TRB 2022

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TRB 2022

Committee on Safety Performance and Analysis (ACS20)

Transportation Research Board Annual Meeting

Monday, January 10, 2022

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Introductions

TRB 2022

Welcome members, friends, guests, and students

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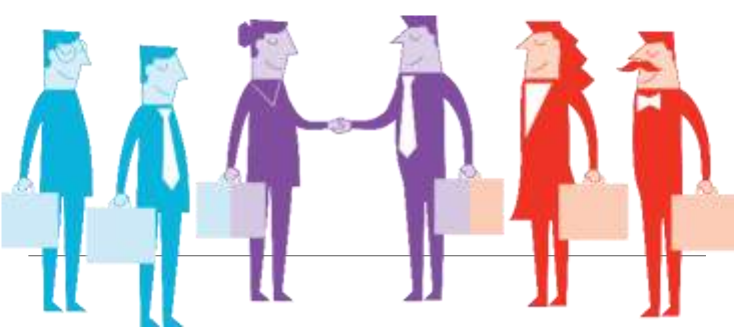
Welcome

TRB 2022



ANB20 Safety Data, Analysis, and Evaluation → **ACS20 Safety Performance Analysis** ← ANB25 Highway Safety Performance

SCAN ME

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Committee Scope

TRB 2022

This Committee fosters collection and innovative use of diverse safety data, and the development of new theories and analytical methods to advance the science of safety to meet the needs of future technologies and road users.

This Committee further promotes the application of these methods and supporting tools, and the institutionalization of science-based methods. In doing so, this Committee supports informed transportation decision-making and improves safety performance on the Nations' roadway infrastructure system, notably by reducing fatalities and injured persons caused by crashes.

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1:50 **Second Edition of AASHTO Highway Safety Manual and Related NCHRP Research**

Update on NCHRP 17-71A, Proposed AASHTO Highway Safety Manual (HSM) Second Edition, Stephen Read and Darren Torbic (20 minutes)

Update on NCHRP Research related to the update of the HSM (10 Minutes each)

- NCHRP 17-81, Proposed Macro-Level Safety Planning Analysis Chapter for the Highway Safety Manual, Ian Hamilton
- NCHRP 17-84, Pedestrian and Bicycle Safety Performance Functions for the Highway Safety Manual, Darren Torbic
- NCHRP 17-89A, HOV/HOT Freeway Crash Prediction Method for the Highway Safety Manual, Scott Himes

Bringing Research into Practical Approaches — Stephen Read, Bonnie Polin

3:00 Update on other National Efforts

- NCHRP 17-89, Safety Performance of Part-Time Shoulder Use on Freeways, Pete Jenior (10 minutes)
- Other efforts?

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Updated on NCHRP 17-71A

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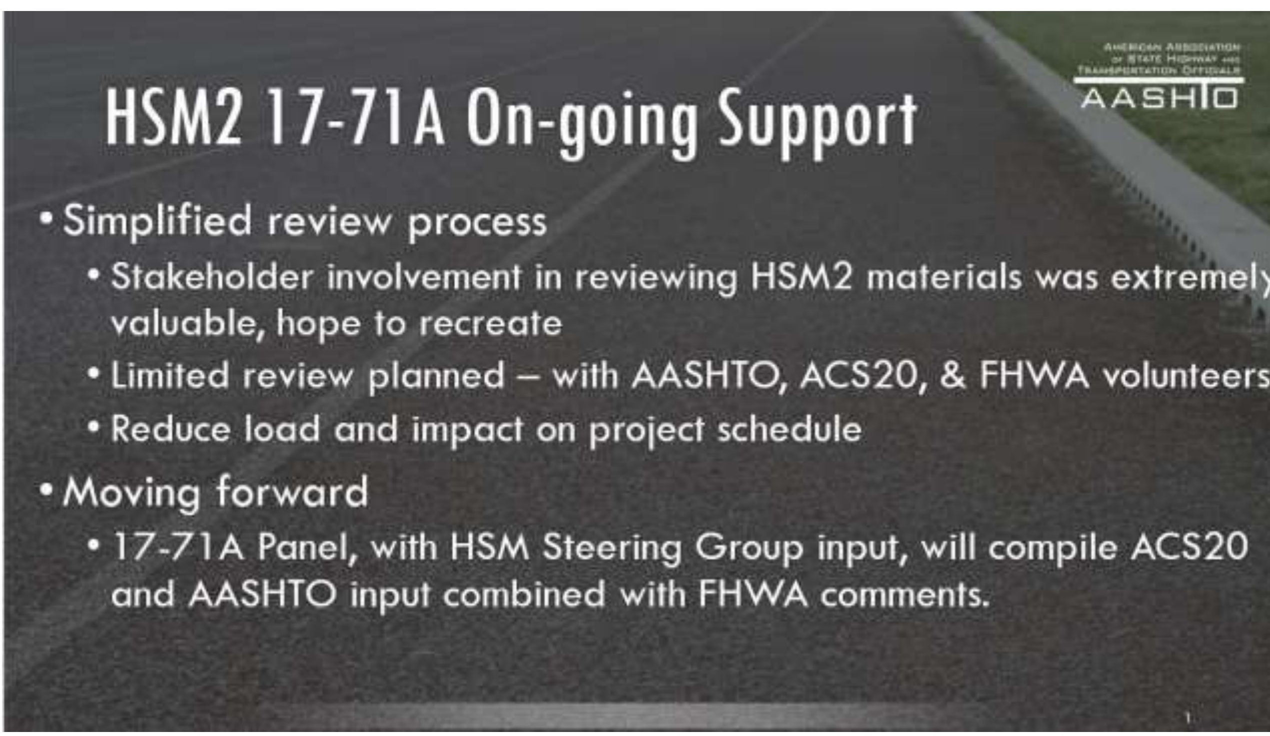

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NCHRP Project 17-71A

Proposed AASHTO Highway Safety Manual, Second Edition

TRB Annual Meeting
January 2022

Texas A&M Transportation Institute

FDR

Exponent

Harwood Road Safety, LLC

Mr. Brelend C. Gowan

Ogle Research, LLC

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Project Objective

- Complete work initiated as part of NCHRP Project 17-71 to develop and prepare a proposed HSM2 in a format suitable for adoption as an AASHTO publication
  - Proposed HSM2 will synthesize and incorporate relevant ongoing and completed research including completed NCHRP Project 17-71 deliverables, related documents, and user feedback to expand the scope and quality of HSM2 to increase application and improve its usability

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The HSM2 Will…

- **Expand** upon the methodologies in HSM1
- **Incorporate** new models and research completed since HSM1
- **Modify** practices based on user experiences and needs

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Research Approach to NCHRP 17-71A

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Research Approach

PHASE I—ASSEMBLE RESOURCES AND PLAN PROJECT (completed)

- Task 1—Kick-off Meeting and Project Management
- Task 2—Review Materials from NCHRP Project 17-71
- Task 3—Assess Research for Potential Incorporation into HSM2
- Task 4—Develop Glossary of Terms and Phrases to be Used and Avoided in HSM2
- Task 5—Prepare Interim Report

PHASE II—PRODUCE PROPOSED HSM2

- Task 6—Execute Approved Phase II Work Plan **(currently executing)**
- Task 7—Prepare Project Deliverables

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Outline of HSM2 and What's New

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Outline of HSM2

HSM2 (Ch.)	HSM1 (Ch.)	Chapter Title
		Preface
1	1	Introduction and Overview to the Highway Safety Manual
Part A- Fundamentals		
		Introduction to Part A
2	3	Road Safety Principles **(Previously titled "Fundamentals")**
3	2	Human Factors
4		**Pedestrians and Bicyclists (NEW)**
Part B – Roadway Safety Management Process		
		Introduction to Part B
5		**Areawide Planning (NEW) (NCHRP Project 17-81: Macro-Level Safety Planning)**
6	4	Network Screening
7	5	Diagnosis
8	6	Countermeasure Selection
9	7	Economic Appraisal
10	8	Project Prioritization
11	9	Safety Effectiveness Evaluation
12		**Systemic Safety Management (NEW)**
Part C – Predictive Method		
		Introduction to Part C
13		**Developing, Calibrating, & Using Safety Performance Functions and Crash Prediction Models (NEW)**
14	10	Predictive Method for Rural Two-Lane, Two-Way Roads
15	11	Predictive Method for Rural Multilane Highways
16	12	Predictive Method for Urban and Suburban Arterials
17	18	Predictive Method for Freeways
18	19	Predictive Method for Ramps
Part D – Crash Modification Factors		
		Introduction to Part D
19		**Selecting Crash Modification Factors (NEW)**
20		**Applying Crash Modification Factors (NEW)**
		Glossary (Applicable to all Parts)

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New NCHRP Research

- 17-50: Lead States Initiative for Implementing the HSM
- 17-58: CPMs for Six-Lane and One-Way Urban and Suburban Arterials
- 17-62: Improved Prediction Models for Crash Types & Severities
- 17-63: Guidance for the Development and Application of CMFs
- 17-68: Intersection Crash Prediction Methods for the HSM
- 17-70: Development of Roundabout CPMs and Methods
- 17-71: Proposed AASHTO Highway Safety Manual, 2nd Edition
- 17-72: Update of Crash Modification Factors
- 17-73: Systemic Pedestrian Safety Analyses
- 17-77: Guide for Quantitative Approaches to Systemic Safety Analysis
- 17-78: Understanding and Communicating Reliability of CPMs
- 17-81: Proposed Macro-Level Safety Planning Analysis Chapter for HSM
- 17-83: Briefings and Training Materials for Implementation
- 17-84: Pedestrian and Bicycle Safety Performance Functions for the HSM
- 17-89: Safety Performance of Part-Time Shoulder Use on Freeways
- 17-89A: HOV/HOT Freeway CPMs for HSM

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Potential Updates to Part C Predictive Methods

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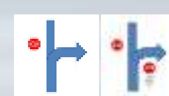
Ch 14. Predictive Method for Rural Two-Lane, Two-Way Roads (Facility Types)

Roadway segments:

- 2-lane undivided (2U) [1]

Intersections:

- 3-leg minor-road stop control (3ST) [1]
- **3-leg turning (3STT)**
- **3-leg signal control (3SG)** [1]
- 4-leg minor-road stop control (4ST) [1]
- **4-leg all-way stop control (4aST)**
- 4-leg signal control (4SG) [1]



3-leg turning configuration (3STT)

Black Font: Facility types addressed in HSM1
Red Font (Bold): New facility types planned for HSM2
[1] Pedestrian & bicycle crashes: Predictive method without EB approach

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Ch 15. Predictive Method for Rural Multilane Highways (Facility Types)

Roadway segments:

- 4-lane undivided (4U) [1]
- 4-lane divided (4D) [1]

Intersections:

- 3-leg minor-road stop control (3ST) [1]
- **3-leg signal control (3SG)** [1]
- 4-leg minor-road stop control (4ST) [1]
- 4-leg signal control (4SG) [1]

Black Font: Facility types addressed in HSM1
Red Font (Bold): New facility types planned for HSM2
[1] Pedestrian & bicycle crashes: Predictive method without EB approach

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Ch 16. Predictive Method for Urban and Suburban Arterials (Facility Types – Roadway Segments)

Roadway segments:

- 2-lane undivided (2U) [1,2]
- 3-lane with center TWLTL (3T) [1]
- 4-lane undivided (4U) [1,2]
- 4-lane divided (4D) [1,2]
- 5-lane with center TWLTL (5T) [1]
- **6-lane undivided (6U)** [1]
- **6-lane divided (6D)** [1]
- **7-lane with center TWLTL (7T)** [1]
- **8-lane divided (8D)** [1]
- **2-lane one-way (2O)**
- **3-lane one-way (3O)**
- **4-lane one-way (4O)**

Black Font: Facility types addressed in HSM1
Red Font (Bold): New facility types planned for HSM2
[1] Pedestrian & bicycle crashes: Predictive method without EB approach
[2] Pedestrian & bicycle crashes: Predictive method with EB approach

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Ch 16. Predictive Method for Urban and Suburban Arterials (Facility Types – Intersections)

3-Leg Intersections:
- Minor-road stop control (3ST)
  - 2 × 2 (with 5 or fewer lanes) [1,2]
  - **2 × 2 (with 6 or more lanes) [1]**
  - **1 × 1**
  - **1 × 2**
- **Minor-road stop control – high speed (3ST-HS) [1]**
- **All-way stop control (3aST)**
- **Turning (3STT)**
- Signal control (3SG)
  - 2 × 2 (with 5 or fewer lanes) [1,2]
  - **2 × 2 (with 6 or more lanes) [1]**
  - **1 × 1**
  - **1 × 2**
  - 2 × 2 (pedestrian crashes)
- **Signal control – high speed (3SG-HS) [1]**
- **Single-lane roundabout (31R)**
- **Two-lane roundabout (32R)**

4-Leg Intersections:
- Minor-road stop control (4ST)
  - 2 × 2 (with 5 or fewer lanes) [1,2]
  - **2 × 2 (with 6 or more lanes) [1]**
  - **1 × 1**
  - **1 × 2**
- **Minor-road stop control – high speed (4ST-HS) [1]**
- **All-way stop control (4aST)**
- Signal control (4SG)
  - 2 × 2 (with 5 or fewer lanes) [1,2]
  - **2 × 2 (with 6 or more lanes) [1,2]**
  - **1 × 1**
  - **1 × 2**
  - 2 × 2 (pedestrian crashes)
- **Signal control – high speed (4SG-HS) [1]**
- **Single-lane roundabout (41R)**
- **Two-lane roundabout (42R)**

5-Leg Intersections:
- **Signal control (5SG)**

Black Font: Facility types addressed in HSM1; Red Font (Bold): New facility types planned for HSM2

[1] Pedestrian & bicycle crashes: Predictive method without EB approach; [2] Pedestrian & bicycle crashes: Predictive method with EB approach

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Ch 17. Predictive Method for Freeways (Facility Types)

Freeways and speed change lanes:

- Rural
  - 4-lane
  - 6-lane
  - 8-lane
- Urban
  - 4-lane **(PTSU; HOV/HOT)**
  - 6-lane **(PTSU; HOV/HOT)**
  - 8-lane **(PTSU; HOV/HOT)**
  - 10-lane **(PTSU; HOV/HOT)**

Note: Part-time shoulder use (PTSU) lane
High occupancy vehicle (HOV) lane
High occupancy toll (HOT) lane

Black Font: Facility types addressed in HSM1
Red Font (Bold): New facility types planned for HSM2

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Ch 18. Predictive Method for Ramps (Facility Types)

HSM
Highway Safety Manual

Ramp segments:

- Rural
  - 1-lane entrance (1EN)
  - 1-lane exit (1EX)
- Urban
  - 1-lane entrance (1EN)
  - 1-lane exit (1EX)
  - 2-lane entrance (2EN)
  - 2-lane exit (2EX)

Ramp terminals:

- 3-leg terminals with diagonal entrance ramp (D3en)
- 3-leg terminals with diagonal exit ramp (D3ex)
- 4-leg terminals with diagonal ramps (D4)
- 4-leg terminals at four-quadrant partial cloverleaf A (A4)
- 4-leg terminals at four-quadrant partial cloverleaf B (B4)
- 3-leg terminals at two-quadrant partial cloverleaf A (A2)
- 3-leg terminals at two-quadrant partial cloverleaf B (B2)
- **Single-point diamond interchanges (SP)**
- **Tight diamond interchanges (TD)**

Black Font: Facility types addressed in HSM1
Red Font (Bold): New facility types planned for HSM2

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Schedule

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Task 6 – Submission and Review Schedule

HSM2 Chapter	Short Title	Individual Chapter Drafts					Full Draft (all chapters)
		Submit for Review and Comments					
		(11/31/21)	(2/28/22)	(6/30/22)	(10/31/22)	(2/28/23)	(5/31/23)
	Preface	X					X
Chapter 1	Intro & Overview		X				X
Part A—Fundamentals							
	Introduction		X				X
Chapter 2	Road Safety Principles			X			X
Chapter 3	Human Factors			X			X
Chapter 4	Peds & Bikes				X		X
Part B—Roadway Safety Management Process							
	Introduction	X					X
Chapter 5	Areawide Planning		X				X
Chapter 6	Network Screening			X			X
Chapter 7	Diagnosis				X		X
Chapter 8	Countermeasure Selection				X		X
Chapter 9	Economic Appraisal	X					X
Chapter 10	Project Prioritization	X					X
Chapter 11	Effectiveness Evaluation			X			X
Chapter 12	Systemic Safety Mgt				X		X
Part C—Predictive Method							
	Introduction		X				X
Chapter 13	Calibration and EB			X			X
Chapter 14	Rural Two-Lane				X		X
Chapter 15	Rural Multilane			X			X
Chapter 16	Urb/Sub Arterials					X	X
Chapter 17	Freeways					X	X
Chapter 18	Ramps		X				X
Part D—Crash Modification Factors							
	Introduction	X					X
Chapter 19	Selecting CMFs		X				X
Chapter 20	Applying CMFs			X			X

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Task 7: Schedule

- Submit draft project deliverables, including draft HSM2
  - End of October 2023
- Submit final project deliverables, including proposed HSM2
  - End of January 2024
- Review, balloting, and publication by AASHTO
  - To be determined

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Questions???

Darren Torbic, Ph.D.
Research Scientist
Texas A&M Transportation Institute
d-torbic@tti.tamu.edu
814-574-9194

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Proposed Macro-Level Safety Planning Analysis Chapter for the Highway Safety Manual (NCHRP 17-81)

Research Team

Persaud & Lyon	VHB	CIMA+
Bhagwant Persaud	R.J. Porter (PI)	Alireza Hadayeghi
Craig Lyon	Ian Hamilton	Soroush Salek
	Vikash Gayah	

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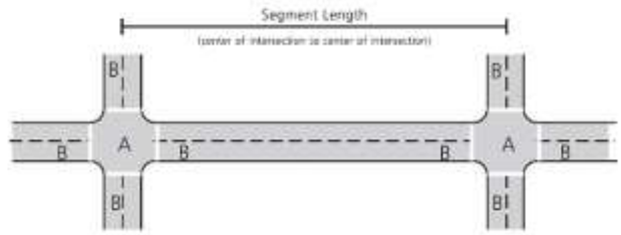
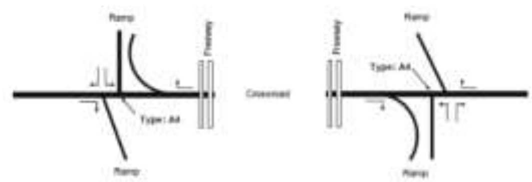
Background: Existing Highway Safety Manual (HSM) Crash Prediction Models (CPMs)

- Fundamental analysis unit of the HSM processes, procedures, and methods is a "site" (e.g., a specific segment, intersection, ramp, or ramp terminal).
- An HSM user can combine analyses of multiple sites into a facility-level analysis (e.g., freeway facility with multiple interchanges).





c. Four-Leg Ramp Terminal at Four-Quadrant Parclo A (A4)

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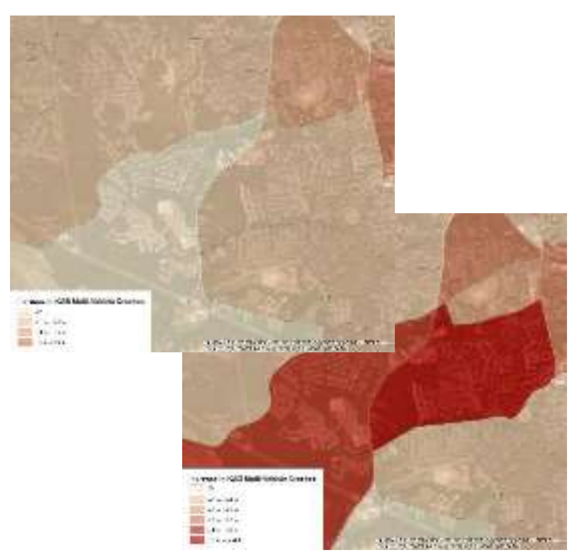
Background: Macro-Level CPMs

- Predict average crash frequency, by crash type and severity, for a defined area, such as a census tract, traffic analysis zone, or county.
- Predictor variables for macro-level models characterize the broader area for which the models apply:
  - Area type classifications and geography
  - Socioeconomics
  - Land use
  - Presence/type/extent of multimodal transportation infrastructure
  - Area-wide operational characteristics and strategies



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NCHRP 17-81 Research Objectives

- Develop and validate quantitative macro-level crash prediction models and demonstrate their use.
  - Including simple-to-use electronic analysis tool and user guide.
- Prepare quantitative safety planning chapter for the HSM.
  - User guide and HSM chapter will describe how to apply and interpret models and ways to integrate models into planning activities.
- Develop a tool to assist practitioners and promote the use of macro-level crash prediction models.

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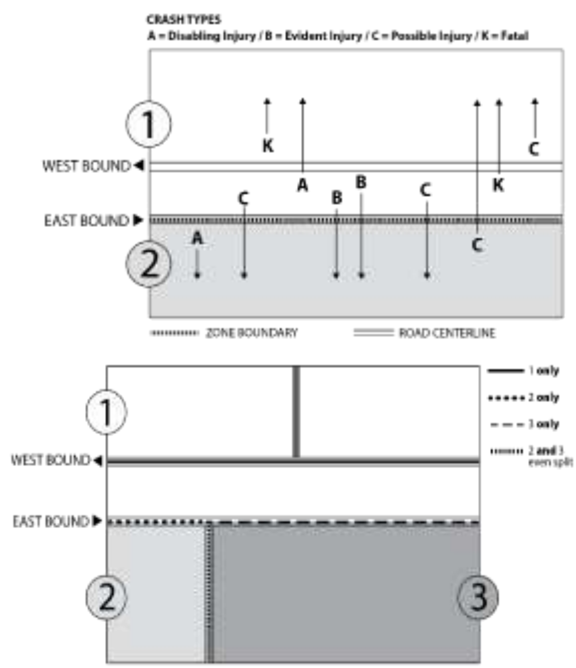
Data Development

- Assignment scheme acknowledges that boundary roads are a product of both adjoining zones.
  - Crashes are assigned randomly, evenly to each zone.
  - Road data (i.e., vehicle miles traveled - VMT) are split between boundary zones.
- Avoiding duplicate data lends analysis to target setting.
  - Allows users to aggregate zones to larger geographies (e.g., counties).
- Integration produces a trivial amount of "error."
  - No more than 1 or 2% of baseline conditions.



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Final CPMs

- Developed separate CPMs according to:
  - Jurisdiction: State, MPO
  - Crash Type: total crashes, bicycle/pedestrian crashes
  - Crash Severity: fatal crash (K), fatal and serious injury crash (KA), fatal and injury crash (KABC), and total crash (KABCO)

Example model structure:

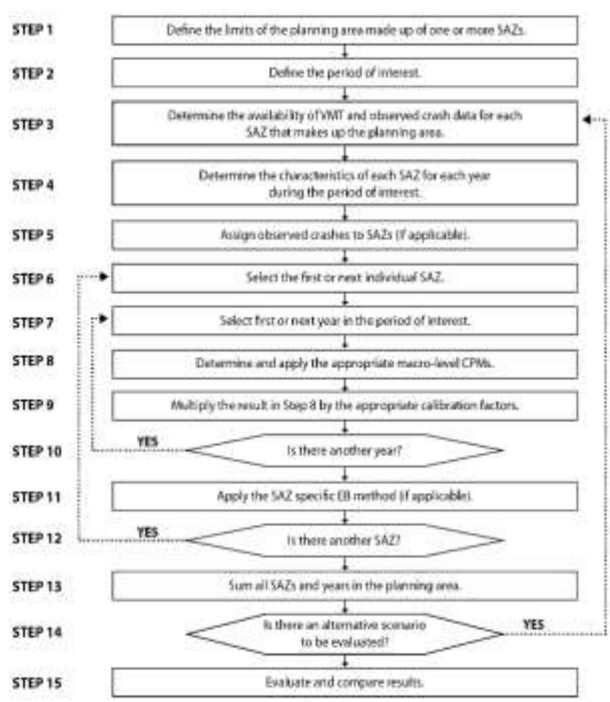
$N_{p,BG,\ MPO,\ y,\ z} = \exp(a + b * \ln(VMT) + c * (INC_{MED} / 1{,}000) + d * INT + e * AREA_{INV} + f * TRANSIT_{DENS} + g * COMM_{nonmot} + h * \ln(POP + EMP)) \times C_{BG,\ MPO,\ y,\ z}$

$N_{p,\ y,\ z,\ BG,\ MPO}$ = predicted average annual crash frequency for a census block group that is part of a planning area inside of MPO boundaries for crash type y and severity z (crashes/year);

- y: at = all types, bp = bicycle and pedestrian
- z: f = fatal, fsi = fatal and suspected serious injury, fi = fatal and all injury, as = all severities

HSM Chapter

- Draft chapter for future edition of HSM.
- Chapter provides context for quantitative safety planning in addition to a step-by-step walkthrough of CPMs.
  - Use and development will likely evolve over time; this is only beginning of a formal approach.
- Will coordinate with HSM2 panel/project team during draft review.



Electronic Tool & User Guide

- Developed spreadsheet tool to assist users in applying macro-level CPMs.
  - Like other predictive HSM spreadsheets: http://www.highwaysafetymanual.org/Pages/Tools.aspx
- Base tab
  - Assess existing conditions
- Alternative tab
  - Assess alternative scenario

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FAQ

- How and why were boundaries handled the way they were (i.e., Modifiable Area Unit Problem – MAUP – etc.)?
  - Keep it simple, repeatable while acknowledging reality on the ground.
  - Preliminary investigation showed minimal differences between schemes.
  - Consistent results across agencies in final models.
  - Subsequent analysis shows similar results using different zone types.
- Why choose Census block groups for this effort?
  - Consistent (and nested) geographic definitions.
  - Consistent data definitions.
  - Publicly available and easily accessible.
  - Existing component of transportation planning practice (i.e., Census informs agencies' travel demand model process).

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FAQ

- Do we have to use Census block groups?
  - No.
  - Concept of safety analysis zone (SAZ) introduced, allow for different zone sizes/types.
  - Different geographies appropriate for different purposes.
- How does this integrate with existing practice?
  - Planning-level models to support safety in the planning process.
  - Serve to inform safety before design details (i.e., HSM1 methods) are known.
  - Best applied in areas where people live, work, and play.
  - Use data readily available, estimate-able by agencies in travel demand/forecasting.
  - Southern California effort using TAZs and activity-based model data to predict.

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FAQ

- What next?
  - Incorporate chapter into HSM2.
  - Spreadsheet tool intended to match existing HSM tools.
  - Models readily integratable into existing safety management system applications.
  - Foundational guidance, but application of these models can be as varied and diverse as existing HSM methods.
    - “Network screening.”
    - Target setting.
    - Scenario planning.
    - Major projects and investments.
  - Open to future research (i.e., what can we do, what works?)

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Thank you

R.J. Porter | rporter@vhb.com | 919.741.5566
Ian Hamilton | ihamilton@vhb.com | 919.741.5401

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MRIGlobal
National Solutions Worldwide Impact

Pedestrian and Bicycle Safety Performance Functions for the Highway Safety Manual (NCHRP 17-84)

Research Team

MRIGlobal | Larson Institute | SafeTREC | Abley, NZ

Texas A&M Transportation Institute

Transportation Research Center

1/17/2022

Defense Energy Health

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Research Objective and Scope

- **Objective**
  - Develop pedestrian and bicycle SPFs for transportation practitioners at all levels to better inform planning, design, and operations decisions
- **Scope**
  - Plan to develop pedestrian and bicycle SPFs for:
    - Roadway segments and intersections
    - Rural and urban areas

Primary Work Plans

- **Work Plan A** – Develop Pedestrian and Bicycle SPFs using Available Exposure Data
- **Work Plan B** – Develop and Test an Alternative Approach to Pedestrian and Bicycle Crash Prediction based on RAP
- **Work Plan C** – Develop Probability of Pedestrian and Bicycle Crashes Based on Crash Data in the Absence of Pedestrian and Bicycle Volume Data

Work Plan A – Develop Pedestrian and Bicycle SPFs using Available Exposure Data

- Focused on developing pedestrian and bicycle SPFs for roadway segments and intersections in urban/suburban areas, for which exposure, crash, and inventory data were available
- Collected inventory, traffic volume, pedestrian and bicycle volume, and crash data in two urban/suburban areas:
  - Minneapolis (MN)
    - Database includes up to 13 yrs of data (2006 – 2018)
  - Philadelphia (PA)
    - Database included up to 5 yrs of data (2014 – 2018)
- Developed direct demand models to estimate pedestrian and bicycle volumes on individual roadway segments as function of demographic variables, segment characteristics, and other metrics associated with built environment

Work Plan A – Develop Pedestrian and Bicycle SPFs using Available Exposure Data

General Segment Elements

- Presence of lighting
- Posted speed limit
- Median type
- Median width
- Number of driveways
- Number of bus stops
- Presence of traffic calming

Directional Elements

- Number of travel lanes
- Width of travel lanes
- Shoulder width
- Parking lane width
- Bicycle facility types
  - Type of protection
  - Buffer width
  - Lane width
  - One-way vs two-way
  - Colored pavement
- Shared use path
  - Path width
  - Buffer width
- Sidewalks
  - Width
  - Buffer width
  - Type of protection
- Midblock Crossings
  - Control type
  - Advanced yield/stop lines
  - Crossing length

Work Plan A – Develop Pedestrian and Bicycle SPFs using Available Exposure Data

General Intersection Elements

- Number of legs
- Control type
- Lighting
- Overhead flashing beacon
- School zone
- Alcohol establishments
- Number of bus stops

Elements by Approach (Inbound and Outbound)

- Width of through lanes
- Width of left-turn lanes
- Width right-turn lanes
- Presence of right-turn channelizing islands
- Parking lane width
- Outside shoulder width
- Inside shoulder width
- Median type / width
- Bike lane width / buffer width
- Type of left-turn or right-turn operations
- Presence of colored pavement for bike lanes
- Presence of bike box
- Presence of crosswalk
- Crosswalk type
- Total crosswalk length
- Presence of median refuge island
- Presence of shared-use path crossing
- Presence of advance yield/stop lines
- Posted speed limit

Work Plan A – Develop Pedestrian and Bicycle SPFs using Available Exposure Data (Summary)

Roadway segments:

Number of Sites, Miles, and Total Mile Years by Road Type

Road Type	Minneapolis			Philadelphia			Total		
	Number of Sites	Miles	Total Mile Years	Number of Sites	Miles	Total Mile Years	Number of Sites	Miles	Total Mile Years
2U	651	65.32	568.87	706	48.76	278.54	1357	114.08	847.41
4U	290	23.91	268.44	60	3.91	23.48	350	27.82	291.92
4D	44	4.98	56.27	48	6.19	34.33	92	11.17	90.60
1-ln one-way	48	4.33	44.29	167	7.20	43.11	215	11.53	87.40
2-ln one-way	115	10.74	78.25	137	9.48	44.47	252	20.22	122.72
3-ln one-way	151	11.93	106.15	32	2.04	11.95	183	13.97	118.10

Work Plan A – Develop Pedestrian and Bicycle SPFs using Available Exposure Data (Summary)

Intersections:

Number of Sites and Site Years by Intersection Configuration

Intersection Configuration	Minneapolis		Philadelphia		Total	
	Number of Intersections	Site Years	Number of Intersections	Site Years	Number of Intersections	Site Years
3ST (2×2)	14	73	15	85	29	158
3SG (2×2)	12	86	20	117	32	203
4ST (2×2)	10	42	1	3	11	45
4SG (2×2)	84	441	43	204	127	645
4SG (2×1)	58	259	11	54	69	313

NOTE: The number at the beginning of the abbreviation indicates the number of legs (i.e., 3 or 4). ST represent two-way STOP control and SG represents signal control. Intersection configurations ending with (2×1) indicates an intersection between a two-way and a one-way roadway; (2×2) indicates an intersection between two two-way roadways.

Work Plan A – Develop Pedestrian and Bicycle SPFs using Available Exposure Data (Methodology)

- Negative binomial regression
  - Segment form

$$N_{spf} = \mathrm{AADT}^{\beta_{AADT}} \times \mathrm{AADT}_{\mathrm{m}}^{\beta_{AADT_m}} \times L \times e^{\boldsymbol{\beta X}}$$

  - Intersection form

$$N_{spf} = \mathrm{AADT}_{\mathrm{ent}}^{\beta_{AADT_{ent}}} \times \mathrm{AADT}_{\mathrm{m,ent}}^{\beta_{AADT_{m,ent}}} \times e^{\boldsymbol{\beta X}}$$

AADT – traffic volume (veh/day)

$\mathrm{AADT}_{\mathrm{ent}}$ - traffic volume entering intersection (veh/day)

$\mathrm{AADT}_{\mathrm{m}}$ – non-motorized traffic volume (veh/day)

$\mathrm{AADT}_{\mathrm{m,ent}}$ – non-motorized traffic volume entering intersection (veh/day)

L – segment length

$\boldsymbol{X}$ – other candidate independent variables

Work Plan A – Develop Pedestrian and Bicycle SPFs using Available Exposure Data (two-lane roadway segments)

	Ped Total (red)		Ped Total (exp)		Ped KA	
Variable	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Constant	-5.328	<0.001	-2.891	0.014	-7.115	0.06
Natural log of average traffic volume in segment (veh/day)	0.331	0.005	0.175	0.136	0.164	0.67
Natural log of average pedestrian volume (peds/day)	0.255	0.004	0.209	0.022	0.397	0.135
Indicator for sidewalk buffer greater than 0 ft	---	---	-0.557	<0.001	---	---
Indicator for sidewalk presence on both sides of the road	---	---	2.266	<0.001	---	---
Average lane width	---	---	-0.038	0.006	---	---
Indicator for one or more bus stops along roadway segment	---	---	0.347	0.003	---	---
Indicator for roadway segment within Pennsylvania	0.466	<0.001	0.0197	0.096	0.12	0.768
Inverse of overdispersion parameter	0.707		1.319		0.131	
2xLog-likelihood at convergence	-2237.13		-2124.685		-332.911	
Total number of crashes	413		413		33	
Total number of observations	2027		2027		2027	

	Bike Total (red)		Bike Total (exp)		Bike KA	
Variable	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Constant	-9.287	<0.001	-8.468	<0.001	0.788	0.941
Natural log of average traffic volume in segment (veh/day)	0.555	0.005	0.52	0.009	0.071	0.945
Natural log of average bicycle volume (bicycles/day)	0.431	0.005	0.47	0.002	-1.249	0.211
Indicator for presence of a buffered bike lane on one or more sides	---	---	-1.091	0.3	---	---
Average lane width	---	---	-0.051	0.029	---	---
Indicator for roadway segment within Pennsylvania	0.352	0.09	0.219	0.306	-0.566	0.635
Inverse of overdispersion parameter	0.334		0.334		17	
2xLog-likelihood at convergence	-1101.862		-1095.968		-57.187	
Total number of crashes	157		157		4	
Total number of observations	2027		2027		2027	

Work Plan A – Develop Pedestrian and Bicycle SPFs using Available Exposure Data (four-lane urban segments)

	Ped Total (red)		Ped Total (exp)		Ped KA (red)	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Constant	-11.092	<0.001	-10.495	0.001	-26.754	<0.001
Natural log of average traffic volume in segment (veh/day)	0.899	0.005	0.897	0.004	2.147	<0.001
Natural log of average pedestrian volume (peds/day)	0.233	0.077	0.243	0.067	0.634	0.001
Indicator for a divided roadway	-1.291	<0.001	-1.423	<0.001	-0.336	0.547
Indicator for speed limit greater than 25 mph	---	---	-0.688	0.0612	---	---
Indicator for roadway segment within Pennsylvania	0.192	0.618	-0.28	0.54	-0.458	0.554
Inverse of overdispersion parameter	0.541		0.531		0.428	
2xLog-likelihood at convergence	-541.046		-538.025		-230.996	
Total number of crashes	113		113		39	
Total number of observations	550		550		550	

	Bike Total (red)		Bike Total (exp)		Bike KA (red)	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Constant	-14.86	<0.001	-14.832	<0.001	-19.085	0.033
Natural log of average traffic volume in segment (veh/day)	1.001	<0.001	0.99	0.001	0.302	0.711
Natural log of average bicycle volume (bicycles/day)	0.659	0.006	0.768	0.002	2.041	0.003
Indicator for a divided roadway	-0.726	0.023	-0.805	0.013	-0.351	0.706
Indicator for speed limit greater than 25 mph	---	---	-0.539	0.231	---	---
Indicator for roadway segment within Pennsylvania	0.694	0.093	0.423	0.367	1.162	0.405
Inverse of overdispersion parameter	0.886		0.902		0.331	
2xLog-likelihood at convergence	-551.676		-550.234		-99.752	
Total number of crashes	118		118		12	
Total number of observations	550		550		550	

Work Plan A – Develop Pedestrian and Bicycle SPFs using Available Exposure Data (one-way segments)

	Ped Total (red)		Ped Total (exp)	
Variable	Coefficient	P-value	Coefficient	P-value
Constant	-10.289	<0.001	-9.35	<0.001
Natural log of average traffic volume in segment (veh/day)	0.827	<0.001	0.871	<0.001
Natural log of average pedestrian volume (peds/day)	0.282	<0.001	0.219	0.001
Indicator for sidewalk buffer greater than 0 ft	---	---	-0.587	0.009
Indicator for speed limit greater than 25 mph	---	---	-0.322	0.317
Average lane width	---	---	-0.051	0.108
Indicator for one or more bus stops along roadway segment	---	---	0.376	0.11
Indicator for two-lane roadway	-0.475	0.086	-0.326	0.326
Indicator for three-lane roadway	-0.658	0.044	-0.549	0.174
Indicator for roadway segment within Pennsylvania	0.604	0.005	0.317	0.183
Inverse of overdispersion parameter	0.729		0.778	
2xLog-likelihood at convergence	-761.131		-747.474	
Total number of crashes	129		129	
Total number of observations	982		982	

	Bike Total (red)		Bike Total (exp)	
Variable	Coefficient	P-value	Coefficient	P-value
Constant	-10.948	<0.001	-10.822	<0.001
Natural log of average traffic volume in segment (veh/day)	0.489	0.043	0.477	0.048
Natural log of average bicycle volume (bicycles/day)	0.788	<0.001	0.791	<0.001
Indicator for speed limit greater than 25 mph	---	---	-0.329	0.358
Indicator for two-lane roadway	-0.703	0.024	-0.576	0.089
Indicator for three-lane roadway	-0.333	0.316	-0.088	0.835
Indicator for roadway segment within Pennsylvania	0.543	0.04	0.419	0.154
Inverse of overdispersion parameter	381		443	
2xLog-likelihood at convergence	-531.263		-530.423	
Total number of crashes	80		80	
Total number of observations	982		982	
NB model may not be appropriate				

Work Plan A – Develop Pedestrian and Bicycle SPFs using Available Exposure Data (3,4-leg stop controlled intersections, 2×2)

	Ped Total	
Variable	Coefficient	P-value
Constant	-71.524	0.058
Natural log of entering traffic volume in segment (veh/day)	5.677	0.1
Natural log of entering pedestrian volume (bikes/day)	2.52	0.128
Indicator for four-leg intersection	-1.354	0.403
Indicator for roadway segment within Pennsylvania	-26.426	0.998
Inverse of overdispersion parameter	6981	
2xLog-likelihood at convergence	-12.92	
Total number of crashes	4	
Total number of observations	37	

	Bike Total	
Variable	Coefficient	P-value
Constant	-48.831	0.006
Natural log of entering traffic volume in segment (veh/day)	1.814	0.171
Natural log of entering bicycle volume (bikes/day)	4.631	0.029
Indicator for four-leg intersection	-2.48	0.303
Indicator for roadway segment within Pennsylvania	2.096	0.449
Inverse of overdispersion parameter	16331	
2xLog-likelihood at convergence	-18.529	
Total number of crashes	8	
Total number of observations	37	

Work Plan A – Develop Pedestrian and Bicycle SPFs using Available Exposure Data (4-leg signalized intersections, 2×2)

	Ped Total	
Variable	**Coefficient**	**P-value**
Constant	-19.085	<0.001
Natural log of entering traffic volume in segment (veh/day)	1.518	<0.001
Natural log of entering pedestrian volume (bikes/day)	0.395	0.017
Indicator for roadway segment within Pennsylvania	1.201	<0.001
Inverse of overdispersion parameter	1.924	
2xLog-likelihood at convergence	-395.059	
Total number of crashes	206	
Total number of observations	127	

	Bike Total	
Variable	**Coefficient**	**P-value**
Constant	-11.949	<0.001
Natural log of entering traffic volume in segment (veh/day)	0.726	0.029
Natural log of entering bicycle volume (bikes/day)	0.488	0.073
Indicator for at least one bicycle facility entering intersection	-0.48	0.09
Indicator for roadway segment within Pennsylvania	-0.059	0.842
Inverse of overdispersion parameter	6.5	
2xLog-likelihood at convergence	-246.776	
Total number of crashes	76	
Total number of observations	127	

Work Plan A – Develop Pedestrian and Bicycle SPFs using Available Exposure Data [4-leg signalized intersections (2×1), 3-leg signalized intersections (2×2)]

	Ped Total	
Variable	**Coefficient**	**P-value**
Constant	-12.72	<0.001
Natural log of entering traffic volume in segment (veh/day)	0.981	<0.001
Natural log of entering pedestrian volume (peds/day)	0.080	0.311
Indicator for four-leg intersection [1 if 4SG (2×1); 0 if 3SG (2×2)]	1.000	0.003
Indicator for roadway segment within Pennsylvania	0.633	0.032
Inverse of overdispersion parameter	2.21	
2xLog-likelihood at convergence	-279.439	
Total number of crashes	114	
Total number of observations	104	

	Bike Total	
Variable	**Coefficient**	**P-value**
Constant	-8.644	0.055
Natural log of entering traffic volume in segment (veh/day)	0.379	0.365
Natural log of entering bicycle volume (bikes/day)	0.342	0.228
Indicator for four-leg intersection [1 if 4SG (2×1); 0 if 3SG (2×2)]	0.450	0.300
Indicator for roadway segment within Pennsylvania	0.154	0.709
Inverse of overdispersion parameter	1.55	
2xLog-likelihood at convergence	-186.646	
Total number of crashes	49	
Total number of observations	104	

Next Steps

- Complete Work Plan C
  - Develop final models for urban intersections
- Finish writing sections of draft final report
- Finalize spreadsheet tools
- Write draft HSM2 text

Draft HSM2 Text

- Initial thoughts and recommendations:
  - Incorporate exposure-only models from **Work Plan A** into network screening chapter
  - Incorporate **Work Plan B** models into Part C chapters
    - Rural 2-lane roads
    - Rural multilane highways
  - Incorporate **Work Plan A & B** models into Part C Chapter
    - Urban/suburban arterials
  - Incorporate **Work Plan C** results into new pedestrian and bicycle chapter

Schedule

- Submit draft final report and project deliverables (including draft text for HSM2)
  - February 2022
- Submit final report and other project deliverables (including draft text for HSM2)
  - May 27, 2022

Questions???

Darren Torbic
Research Scientist
Traffic Operations and Roadway Safety Division
Texas A&M Transportation Institute
d-torbic@tti.tamu.edu
814-574-9194

Texas A&M Transportation Institute

NCHRP Project 17-89A: HOV/HOT Freeway Crash Prediction Method for the Highway Safety Manual

Scott Himes, PhD, PE

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Project Purpose

- Develop a predictive method for freeway facilities with HOV/HOT lanes
  - Predict total crash frequency and multiple-vehicle crash frequency
  - Develop severity distribution functions to predict crash severity
  - Focus on directional freeway segments
- Develop proposed text for inclusion in the HSM
- Develop an implementation tool for the predictive method

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Applicable Freeways

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HOV and HOT lane design configurations and application frequency.

Lateral Separation	HOV and HOT Access Type	HOV and HOT Application Frequency by Lane Orientation [a, b]			
		Concurrent Lane	Separate Roadway	Reversible Lane	Contraflow Lane
Lane line	Continuous (dashed)	Often used; addressed by method	—	—	—
	At-grade entrance and exit zones	Often used; addressed by method	—	—	—
Flush buffer	Continuous (dashed)	Occasionally used	—	—	—
	At-grade entrance and exit zones	Often used; addressed by method	—	—	—
Pylon buffer	Grade-separated entrance and exit points	—	Often used	—	—
	At-grade entrance and exit zones	Often used; addressed by method	—	—	Often used
Barrier	Grade-separated entrance and exit points	—	Often used	Often used	—
	At-grade entrance and exit zones	Often used; addressed by method	—	Often used	Often used

[a] Predictive method addresses combinations associated with a cell having a white background.
[b] "—" identifies combinations not used (or rarely used).

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Data Needs Comparison to Existing Freeway Predictive Method

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SPF Adjustment Factor	Freeway Segments	Speed-Change Segments	Unique to this Method
Lateral separation and access type	✓	✓	✓
Freeway AADT	✓	✓	
Entrance or exit ramp AADT		✓	
Inside shoulder width	✓	✓	
Outside shoulder width	✓	✓	
Median width	✓	✓	
Median barrier	✓	✓	
Outside barrier	✓	✓	
Type C weaving section	✓		✓
Average speed differential	✓	✓	✓
High-volume hours	✓		✓
Number of HO lanes		✓	✓

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Data Needs for Assessing Crash Severity

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SPF Adjustment Factor	Freeway Segments	Speed-Change Segments
AADT	✓	✓
Posted speed limit	✓	✓
Number of GP lanes	✓	✓
HO lane access and separation type	✓	✓
Outside barrier	✓	✓
Median barrier	✓	✓
Outside barrier	✓	✓
Restriction period	✓	✓
Horizontal curvature	✓	✓
High-volume hours	✓	✓
Upstream entrance distance and AADT	✓	✓
Downstream exit distance and AADT	✓	✓

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Application Scope

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1. Applicable to Urban Freeways with Concurrent HO Lanes
2. Projects Adding HOV or HOT Lanes
3. Weaving Section Analysis
4. Alternative Cross Section Analysis
5. Not Applicable to Left-Side Ramps
6. Not Able to Predict HOV- or HOT-Related Crash Frequency

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Implementation Spreadsheet

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Segment 1 through Segment 20 contains input data for:

crash frequency and severity models for basic freeway segments

Entrance and exit speed-change lanes

Detailed calculations and results by crash type and severity from the predictive method

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Other Deliverables

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Proposed text for HSM Chapter

Safety Implementation Guide

- Provides details on predictive method calculations
- User guide for implementation spreadsheet

Informational Guide

- Details operational and safety benefits
- Allows user to consider potential trade-offs

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Questions??

Scott Himes| shimes@vhb.com | 919.334.5608

www.vhb.com

Offices located throughout the east coast

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Bringing Research Into Practical Approaches HSM Part C – Crash Prediction Models States' Perspective

Presenter

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Ideal Situation

- Based on the research, states (or other jurisdictions) develop their own SPFs for all facility types and results are intuitive

Less than Ideal Situation

- States (and other jurisdictions) develop some SPFs for some facility types
- Calibrate some facility types
- Results are intuitive

Less than Less than Ideal Situation

- States (and other jurisdictions) try to use anything available to them
- Ask for advice from consultants and "experts" what can be used that is "good enough and defensible"
- Results are counterintuitive

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Need to use something that is available and defensible

- Many practical / real life cases are the edge cases
- How to apply some HSM results when they are counterintuitive
  - Example: some types of ramp terminal intersections SPF always result in more FI crashes for signalized vs. stop controlled (regardless of the AADT)
- If there are not enough sites to calibrate, what can be done
- Some facility types have SPFs and some do not, how to compare
- Calibration was a stop-gap measure until SPFs were developed but calibrations are most likely not constant
- Are calibrations transferable from similar jurisdictions
- States check with consultants and researchers and are provided different results (are they scientifically based)

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Now more than ever with ICE Policies

- Operations is not routinely calibrated for jurisdictions (but have input factors by type like mountainous, rolling, level) but frequently used and accepted by all
- Safety CPM must be calibrated or developed for individual jurisdictions but often not used or accepted by all

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Practical Approaches

- Need to decide what is “good enough” and defensible
- Need to all get on the same page (researchers, practitioners, software developers)
- Have a forum to discuss this and get the message out (Community of Practice)
- Continue with cutting edge research but ensure all new research follows some guidelines for practical uses
- Is enhanced guidance needed and should that be integrated with HSM (HSM2?, HSM3, separate guide)?

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TRB Safety Performance and Analysis Committee
January 2022

KITTELSON & ASSOCIATES
PennState
Dr. Fred Mannering

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What is Part-time Shoulder Use (PTSU)?

- Use of the left or right shoulders of an existing roadway for travel during certain hours of the day.
  - Preserves shoulder as shoulder during most hours of day
- Other names
  - Hard shoulder running
  - “Branded” names such as Flex Lane, Smart Lane, etc.
- Open to all vehicles or open to buses

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NCHRP Project 17-89

- Sought to fill gap in Highway Safety Manual (HSM)
  - 2014 HSM Supplement has procedure for freeways, but not with PTSU
- Collected data from five states – GA, HI, MN, OH, VA
- Data Collected
  - Crashes
  - Roadway geometry/infrastructure
  - PTSU hours of operation
- Site characteristics
  - PTSU sites and comparison sites
  - Right and left-side PTSU (mostly right)
  - Urban
- CPMs are for PTSU open to all vehicles
  - Bus-on-shoulder did not have statistically significant difference in crash frequency

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17-89 Crash Prediction Models

- CPMs for freeways w/ PTSU
  - Single-direction models
  - Adjustment Factor (AF) identifies PTSU presence, so models can be used on freeways with or without PTSU
- All CPMs developed used negative binomial regression
  - Fixed parameter models proposed for HSM
  - Random parameter and latent class models also explored
- All CPMs developed for F+I crashes and PDO crashes
- CPMs account for site type
  - Freeway segment
  - Entrance speed-change lane
  - Exit speed-change lane

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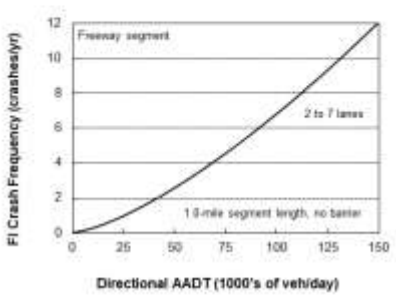
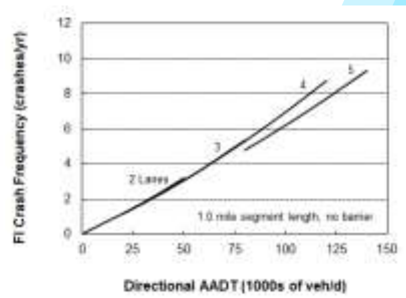
Comparison of 17-89 FI and HSM FI Models



17-89 Model



HSM Supplement Model

Adjustment Factors

Adjustment Factor	Variables Included
Horizontal Curvature	Curve radius (ft)
Inside Shoulder Width	Number of lanes, inside shoulder width (ft)
Rumble Strip Presence on Inside Shoulder	Number of lanes, proportion of segment with inside rumble strips
Lane Changes	AADT of upstream entrance ramp, AADT of downstream exit ramp, distance from beginning of segment to upstream entrance ramp gore, distance from end of segment to downstream exit ramp gore, length of segment
Lane Width	Lane width (ft)
Median Width	Proportion of segment with median barrier present, number of lanes, width of median not including shoulders (ft), distance from edge of inside shoulder to barrier face (ft)
Median Barrier	Proportion of segment with median barrier present, number of lanes, distance from edge of inside shoulder to barrier face (ft)
Outside Shoulder Width	Number of lanes, width of outside shoulder (ft)
PTSU Operation	Proportion of time during average day that PTSU operates, number of lanes, width of shoulder allocated to PTSU, proportion of PTSU in site that is a PTSU transition zone

Adjustment Factors Con't

Adjustment Factor	Variables Included
Rumble Strip Presence on Outside Shoulder	Number of lanes, outside shoulder width (ft)
Roadside Barrier	Proportion of segment with outside barrier present, number of lanes, distance from edge of outside shoulder to barrier face (ft)
Turnout Presence	Proportion of segment with turnout present, number of lanes
Speed Change Lane Length	Length of exit or entrance speed change lane (mi)

- Not all AFs appear in all CPMs

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FP Model – PTSU Adjustment Factor

$$AF_{ptsu|agg,fs,fi} = (1.0 - P_{t,ptsu}) \times \exp(f_{w,closed}) + P_{t,ptsu} \times \exp(f_{ptsu,open} + f_{near,open} + f_{w,open})$$

$$f_{w,closed} = (b_{s,ast,fi}/n \times \min\{W_{ptsu}, 12\}) \times I_{ptsuLane}$$

$$f_{w,open} = (b_{s,ast,fi} \times \min\{W_{ptsu}, 13\} - 12) \times I_{ptsuLane}$$

$$f_{ptsu,open} = b_{ptsuOpen,ast,fi} \times I_{ptsuLane}$$

$$f_{near,open} = b_{nearOpen,ast,fi} \times (1 - I_{ptsuLane}) \times P_{transition,fs}$$

$$P_{transition,fs} = L_{transition,site}/L_{fs}$$

Where

n = number of lanes

$P_{t,ptsu}$ = proportion of time during average day that PTSU operates

W_{ptsu} = width of shoulder allocated to part-time vehicular traffic use (i.e., as an additional travel lane) (ft)

$I_{ptsuLane}$ = indicator variable (= 1.0 if PTSU lane [or tapered transition] is present, 0.0 otherwise)

$P_{transition,fs}$ = proportion of segment length with PTSU transition zone present upstream, downstream, or both

$L_{transition,site}$ = total length of PTSU transition zones within site (i.e., between site begin and end mileposts) (mi)

L_{fs} = length of freeway segment (mi)

"b" terms are regression coefficients

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Effect of PTSU on FI Crash Frequency

PTSU Type	PTSU Lane Width (ft)	Proportion Time PTSU Operating[1]	AF Value by Number of Lanes		
			2	4	6
PTSU Lane (no turnouts)	11	0.1	1.11	1.19	1.22
		0.2	1.42	1.49	1.52
		0.3	1.73	1.79	1.82
		0.4	2.04	2.09	2.11
	12	0.1	1.08	1.17	1.20
		0.2	1.37	1.45	1.48
		0.3	1.67	1.74	1.77
		0.4	1.96	2.03	2.05
PTSU lane (turn-out every 0.5 mi)	11	0.1	1.00	1.13	1.18
		0.2	1.28	1.41	1.46
		0.3	1.56	1.70	1.75
		0.4	1.84	1.98	2.04
	12	0.1	0.97	1.11	1.16
		0.2	1.24	1.38	1.43
		0.3	1.51	1.65	1.70
		0.4	1.77	1.92	1.97
PTSU transition zone[2]	Any	0.1	1.11	1.11	1.11
		0.2	1.22	1.22	1.22
		0.3	1.33	1.33	1.33
		0.4	1.43	1.43	1.43

1 – Proportion time PTSU operating = (weekday hours × 5/7 + weekend hours × 2/7)/24
2 – Segment length is 0.27 miles.

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Severity and Type

- Severity Distribution Functions (SDFs)
  - Predicts the percent (“distribution”) of K, A, B, and C crashes at a site within the frequency of FI crashes
  - Separate SDFs for each site type
- Crash Type Distribution Default Tables
  - Provides percent (“distribution”) of 10 crash types at a site within the frequency of FI crashes and PDO crashes
  - Separate distributions for each site type

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Key Findings

- **Key Finding: Sites with PTSU associated with increased fatal and injury crashes on annual basis, although they are also associated with decrease in proportion of fatal and severe injury crashes**
  - Led to decrease in monetized crash costs if PTSU used for short periods of the day
  - Wider shoulder lanes and presence of emergency turnouts result in a lesser increase of fatal and injury crashes
- Other findings
  - Dynamic PTSU associated with slightly fewer crashes than static PTSU
  - Limited data on left-side versus right-side PTSU – future research needed

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NCHRP 17-89 Final Products

- NCHRP Web-only Report 309
  - Volume 1
    - PTSU Informational Guide
    - PTSU Safety Evaluation Guidelines (including draft HSM text)
  - Volume 2
    - Research Report
- Spreadsheet Tool to perform crash prediction
- Talk to Pete Jenior

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Inclusion in HSM2

- HSM2 team plans to include
- Options include:
  - Multiple freeway models (current HSM, 17-89, 17-89A HOV/HOT?)
  - Single freeway model incorporating PTSU

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First Break

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Committee on Safety Performance and Analysis (ACS20)

Transportation Research Board Annual Meeting

Monday, January 10, 2022

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Welcome Back from Break!

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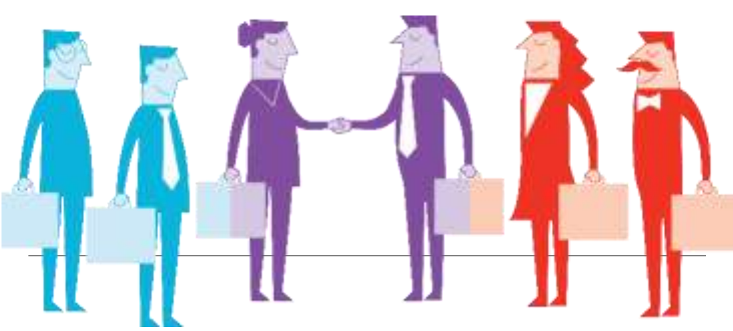

ACS20 Safety Performance Analysis

SCAN ME

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3:35	**Business Meeting**	
	Call to Order	Kim Eccles
3:40	Secretary and Communications Report	Derek Troyer
	Approval of Previous Meeting Minutes	
3:45	NCHRP Report	David Jared
4:00	Reports -- Committee Activities	
	• Subcommittee Updates	Subcommittee Chairs
	• Status of Research Needs Statements	Doug Harwood
	• Paper Reviews	Xiao Qin
	• Paper Award Process	Daniel Carter
	• Synthesis Report	Alfonso Montello
	• Doctoral Student Workshop	Pete Savolainen

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4:50	Organizational Updates	
	USDOT Updates	Tim Pickrell, NHTSA -website Jerry Roche/Carol Tan (FHWA)
	AASHTO Update	Kelly Hardy, Stephen Read, Bonnie Polin
5:10	State of the Committee and a Look Forward	Kim Eccles
	• Status of Committee Chair	
	• Committee Rotation in Spring 2022	
	• Mentor Program	
	• 2022 Mid-Year Meeting	
	• Planning for 2023 Annual Meeting	
5:20	Other News	
	• Related PIARC Activities	John Milton
	• Upcoming Events	

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TRB 2022

Secretary and Communications Report

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TRB 2022

Approval of Meeting Minutes

TRB 2021 Annual Meeting Minutes, sent over email

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trbacs.org

Our amazing and frequently updated website

TRB 2022

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TRB 2022

Subcommittee Updates

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Subcommittees

TRB 2022

Subcommittees

- Safety Analytical Methods (ACS20(1))
- User Liaison (ACS20(2))
- Surrogate Safety Measures (ACS20(3))
- Rural Road Safety Policy, Programming, and Implementation Subcommittee, ACS10(4), Joint Subcommittee of ACS10, ACS20, AKD30
- Pedestrian and Bicycle Safety Analysis (ACS20(5))

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TRB Safety Performance and Analysis Committee (ACS20)

User Liaison Subcommittee (ACS20(2)) Report

January 10, 2022

Mike Dimaiuta

Geni Bahar

TRB Safety Performance and Analysis Committee (ACS20)

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Working Groups - ULSC Initiatives

- Permanent Working Groups:
  - Policy and Legal Aspects *(Priscilla Tobias)*
  - International Safety Research *(Jennifer Ogle)*
- Temporary Working Groups:
  - TRB 2022 Workshop *(Kim Kolody)*
  - HSM Part C Tools *(Bonnie Polin/Mike Dimaiuta)*
  - Practical Application of the HSM *(Tim Barnett)*
  - Road Safety Training for Local Agencies *(Cong Chen/ Tim Colling)*
  - HSM User Discussion Forum *(Daniel Carter/Tariq Shihadah)*
  - HSM Part C Informational Guide *(Khalid Jamil)*
  - HSM Website *(Stephen Read)*
  - HSM FAQs *(Jake Farnsworth)*

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Policy and Legal Aspects

- Liability Neutral Roadway Safety Document
  - Publication: *Guidelines for Drafting Liability Neutral Transportation Engineering Documents and Communication Strategies*
  - Webinar: Joint AASHTO-TRB (Kelly Hardy/Priscilla Tobias)
- HSM2
  - Glossary of Terms
  - Style Guide/Terms of Use
  - Consideration of Tort Liability Implications

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International Safety Research

- Synthesis statement submitted to NCHRP was not approved for this year; now refining the statement of work for future submissions
- Creating a list of international safety meetings and research studies
- Considering the local agency training materials developed in the past for potential adaptation to suit jurisdictions with very limited data availability

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TRB 2022 Workshop

- **Making Safe System a Reality: Planning to Implementation**
  - The Safe System (SS) approach is critical for saving lives.
  - This workshop explored SS using real-world applications and breakout discussions to define SS for all users, discuss barriers (e.g. data, measures, equity, funding, legal implications) and opportunities for SS coordination (e.g. HSM, Greenbook) and implementation, share lessons learned, and identify research needs.
  - This builds on a series that has engaged 500+ agency leaders, practitioners and academics and aligns with Committee Strategic Plans.

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TRB 2022 Workshop: Partnership and Collaboration

- 2022 TRB AM Workshop Sponsors and Co-Sponsors
  - **ACS10: Transportation Safety Management Systems**
  - **ACS20: Safety Performance and Analysis**
  - AKD10: Performance Effects of Geometric Design
  - ACH10: Pedestrian
  - ACH20: Bicycle Transportation
  - A0040C: Rural Transportation Issues Coordinating Council
  - ACS30: Traffic Law Enforcement
  - ACS40: Occupant Protection
  - ACS60: Truck and Bus Safety
  - ACS50: Impairment in Transportation

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HSM Part C Tools

- The Working Group prepared an ***HSM Part C Analysis Tools Survey***, to understand the needs of safety practitioners related to the HSM Part C or site-specific predictive analysis tools. This was a joint effort from the AASHTO Committee on Safety and TRB ACS20.
- Survey went out to all AASHTO COS members on 9/28/21.
- Received responses from 23 states and results have been compiled.

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Practical Application of HSM

Research Topics submitted (by Tim Barnett) and considered by AASHTO Committee on Safety:

- Applications Guide to the Highway Safety Manual *– RNS submitted*
- Safety Performance Functions and Crash Modification Factors for Weather Related Crashes *– RNS submitted*
- Developing SPFs and CMFs for Light, Medium, and Heavy Rail and Roadway Interfaces *– RNS not submitted*

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Road Safety Training for Local Agencies

Problem: Need to determine local agency training demand and compare to supply to find gaps.

Goal: Investigate and secure survey data regarding local agency needs for training.

Sources:

- FHWA Center for Local Aid Support – Previous comprehensive survey
- AASHTO Local Roads Subcommittee – In process survey (completed August 2021; received for use in September 2021)
- LTAP Centers – Conduct a new survey

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HSM User Discussion Forum

- Growing interest in creating a forum to…
  - Increase user interactions and peer exchange
  - Identify, respond to technical questions in centralized platform
  - Share news, research, and information
- Working group goals
  - Find the best solution for the need
  - Work with AASHTO and stakeholders to implement
- Actions:
  - Prepared a survey – will send out soon to a broad range of users
  - Discussion planned at ULSC meeting tomorrow

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HSM Part C Informational Guide

- Issue: HSM Part C is underutilized
  - Need to convey benefits of using HSM Part C
- Meeting held in November with leads of other ULSC Working Groups that are focused on providing guidance on using/applying HSM methods (e.g., HSM User Discussion Forum; HSM FAQs; Practical Applications of the HSM; Policy and Legal Aspects), as well as the HSM Implementation Pooled Fund, NCHRP 17-50.
  - Need to get researchers and practitioners together
  - Education is a key component; what is "reasonable and defensible"?
  - 2 parts: what can we do NOW to help agencies struggling with using/applying HSM Part C? What to do in the FUTURE?
  - Consider a synthesis of what States are currently doing – develop synthesis topic on "***HSM use at the State and local level***"
  - **"Bringing Research into Practical Approaches"**
    - Discussion today and plan to discuss in more depth (e.g., at ACS20 2022 MYM)

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Research Topic Statements submitted by ULSC

- Practical Approaches to Quantifying Safe System Concepts *(Bonnie Polin)*
- Pavement Friction and Safety Performance Integration *(Priscilla Tobias)*
- Safety Performance Functions for Curves *(Priscilla Tobias)*
- Applications Guide to the Highway Safety Manual *(Tim Barnett) – RNS submitted*
- Safety Performance Functions and Crash Modification Factors for Weather Related Crashes *(Tim Barnett) – RNS submitted*
- Developing SPFs and CMFs for Light, Medium, and Heavy Rail and Roadway Interfaces *(Tim Barnett) – RNS not submitted*

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ULSC Meeting

- Tuesday January 11; 8:00 – 9:30 am
- Convention Center – Room 103
- All are invited to attend. Hope to see you there!
- Bring your breakfast! ☺

TRB Safety Performance and Analysis Committee (ACS20)

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Thank you!

Subcommittees

TRB 2021

Subcommittees

- ***Safety Analytical Methods Subcommittee****, ACS20(1),*
  - *Monday, January 10,10:30 AM-12:00 PM ET*
- **User Liaison Subcommittee**, ACS20(2),
  - Tuesday, January 11, 8:00 AM-9:30 AM ET,
- **Pedestrian and Bicycle Safety Analysis**, ACS20(4),
  - Tuesday, January 11, 6:00 PM-7:30 PM ET
- **Rural Road Safety Policy, Programming, and Implementation**, ACS10(4), Joint Subcommittee of ACS10, ACS20, AKD30,
  - Tuesday, January 11, 6:00 PM-7:30 PM ET
- **Surrogate Safety Measures Subcommittee**, ACS20(3),
  - Wednesday, January 12, 8:00 AM-9:30 AM ET

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Status of Research Needs Statement

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Current Status

- In 2021, the AASHTO Committee on Safety considered 30 research topics
- 14 of the 30 research topics came from the TRB Safety Performance and Analysis Committee
- Initial ranking by the AASHTO Committee placed 8 of our 14 topics in the top 20 of 30 problems
- We decided to finalize fully developed research problem statements for these 8 topics
- Research problem statements were developed considering comments from AASHTO reviewers

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Highest Ranked Research Problem Statements

2. Intersection Crash Prediction Models for Future Editions of the HSM (Lead Author: Darren Torbic)
3. SPFs for Curves (Lead Author: Mike Vaughn)
8. Pavement Friction and Safety Performance Integration (Lead Author: Priscilla Tobias)
9. Safety Performance Effects of Traffic Signal Control Technology and Timing Practices (Lead Author: Jerry Roche)
14. Safety Performance of Intersection Right-Turn Lanes (Lead Author: Jason Hershock)

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Highest Ranked Research Problem Statements

15. Practical Application Guide to the HSM (Lead Author: Tim Barnett)
19. Developing SPFs and CMFs for Weather-Related Crashes (Lead Author: Tim Barnett)
18. Validity of Surrogate Measures for Making Safety Assessments (Lead Author: Bhagwant Persaud) – deferred to 2022

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Current Status

- 7 statements provided back to AASHTO for further consideration
- Remaining 7 statements can be resubmitted to the AASHTO Committee on Safety for consideration in 2022

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Lower Ranked or Deferred Research Topics

18. Validity of Surrogate Measures for Making Safety Assessments (Lead Author: Bhagwant Persaud) – deferred to 2022
21. Safety Performance Effects of Ramp Metering (Lead Author: Jerry Roche)
23. Modernizing the Network Screening Process Using Machine Learning and Artificial Intelligence (Lead Author: Jonathan Wood)
24. Commercial Motor Vehicle Safety Performance Models (Lead Author: Tim Barnett)
25. Safety Performance Effects of Bus Facilities and Preferential Treatments (Lead Author: Jerry Roche)
27. Frontage Road Safety Performance Functions for the HSM (Lead Author: Tim Barnett)
29. Developing SPFs and CMFs for Light, Medium, and Heavy Rail and Roadway Interfaces (Lead Author: Tim Barnett)

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Next Steps

- We can submit to the AASHTO Committee on Safety in 2022:
  - Research problem statements submitted in 2021 but not funded
  - Lowered ranked or deferred topics
  - New topics generated by the TRB Safety Performance and Analysis Committee

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QUESTIONS?

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Paper Reviews

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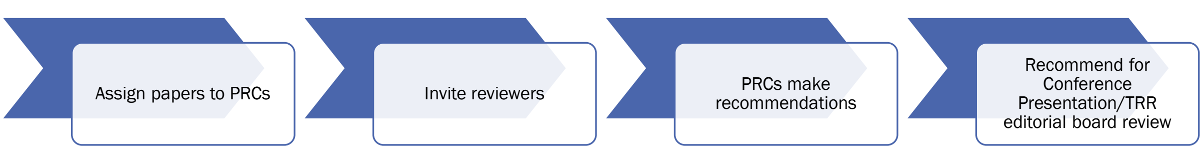
ACS20 Paper Review Process



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ACS20 Paper Submission

2021 ACS20		
Presentation Only	60	31%
Presentation and Publication	90	69%
Total	150	100%

2022 ACS20*		
Presentation Only	108	44%
Presentation and Publication	137	56%
Total	246	100%

*As of 08/13/2021, papers in specialty pool are not included.

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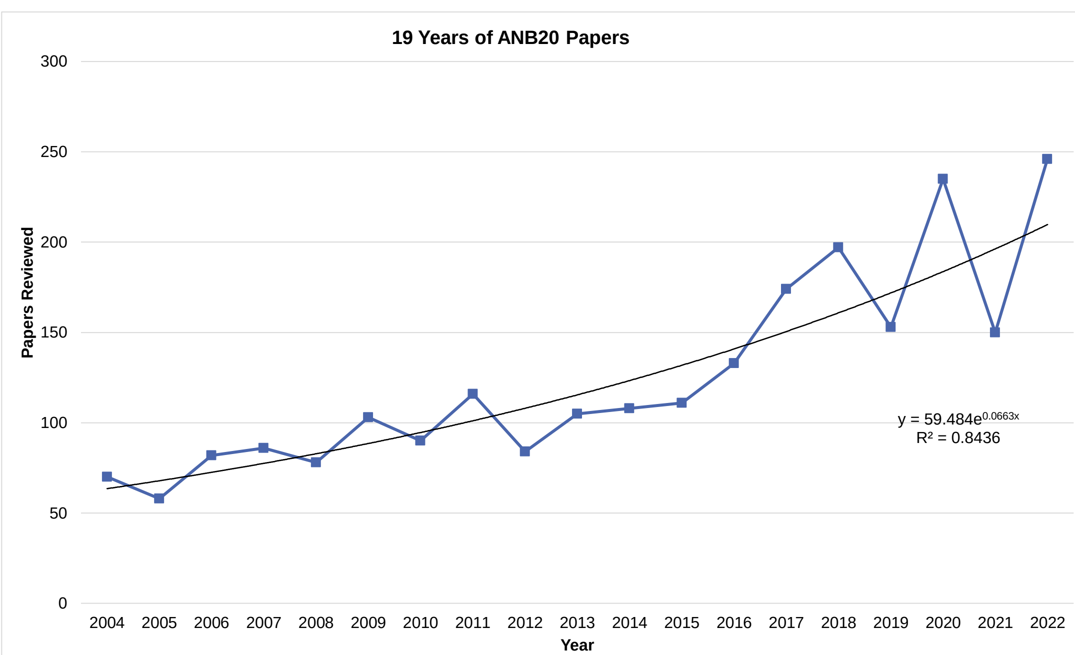

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Accepted for Presentation

Poster Session 1056 Safety of Motorcyclists and Active Transportation Modes (Monday, January 10 8:00 AM- 9:30 AM ET, Conventio[illegible] Center, Hall A): **37 papers;**

Poster Session 1304 Safety Performan[illegible]gies (Tuesday, January 11 1:30 PM- 3:00 PM ET, Convention [illegible]): **60 papers;**

Poster Session 1340 Adv[illegible]ethods and Data (Tuesday, January 11 4:00 PM- 5:30 PM E[illegible] Center, Hall A): **59 papers;** and

Poster Session 12[illegible] Minority Student Fellows Research Presentations (Tuesday, January 11 10:30 AM- 12:00 PM ET Convention Center, Hall A): a few TRB Minority Student Fellows Research Presentations

Acceptance Rate: ~60%

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ACS20 Paper Reviewers

A great team of Paper Review Coordinator (PRCs): Xiao Qin, Raghavan Srinivasan, Peter Savolainen, Ward Vanlaar, George Yannis, Cong Chen, and Juan Medina.

THANK YOU, REVIEWERS!

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Paper Award Process

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Synthesis Report

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TRB 2022

Doctoral Student Workshop

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Doctoral Student Research

Overview

- AED60 - Statistical Methods & ACS20 - Safety Performance Analysis Committees continue to sponsor a special session that highlights work by Ph.D. students who are nearing the completion of their doctoral research on transportation safety.
- Format
  - 12 presenters
  - 3-minute presentations from each person
  - Posters that provide greater detail
  - Moderated question-and-answer period between presentations

Lectern Session 1246: **Doctoral Student Research in Transportation Safety**

Tue., Jan. 11, 10:30 AM - 12:00 PM | Convention Center, Salon AB

Peter Savolainen, Michigan State University, presiding

Co-Sponsored with ACS20 - Safety Performance and Analysis

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Doctoral Student Research (cont.)

The Process

1. Students submit, via e-mail, an abstract that summarizes their research. A template is provided for their use. Submission occurs after, and separate from, the TRB call.
2. Students copy their faculty advisor on the e-mail to allow for confirmation of the anticipated graduation date. Priority is given to students who are nearest to graduation.
3. A group of volunteers from AED60 and ACS20 reviews and rates the abstracts. Selections are made after consultation with committee chairs.
4. The event is held during the TRB Annual Meeting and a group of volunteers rate the presentations, culminating in a Best Presentation Award.

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Doctoral Student Research (cont.)

This Year's Presenters and Topics

Student Name	Institution	Title
Meghna Chakraborty	Michigan State University	Relationship Between Horizontal Curve Characteristics and Single Vehicle Crashes on Rural Two-Lane Highways
Rebeka Yocum	The Pennsylvania State University	Socialization of Safety: An Investigation into the Impact Socioeconomic Factors Have on Crash Frequency, Severity, Risk, and Cost in Pennsylvania
Arash Khoda Bakhshi	University of Wyoming	Safety Performance Assessment of the Wyoming Connected Vehicle Pilot Deployment Program
Aryan Hosseinzadeh	University of Louisville	Linking Motor Vehicle Crashes with Emergency Medical Services Runs and Trauma Registry for Injury Outcome Assessment
Qing Chang	Auburn University	A Machine Learning Approach to Quantify Effects of Design Features on Wrong-Way Driving Incidents at Off-Ramp Terminals of Partial Cloverlead Interchanges
Qingyu Ma	Virginia Department of Transportation	E-Scooter Safety: Understanding the Impact of Wheel Size Using Mobile Sensing Data
Ashutosh Arun	Queensland University of Technology	A Novel Road User Safety Field Theory to Estimate Crash Frequency by Severity: Application of Computer Vision Techniques for Automated Safety Assessment
Hananeh Alambeigi	Texas A&M University	Modeling Driver Behavior During Automated Vehicle Takeovers
Yu Song	University of Connecticut	Traffic Crash Patterns and Causations Based on Sequence of Events: Preparing for a Transition into Automated Transportation
Tobias Panwinkler	Federal Highway Research Institute (BASt)	Accident of Pedelecs (Pedal Electric Bicycles) and Conventional Bicycles in Comparison: Structural and Spatial Analysis
Maria Rella Riccardi	University of Naples Federico II	Econometric Methods and Machine Learning Algorithms to Investigate Factors Contributing to Pedestrian Crash Severity
Ganesh Pai	University of Massachusetts, Amherst	Drivers' Hazard Avoidance During Vehicle Automation: Impact of Mental Models and Implications for Training

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Doctoral Student Research (cont.)

Thanks to this year's volunteers who assisted with abstract review!

- Deogratias Eustace, University of Dayton
- Mary Martchouk, MMTAM
- Juan Medina, University of Utah
- Michael Pawlovich, South Dakota State University
- Peter Savolainen, Michigan State University
- Jonathan Wood, Iowa State University

Request for Jurors!

- Anyone who is interested in serving as a judge for this competition can email Peter Savolainen (pete@msu.edu).
- Or just show up at Salon AB at 10:30 AM!

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USDOT Updates

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FHWA Update

Jerry Roche, PE
Office of Safety
jerry.roche@dot.gov

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AASHTO Update

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Committee on Safety: technical publications and outreach activities

Stephen W. Read, P.E. Virginia DOT

ACS 20 Annual Meeting January 10, 2022

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Safety Management System Webinars

Network Screening Webinars (see HighwaySafetyManual.org)

- Overview
  - Co-hosted with Kerry Wilcoxon of Arizona DOT in April
  - Presented innovative approaches by CT, FL, KS, KY, WY, IL, CO
  - Highlighted notable analysis and visualization approaches, data sources, and analysis methods
- Deeper Dive
  - June 30th more detailed descriptions and demonstrations from CO, CT, and FL

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Safety Management System

- Project Evaluation Dec. 15th webinar
  - F Gross overview of NCHRP 52-08 Eval methods and practices
  - Presentations by GA, IL, PA, NC, WS on their data collection and methods
- Asking states about other SMS presentation topics

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Planning Completed Research Webinars

- States want webinars to introduce recently completed NCHRP projects
- To introduce newly available analysis approaches while the HSM2 publication is being developed
- Possible Topics will include:
  - Pedestrian/bicycle predictive modeling
  - New facility types predictive modeling
  - Systemic analysis methods
  - And more…

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HSM Website Update

- HSM2 Overview slide deck
  - Describes what's coming in the HSM2, additions, changes
  - Lists new research which will be included in HSM2 and how to find the outcomes in the meantime
  - To be updated with new NCHRP 17-71A work plan
- Beginning plans to update the User Discussion Forum with User Liaison SC

Available on the HSM website (HighwaySafetyManual.org)

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Future HSM Research Needs

HSM research:

- **NCHRP projects funded but beyond 17-71A HSM2 inclusion period**
- **Steering Committee request for NCHRP 20-123 funds was approved to look forward and develop a HSM roadmap**
- **Continue HSM research gap assessment with ACS20**

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HSM2 Steering Committee and Tech Safety Publications Sub-Committee

Thank you to our dedicated Steering Group members!

Working to clarify longer term role and scope of committees

- Stephen Read, Chair (Virginia DOT)*
- Bonnie Polin, Co-Chair (Massachusetts DOT)*
- Dennis Emidy (Maine DOT)
- Brad Foley (Maine DOT)
- Jason Hershock (Pennsylvania DOT)*
- Trey Jesclard (Louisiana DOT)
- Jason Siwula (Kentucky TC)
- Alan El-Urfali (Florida DOT)
- Trey Tillander (Florida DOT)
- John Milton (Washington DOT)*
- Kelly Hardy (AASHTO)*

* 17-71A Panel Members

Thanks to and best wishes for Derek Troyer (Ohio DOT to FHWA)

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Thank you.

Questions?

Stephen Read – Virginia DOT stephen.read@vdot.virginia.gov
Bonnie Polin – Massachusetts DOT bonnie.polin@state.ma.us
Kelly Hardy – AASHTO khardy@aashto.org

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Looking Ahead

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Rotation, Rotation, Rotation

TRB 2022

- It will finally happen this Spring
  - Term limits and overall size are limiting
  - Presents opportunity for new ideas
- Our goal: Retain amazing term limited leaders through mentor program
- Dr. Karen Dixon will be the sole chair

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2022 Meetings and Other Upcoming Events

TRB 2022

- Plan for mid-year meeting
- Alignment with other meetings?
- Continue periodic meetings with an emphasis on research activities
- Volunteer Opportunity

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Other News

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2022

THANK YOU and SAFE TRAVELS

Transportation Research
Board Annual Meeting

Monday, January 10, 2022

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