



HSM2 – Part D

NCHRP 17-72 and CMFs in the HSM

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

Project Team

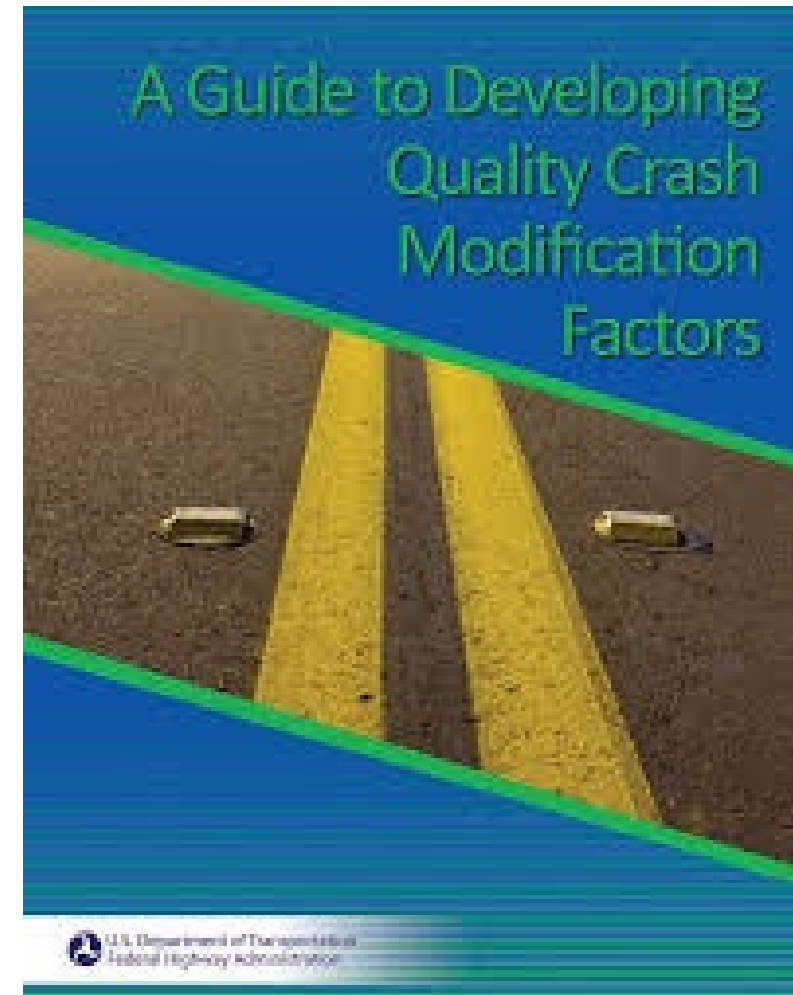
- UNC Highway Safety Research Center
- VHB

What is a CMF?

$$CMF = \frac{\textit{Crash Frequency with Treatment}}{\textit{Crash Frequency without Treatment}}$$

Where do CMFs come from?

- Before-After with Comparison Group Studies
- Empirical Bayes Before-After Studies
- Full Bayes Studies
- Cross-Sectional Studies
- Case-Control Studies
- Cohort Studies
- Additional alternative approaches



When do we use CMFs?

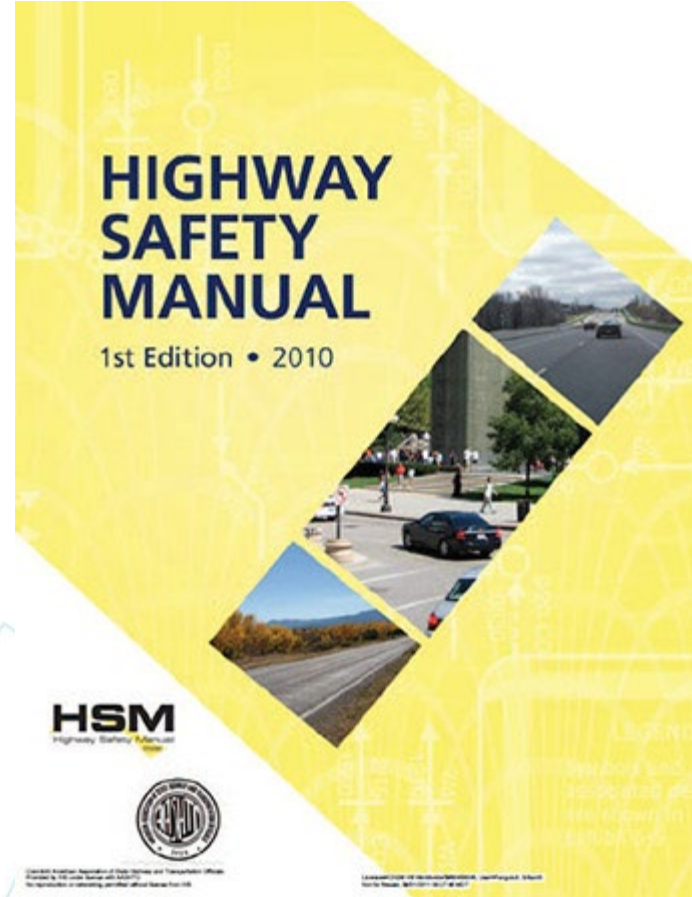
- Planning
- Design
- Construction
- Evaluation



HSM 1 – What is in Part D

Part D of the HSM

- 5 chapters of CMFs for various countermeasures
 - Segments
 - Intersections
 - Interchanges
 - Special Facilities
 - Networks



HSM 2 – The New Part D

Part D of HSM2

- No more CMFs
 - Refer to CMF Clearinghouse
 - HSM stamp of approval
 - More rigorous assessment of quality
- More guidance-oriented
 - How to select CMFs
 - How to apply CMFs



HSM 2 – Selecting a CMF

Step 1 – Identify Appropriate CMF(s)

- Identify the most applicable CMF(s)
- Identify the highest quality CMF(s)

Step 2 - Convert CMF(s) for Proper Application

- Convert the CMF(s) to the base condition
- Convert CMF(s) to reflect conditions of interest
- Combine multiple CMFs for the same countermeasure

Identifying Appropriate CMF

Most Applicable CMFs

- Research site characteristics
- Countermeasure description
- Facility type
- Crash type and severity
- Exposure
- Speed
- Site geometry

Highest Rated CMFs

- CMF Clearinghouse Star Rating
- Control for statistical biases
- Better study design
- Larger sample sizes
- HSM approved CMFs

Converting the CMF – Adjusting for Base Condition

$$CMF = \frac{CMF_{Proposed}}{CMF_{Existing}}$$

Reflecting Conditions of Interest

Step 1. Identify proposed countermeasure & subject site

Step 2. Identify characteristics of subject site

Step 3. Identify existing CMFs for proposed countermeasure

Step 4. Compare subject site characteristics to known influential factors on the CMF

Step 5. Convert CMF to disaggregate CMFs (procedure from NCHRP Project 17-63)

Step 6. Processing disaggregate CMFs

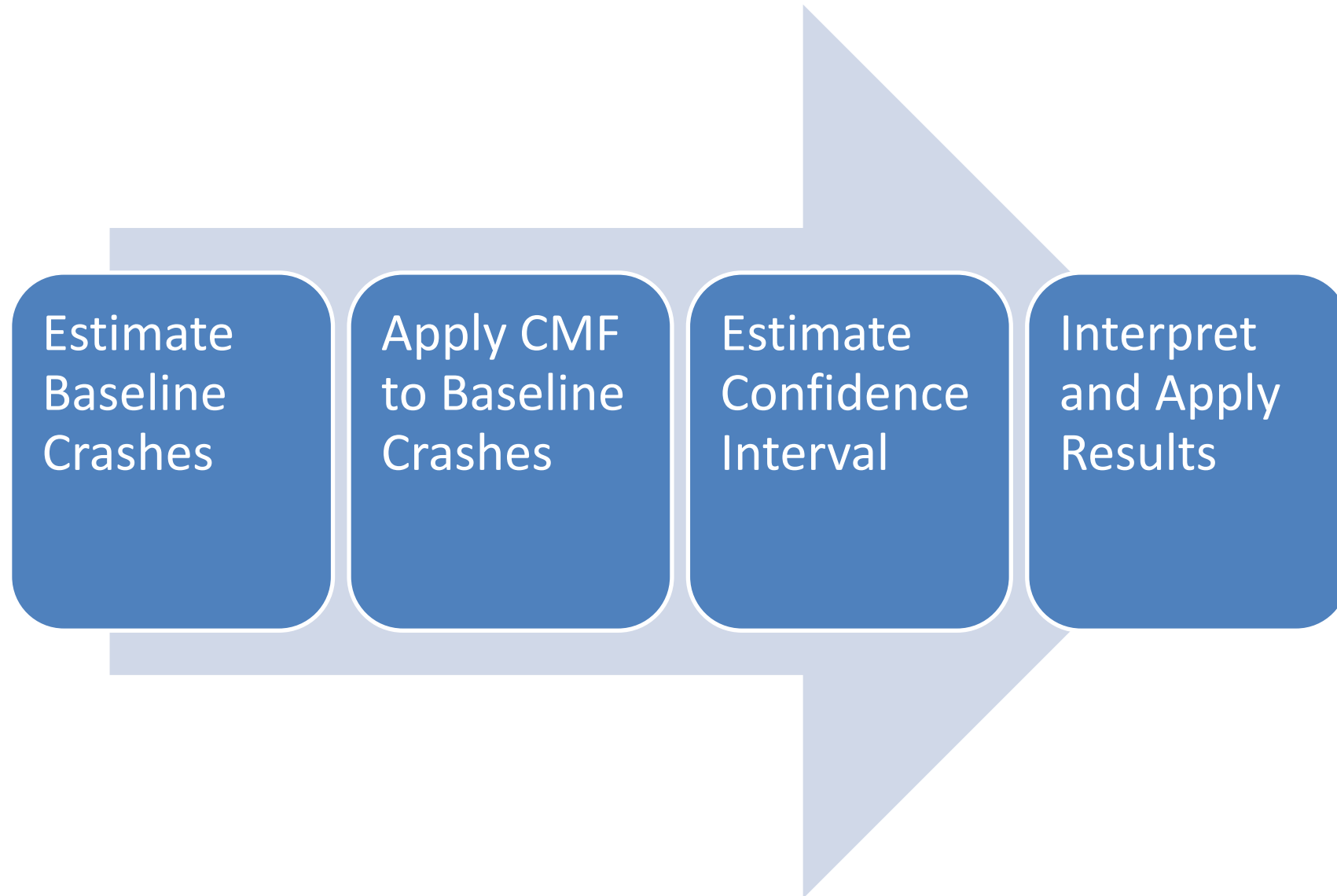
Step 7. Develop aggregate CMF

What if no CMF exists?

- Case 1: CMF Exists but is not high quality
- Case 2: CMF for Related Countermeasure Available
- Case 3: Data-Driven Behavioral Studies
- Case 4: Expert Opinion



HSM 2 - Applying CMFs



Step 2 – Apply CMF to Baseline Crashes

- Crash Frequency with Treatment = Baseline Crash Frequency * CMF
- Combining multiple countermeasures and CMFs
 - Bounds of the combined effect
 - Magnitude of the individual countermeasure effects
 - Overlapping effects
 - Applicability of individual CMFs

Methods for Combining CMFs

- If one of the CMFs is > 1.0 , then use the multiplicative effect (Combined CMF = $CMF_1 * CMF_2$), otherwise:
 - Additive effect for zero overlap or enhancing effects
 - *Combined CMF* = $1 - [(1 - CMF_1) + (1 - CMF_2)]$
 - Dominant effect for complete overlap
 - Combined CMF is the larger reduction of CMF_1 and CMF_2
 - For some overlap, select the largest reduction between Dominant effect and Dominant Common Residuals
 - *Combined CMF* = $(CMF_1 * CMF_2)^{CMF_1}$

Confidence Intervals

Confidence Interval

$= CMF \pm \text{Standard Error} * \text{Multiple of Standard Error}$

Common Misapplications of CMFs

Applying CMFs to different scenarios

Applying CMFs to different crash types or severities

Multiplying CMFs for different crash types and severities

Applying CMFs inconsistently across an agency

Summary

- CMFs are multiplicative factors used to estimate the change in safety performance due to a treatment
- The HSM Committee elected to adopt the CMF Clearinghouse as the CMF resource and modify Part D to provide CMF Guidance
- The new HSM Part D will provide guidance on selecting and applying CMFs

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