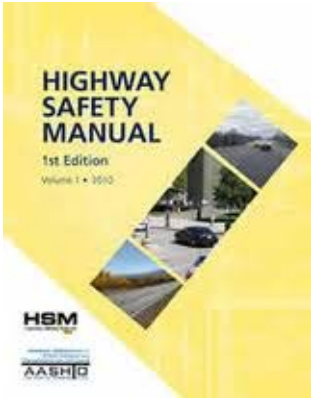
Analysis Procedures Manual (APM) Safety Analysis



- Safety analysis procedures for
  - Plans - focusing on TSPs, corridor plans, and refinement plans
  - Project development - focusing on NEPA-level projects
- Does not include Highway Safety Program or Traffic Operations procedures such as
  - Road safety audits
  - Collision diagrams
  - Benefit/cost ratio analysis
  - Final countermeasure decisions

New APM Chapter 4 – Safety [1]

- Procedures for applying key Highway Safety Manual (HSM) methods
- Published August, 2013
- Addition of new methods and update of existing safety analysis methods
- Interim update – a more comprehensive evaluation of new safety analysis procedures is in progress



Crash Rate Analysis

- New recommended methods
  - HSM Critical Rate
  - ODOT published 90th percentile intersection crash rates
- Segment crash rate comparisons to statewide average
  - Segments not homogeneous
  - Short segments
  - Still applicable but may be better/supplemental methods
- Intersection crash rate rule of thumb (threshold of 1.0 crashes/MEV)
  - Replaced by new method

HSM Critical Rate Method

- HSM Part B network screening/flagging tool
- Uses standard crash rates
- ODOT spreadsheet calculator developed [2]
- Intersections and segments within study area are grouped by roadway or traffic control characteristics
- Crash rates for each site are analyzed and compared statistically within their group

Reference Populations

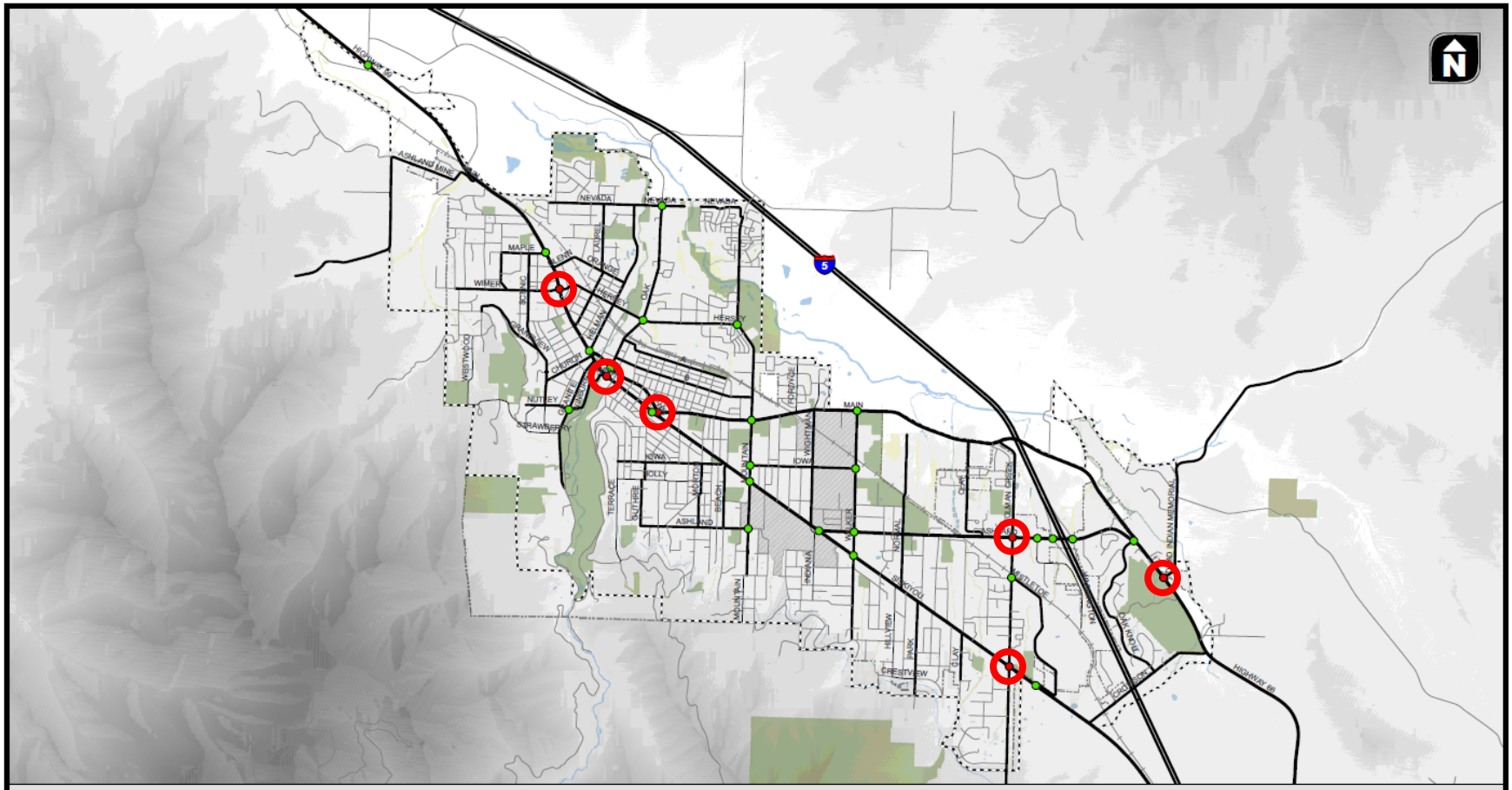
- Intersections
  - Unsignalized versus signalized
  - 3-leg versus 4-leg

- Segments
  - Divided versus undivided
  - 2-lane versus 4-lane
  - Terrain – level, rolling, mountainous
  - Passing lane or climbing lane segments

Critical Rate Method - Ashland TSP

City of Ashland Transportation System Plan Update

November 2010



Intersection Crash Analysis

CITY OF ASHLAND

Figure 9

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Statewide 90th Percentile Intersection Crash Rates[3]

Exhibit 4-1 Intersection Crash Rates per MEV by Land Type and Traffic Control

	Rural				Urban			
	3SG	3ST	4SG	4ST	3SG	3ST	4SG	4ST
No. of Intersections	7	115	20	60	55	77	106	60
Mean Crash Rate	0.226	0.196	0.324	0.434	0.275	0.131	0.477	0.198
Median Crash Rate	0.163	0.092	0.320	0.267	0.252	0.105	0.420	0.145
Standard Deviation	0.185	0.314	0.223	0.534	0.155	0.121	0.273	0.176
Coefficient of Variation	0.819	1.602	0.688	1.230	0.564	0.924	0.572	0.889
90th Percentile Rate	**0.464**	**0.475**	**0.579**	**1.080**	**0.509**	**0.293**	**0.860**	**0.408**

Source: Assessment Of Statewide Intersection Safety Performance, FHWA-OR-RD-18, Portland State University and Oregon State University, June 2011, Table 4.1, p. 47.

Excess Proportion of Crash Types

- HSM Part B Network screening tool
- Identifies locations with significantly high proportions of crash types
  - Turning
  - Rear-end
  - Angle

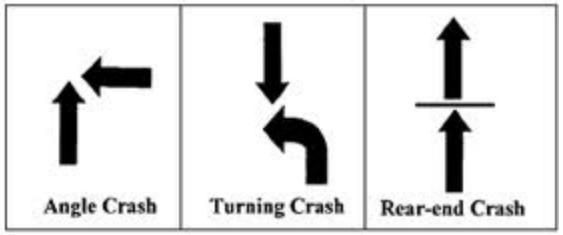


Figure 3-2. Common Crash Types Associated with Red-Light Running.

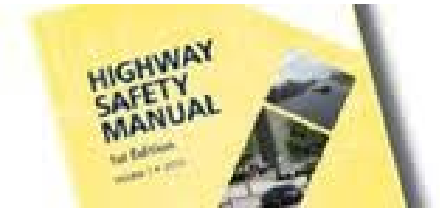
- ODOT spreadsheet calculator [4] developed

Crash Modification Factors (CMFs)

- Identify potential crash reductions from proposed countermeasures
- Useful for relative comparisons between alternatives
- Crash Modification Factor Clearinghouse [5]
  - Star rating system
  - Access to research
- ODOT Guidance on use of CMFs [6]

CRASH MODIFICATION FACTORS CLEARINGHOUSE

Predictive Analysis



- HSM Part C
- Safety Performance Functions (SPFs)
  - Equations predicting crash frequency based on AADT, roadway and operational characteristics
- Data intensive - too detailed for TSPs
- New SPFs continue to be developed nationally and in Oregon
- Oregon calibration factors required for national SPFs
  - Oregon's required crash reporting threshold higher than most other states ($1500)
  - Many minor crashes not reported

Oregon HSM Calibration Factors [7]

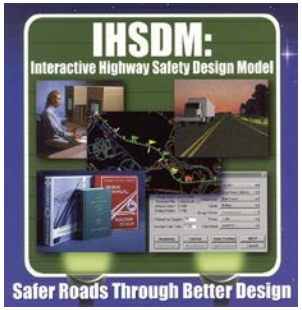
Table 7.1: Recommended Oregon HSM Calibration Factors (based on locally derived crash proportions)

Facility Type		Observed Crashes	Predicted Crashes	Calibration Factor, C
SEGMENTS				
	Rural Two-Lane			
R2	2-lane undivided	394	529	0.74
	Rural Multilane			
MRU	Undivided	364	996	0.37
MRD	Divided	58	75	0.77
	Urban and Suburban Arterials			
U2U	2-lane undivided	377	610	0.62
U3T	3-lane with TWLTL	215	267	0.81
U4D	4-lane divided	161	114	1.411
U4U	4-lane undivided	506	803	0.63
U5T	5-lane with TWLTL	772	1214	0.64
INTERSECTIONS				
	Rural Two-Lane			
R3ST	3-leg, minor STOP	108	344	0.31
R4ST	4-leg, minor STOP	204	655	0.31
R4SG	4-leg, signalized	142	318	0.45
	Rural Multilane			
MR3ST	3-leg, minor STOP	37	239	0.15
MR4ST	4-leg, minor STOP	178	455	0.39
MR4SG	4-leg, signalized	157	1053	0.15
	Urban and Suburban Arterials			
U3ST	3-leg, minor STOP	103	291	0.35
U4ST	4-leg, minor STOP	105	231	0.45
U3SG	3-leg, signalized	321	439	0.73
U4SG	4-leg, signalized	690	654	1.05

1 Use with caution (see discussion in text). If using the SPFs to evaluate future facilities use calibration factor of 0.64

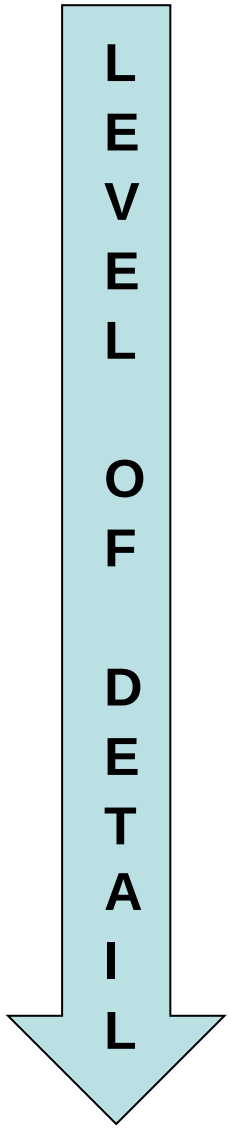
New Safety Analysis Tools

- HSM predictive method
  - Highway Safety Manual Spreadsheets
  - Interactive Highway Safety Design Model (IHSDM)
  - HiSafe
- PlanSafe
- SSAM (Surrogate Safety Analysis Method/Model)



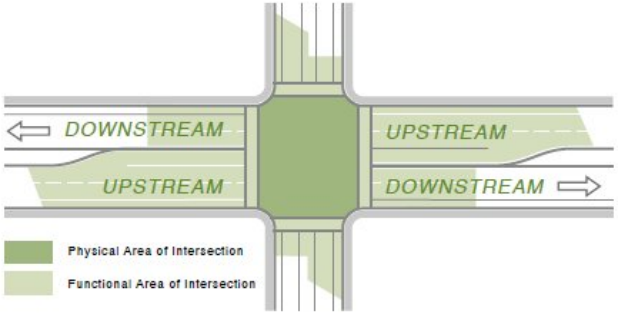
Level of Detail in Safety Analysis

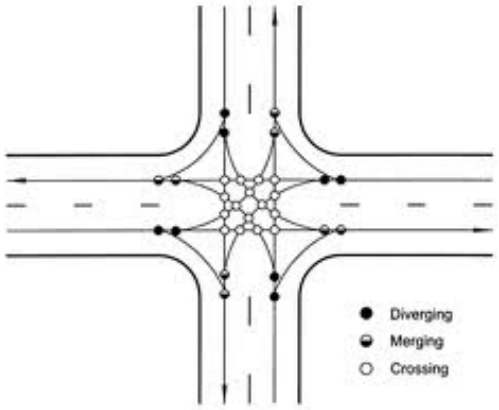
- TSPs – least detailed
  - Identify safety priority locations for further review
  - Predictive analysis generally not appropriate
- Refinement plans and NEPA project development - mid-range detail
  - Predictive analysis appropriate for identified safety priority locations
- Design and Traffic approvals - highest level of detail
  - Collision diagrams, benefit/cost ratios
  - Design of countermeasures



Other Safety Analysis Methods

- Functional Area of an Intersection
- Sight Distance
- Conflict Points
- Access Management
- Turn Lane Criteria
- Traffic Control
- Multimodal Methods





Multimodal - Pedestrian and Bicyclist Safety Analysis

- Crash rates and CMFs
  - Limited crash database
  - Not indicative of facilities avoided by peds and bikes

- User perception rating systems
  - Level of Traffic Stress
  - Multimodal Pedestrian and Bike Level of Service
- Guidance on specific multimodal safety issues, such as
  - NCHRP 562 - Improving Pedestrian Safety at Unsignalized Crossings [8]

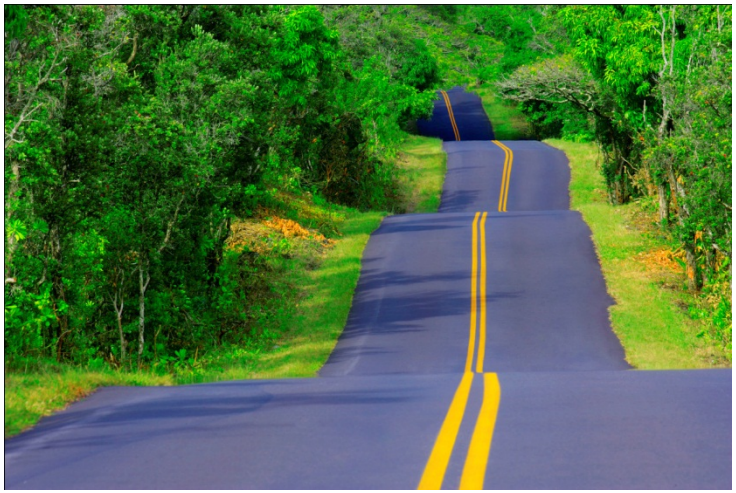
General Risk Factors for Pedestrians and Bicyclists

- Wide roadway/multiple lanes to cross
- Absence of or narrow buffers
- High speeds and volumes
- Complex intersections
- Absence of or narrow ped/ bike facilities/connectivity
  - Bike lanes
  - Sidewalks
  - Crossing islands

Multimodal Safety Countermeasures

- Sidewalk and bike lane improvements, buffers, off-street paths
- Curb extensions, pedestrian median islands, road diets
- Bike boxes, bike signals
- RRFB, HAWK signal, protected left turn phase
- ITS improvements

Project: Safety Evaluation in Planning and Project Development



Overview

- Comprehensive review and analysis of safety evaluation methods in planning and NEPA – level projects
- Evaluate current and potential safety analysis methods not addressed in interim APM chapter update
- Expand procedures for safety analysis in planning and project work
- Document processes/tools and outreach to ODOT groups and consultants

Project Tasks

- ✓ Stakeholder Survey
- Review of Existing Tools
- Evaluation of Potential Tools
- Case Studies
  - –Planning
  - –TIA
  - –Project Development
- Documentation
- Outreach

Project Contacts

- TAC:
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  - Nick Fortey, FHWA
  - Lidwien Rahman, Rg 1
  - Rod Cathcart, Rg 4
  - Dick Reynolds, TDD

- Contractor: DKS
  - John Bosket, Project Manager

Key ODOT Safety Analysis Resources

- Analysis Procedures Manual
- Highway Safety Program
- Highway Safety Manual (HSM) in Oregon
- Highway Design Manual
- Traffic Manual
- Oregon Traffic Safety Division
- Crash Analysis and Reporting

Key National Safety Analysis Resources

- AASHTO Highway Safety Manual Home
- FHWA Safety Program
- Proven Safety Countermeasures
- FHWA Data and Safety Analysis Tools

References

1. APM V2 Chapter 4 - Safety
2. Critical Rate Calculator
3. Assessment of Statewide Intersection Safety Performance
4. Excess Proportion of Specific Crash Types Calculator
5. Crash Modification Factors Clearinghouse
6. Crash Modification Factors: Instructions
7. Calibrating The Highway Safety Manual Predictive Methods For Oregon Highways
8. Improving Pedestrian Safety at Unsignalized Crossings

Questions?