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NCHRP 17-72: Update of Crash Modification Factors for the Highway Safety Manual

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Objectives

- Assess existing process for identifying CMFs for inclusion in the HSM

- Develop proposed revisions to the criteria and process

- Apply the revised evaluation criteria and develop a list of CMFs for the 2nd edition of the HSM

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Project Team

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- VHB
  - Frank Gross, Scott Himes, Thanh Le, & RJ Porter
- Persaud & Lyon (P&L)
  - Bhagwant Persaud and Craig Lyon
- Kittelson and Associates (KAI)
  - James Bonneson and Erin Ferguson

Approach

- Two phase effort
- Phase 1
  - Task 1: Review inclusion criteria for CMFs
  - Task 2: Review CMF Clearinghouse star rating system
  - Task 3: Determine user preferences and practices
  - Task 4: Develop recommendations for how CMFs may be incorporated in the HSM
  - Task 5: Develop interim report
  - Task 6: Interim meeting

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Approach, *contd.*

- Phase 2
  - Task 7: Review existing CMFs
  - Task 8: Assemble CMFs to be recommended for incorporation in the 2nd edition of the HSM
  - Task 9 – Conduct CMF gap analysis
  - Task 10 – Develop guidance for practitioner use
  - Task 11 – Develop a stand alone document describing the inclusion criteria
  - Task 12 – Develop final report and other documents

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Task 1 & Task 2

- Review existing procedures for assessing CMF quality
  - NCHRP 17-25 procedure
  - HSM 1st edition procedure
  - CMF Clearinghouse star rating procedure
  - Elvik procedure
- Factors used to assess CMF quality

Task 3: Determine user preferences and practices

- Nationwide questionnaire
- Focus group (8 states)
- Obtain information on preferences and practices of CMF users
  - What kinds of CMFs do you use?
  - Do you use information on CMF quality and how?
  - How should CMFs be presented?
  - Should CMFs be presented in the 2nd edition?
  - What guidance on CMFs should be presented in the HSM 2nd edition?
- Findings presented last year

CMF rating systems

- Next few slides provide overview of:

  – HSM 1st edition CMF inclusion procedure

  – CMF Clearinghouse star rating

  – NCHRP 17-72 CMF rating procedure

HSM 1ˢᵗ edition inclusion procedure

- Documented in Bahar: TR Circular E-C142

- Calculate ideal standard error

- Calculate adjusted standard error (ASE)

  - Ideal standard error × method correction factor (MCF)

  - MCF (ranged from 1.2 to 7) is primarily a function of

    - Study design
    - Control of confounding factors

  - Better studies got a lower MCF

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HSM 1st edition inclusion rule

– If ASE > 0.1, they were rounded

- ASE = 0.14 was rounded to **0.1**
- ASE = 0.16 was rounded to *0.2*

– For a study to be included in Part D

- The ASE of at least one of the CMFs should be 0.1 or lower
- Other CMFs from the same study were included as long as the ASE was 0.3 or lower

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CMF Clearinghouse Rating Procedure

- Five factors
    - Study design
    - Sample size
    - Standard error
    - Potential bias
    - Data source
- Each of these could be: excellent (2 points), fair (1 point), and poor (0 points)
- Score = (2*study design) + (2*sample size) + standard error + potential bias + data source
- Star rating based on this score: maximum is 5 star and minimum is 1 star

NCHRP 17-72 CMF rating procedure

- Rating/inclusion process for CMFs
  - Factors (e.g., sample size, methodology, statistical significance)
  - Levels within factors and points for each level
  - Total score calculated by adding the points; maximum possible score is 150
    - Possible threshold of inclusion in HSM 2nd edition (100 out of 150)
  - Study types: Before-after; Cross-sectional; Meta analysis & meta regression studies

Before-After Study Design; Individual CMFs

- Data (sample size); 55 points
  - Number of sites/miles for reference and treatment sites
  - Expected number of crashes in the after period and observed crashes in the before period
  - Availability of traffic volume in the before and after periods

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Before-After Study Design; Individual CMFs

- Confounding and Appropriateness of Statistical Analysis; 75 points
  - Address RTM bias
  - Account for changes in traffic volume
  - Account for time trends
  - Reference and treatment groups from the same population
  - Appropriateness of SPFs
- Statistical significance; 20 points

Cross-sectional study design

- Data (sample size): 55 points
  - Number of miles/sites of sites with and without the treatment
  - Number of crashes
  - Number of years of traffic volume data

Cross-sectional study design

- Confounding and Appropriateness of Statistical Analysis; 75 points
  - Similarity of sites with and without treatment
  - Model and functional form
  - Consideration of omitted variable bias
  - Consideration of correlation between variables
  - Consideration of spatial and temporal correlation
- Statistical significance; 20 points

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Meta Analysis and Meta Regression

- Recently developed and still being tested
- Methodology and Data; 55 points
  - Did individual studies apply similar methodology and accounted for same confounding factors
  - Consistent crash type and severity definitions across studies
  - Consistency in the direction of effect
  - Was publication bias tested?

Meta Analysis and Meta Regression

- Meta Analysis
  - <u>Quality of individual CMFs; 35 points</u>
  - Appropriateness of combining the individual CMFs; 40 points
  - Statistical significance; 20 points
- Meta Regression
  - Individual CMF quality; 35 points
  - Appropriateness of statistical method for developing crash modification function; 60 points

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Current Activity

- Task 7 – Review Existing CMFs
- Identification and Assembly
  - CMF Clearinghouse
  - CMFs from the 1st edition of the HSM
- Evaluation
  - Use inclusion/rating process from Phase 1
    - Possible tweaks to the rating process

Review of Existing CMFs

- Group 1 CMFs
  - Review and rate studies where the highest rated CMF is 4 or 5 star (based on the CMF Clearinghouse rating procedure)
  - Pretty much completed
- Group 2 CMFs
  - Review studies where the highest rated CMF is 3 star or lower
  - Started this Fall

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NCHRP 17-72 versus CMF Clearinghouse rating system

- Good consistency between the NCHRP 17-72 rating system and the CMF Clearinghouse rating system

- CMFs with higher star rating also have higher ratings from the 17-72 system

NCHRP 17-72 versus HSM 1ˢᵗ edition Inclusion Procedure

- Identified studies with at least one CMF with ASE $\leq$ 0.14 ($\leq$ **0.1** after rounding)
  - CMFs from these studies would be included in the HSM based on the 1ˢᵗ edition inclusion procedure

- Determined the 17-72 rating for all the CMFs from these studies

- Within each study, the maximum 17-72 rating was $\geq$ 100 for all studies

Task 10: Guidance Document for Part D of the HSM

- Chapter 1: Introduction
- Chapter 2: Selecting CMFs
- Chapter 3: Applying CMFs
- Chapter 4: Developing CMFs
- Appendix A: NCHRP 17-72 rating system
- Appendix B: Potential influential factors
- Appendix C: Adjusting CMFs to local conditions
- Appendix D: Combining multiple CMFs for the same countermeasure

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References in the Guidance Document

- 31 references
- Key references
  - NCHRP Project 17-63 final report (*Guidance for the Development and Application of Crash Modification Factors*) (in press)
  - Hauer, *Observational before-after studies in road safety*
  - HSM 1st edition
  - *A guide to developing quality CMFs* (FHWA)
  - *Recommended protocols for developing CMFs* (NCHRP 20-7)