

NCHRP PROJECT 17-63

Guidelines for the Development and Application of Crash Modification Factors

Implementation of Research Findings and Products (Submitted 03/11/2017)

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Research Product

This product of the Project 17-63 research focused on guidelines for safety practitioners and researchers who work to apply or develop CMFs to accurately estimate the effect of a safety treatment. These primary guidelines, produced as step-by-step procedures or more general discussion of potential modeling issues, are accompanied by other relevant products such as Excel tools and CMFs developed during the research.

The primary guidelines produced under this research include

- A procedure for estimating the effect of a proposed treatment on a site of interest through a process that identifies potential CMFs, matches them on major site characteristics, and adjusts or combines them to produce a final CMF to be used at the site of interest (Appendix A of the final report).
- A procedure to estimate the combined safety effect of two treatments at the same location using a method that hinges on the magnitudes of the individual treatment effects and the determination of how much overlap there is between the treatments (Appendix B).
- Guidelines on developing CMFunctions either from cross-sectional regression models or from a set of CMF point estimates (Appendix C).

Secondary products include

- Excel tools and user manuals for implementing the procedures involved in selecting and adjusting CMFs for a site of interest (supporting procedures of Appendix A)
- List of site characteristics that significantly influence the value of a CMF (secondary product of the Appendix A procedure)
- CMFs for combined effects of specific countermeasures evaluated in this research (secondary product of the development of the Appendix B procedure)
- CMFunctions for four countermeasures evaluated in this research (secondary product of the Appendix C case studies)

- Guidelines on designing future studies to produce the best quality CMFs (Appendices F and G)

Audience

These products have a dual audience. The first is safety practitioners who employ CMFs as a part of their agency work. These practitioners will be the primary users of the guidelines on selecting and adjusting a CMF (Appendix A) and estimating the combined effect of two treatments (Appendix B). This safety practitioner audience would be expected to include state safety engineers; other state-level engineers who consider the safety of proposed projects or site improvements; and local agency engineers (i.e., city, town, county, MPO, RPO).

The second audience consists of researchers and analysts who design research studies and analyze data to develop CMFfunctions. The guidelines in Appendix C as well as the demonstrations with real datasets will provide them with the knowledge necessary to develop high-quality CMFfunctions.

Impediments to Successful Implementation

Each of the major guideline products of this research has certain potential challenges to implementing the product.

Procedure for selecting and adjusting a CMF for a site of interest (Appendix A)

- Some parts of this procedure require specific data to function. To implement much of the procedure at all, the user must be able to at least one CMF for the proposed treatment based on a review of the literature or CMF resources. Moreover, any identified CMF must match the site of interest on several influential factors (i.e., major site characteristics). If there is not an existing CMF that matches the major influential factors, the user will have to undertake the development of an appropriate CMF.
- To convert an aggregate (total) CMF to disaggregate CMFs (specific to crash type or severity), the user must know the crash distribution of the data used to develop the CMF. Such crash distribution information may not be available in the original study report.

Procedure for estimating the combined effect of two treatments (Appendix B)

- This procedure requires that the CMFs for the individual treatments are known and are of sufficiently reliable quality.
- The procedure was developed for two treatments only; some agencies may desire to know the combined effect of more than two treatments. The guidelines provide some discussion on how to extrapolate the results to more than two treatments, but there was insufficient data to provide reliable guidelines on more than two treatments.

Guidelines on developing CMFfunctions (Appendix C)

- Cross-sectional datasets must have sufficient detail to allow the analyst to properly account for various biases and issues (as presented in the guidelines).
- CMFfunctions developed from individual CMF estimates require sufficient detail from the individual studies, such as documentation of base conditions, standard errors, and how underlying potential biases were addressed.

Leadership in Applying Product

Those who can carry these products forward to implementation include those from the practitioner and researcher audiences. Practitioners such as state safety engineers are the target user group for the directly applicable products and can incorporate these guidelines into their agency's practices. Practitioner organizations such as AASHTO can incorporate these guidelines in trade publications such as the *Highway Safety Manual*. Federal Highway Administration (FHWA) and its training arm, the National Highway Institute, can play a role in conducting technical training on using these products, as well as training on basic CMF application and development. FHWA also has the opportunity through its CMF Clearinghouse to develop website functionality to implement some parts of the CMF procedures developed in this research. The research audience, including safety researchers and research groups such as TRB, can incorporate these guidelines into their work and publications, especially the guideline dealing with future CMF and CMFunction development. Researchers also have a responsibility to advance the state of knowledge and provide sufficiently detailed documentation in their research studies, particularly in CMF development studies, to allow users to obtain the information needed to properly use their CMFs in the procedures presented in this research product.

Activities for Successful Implementation

The problem of insufficient data (e.g., high-quality CMFs for treatments of interest) will be overcome in the future as research moves forward and produces more high-quality studies with robust datasets. Researchers must also be strongly encouraged to provide sufficiently detailed documentation of their CMF development to allow the use of the procedures developed in this project. The AASHTO document "Recommended Protocols for Developing Crash Modification Factors" provides a list of the items that should be documented in a CMF development study (Carter et al., 2012).

Another challenge to employing the guidelines will be ensuring that the potential user base (safety engineers) is sufficiently knowledgeable about CMFs, including how to use them appropriately and how to identify CMFs that are correctly applied to their specific situations. Efforts are underway through agencies such as FHWA to provide educational opportunities through brochures, online resources, webinars, and courses. The AASHTO HSM is expected to include much of this research product in the second edition of the HSM; the training for the second edition will presumably provide education on the appropriate use of these procedures and the information required to implement them.

Criteria for Judging Progress and Consequences of Implementation

The success and progress of this project's results will be seen in the incorporation of these guidelines into the safety management practices of state and local agencies, such as benefit-cost analyses. Progress would entail agencies using the procedures from this research to select, adjust, and combine CMFs as intended in this research. Progress would also be seen as future evaluation studies are conducted, whether the researchers incorporate these guidelines in the development of CMFunctions or CMFs that can be used by practitioners with the procedures from this research.