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An Innovation Partnership with States

Quick Start Guide to Using CMFs





A Crash Modification Factor (CMF) estimates a safety countermeasure's ability to reduce crashes and crash severity. Transportation professionals frequently use CMF values to identify countermeasures with the greatest safety benefit for a particular crash type or location. Practitioners can use the following process to identify a CMF for each prospective countermeasure and to inform countermeasure selection. The scenario below illustrates this process.

STEP 1 Develop a List of Prospective Countermeasures.

Ensure these countermeasures address the types of crashes occurring at the identified problem location.

STEP 2 Identify All Relevant CMFs for Each Prospective Countermeasure.

First, contact your State agency to see if there is a State-approved list of CMFs. If not, the CMF Clearinghouse[1] is an extensive, easily accessible, *FREE* online resource that includes all available CMFs, including those from the Highway Safety Manual (HSM) and some State-specific CMF lists[2]. The *CMF Clearinghouse User Guide*[3] provides an overview on how to navigate the website and use CMFs.

Develop a list of all CMFs that relate to each prospective countermeasure. Note differences in effectiveness for different crash and injury types, as these factors may be important considerations when choosing applicable CMFs.

STEP 3 Confirm CMF Applicability.

Prioritize the list of CMFs based on their relevance to the project site. The most applicable CMFs are those which match the project site characteristics such as area type, number of lanes, and traffic volume. This may result in a list of several potential CMFs to use for each countermeasure.

STEP 4 Select a Single CMF for Each Countermeasure.

Once you have narrowed the list of potential CMFs based on site characteristics, select the CMF with the highest star rating. If two studies have the same star rating but different CMF values, read each study to learn about potential differences in study locations or crash type characteristics. For more information about CMF star quality ratings, visit: http://www.cmfclearinghouse.org/sqr.cfm.

SCENARIO: STEP 1

A rural two-lane horizontal curve is experiencing an average of 10 run-off-road (ROR) crashes per year. The curve has centerlines but no edge lines. Upon taking a closer look, the owner agency found that an average of 4 crashes occur during wet conditions while the remaining occur during dry conditions. Due to the high proportion of wet crashes, the agency is considering applying edge lines, chevrons, or a high friction surface treatment (HFST). The agency wants to choose the most cost-effective solution.

SCENARIO: STEP 2

The agency identified all relevant CMFs for each countermeasure. The CMFs range in value because each was developed for a specific crash and injury type.

	CMF Range	Crash Type Addressed	Injury Type Addressed
Edge Lines[4]	0.67-0.96	All, ROR, Speed	All
Chevrons[5, 6]	0.41-0.96	All, ROR, Wet	All, Fatal & Injury
HFST[7]	0.13-0.65	All, Wet	All, Fatal & Injury

1 To access the CMF Clearinghouse, visit: http://www.cmfclearinghouse.org/index.cfm.

2 To find State Specific CMFs on the CMF Clearinghouse, visit: http://www.cmfclearinghouse.org/stateselectedlist.cfm.

3 Federal Highway Administration, CMF Clearinghouse User Guide. Washington, D.C. Accessible at: http://www.cmfclearinghouse.org/userguide.cfm.

4 A.R. Tsyganov, N.M. Warrenchuk, and R. B. Machemehl, "Driver Performance and Safety Effects of Edge Lines on Rural Two-Lane Highways," TRB 88th Annual Meeting Compendium of Papers CD-ROM. Washington, D.C., (2009).

5 Federal Highway Administration Safety Evaluation of Improved Curve Delineation, FHWA-HRT-09-045, (Washington, D.C.: 2009).

6 A. Montella, "Safety Evaluation of Curve Delineation Improvements An Empirical Bayes Observational Before-After Study." TRB 88th Annual Meeting Compendium of Papers CD-ROM. Washington, D.C., (2009).

7 Federal Highway Administration, Evaluation of Pavement Safety Performance, FHWA-HRT-14-065 (Washington, DC: February 2015).

STEP 5 **Apply the CMF.**

After identifying a single CMF for each countermeasure, use the CMF to predict the expected number of crashes after the countermeasure is implemented. To do this using the most simplistic method, multiply the CMF value by the average yearly number of crashes at the project site over the past three to five years. The final value represents the number of crashes expected to occur after the countermeasure has been implemented. FHWA's *CMFs in Practice*[8] series provides more guidance and information on how to apply CMFs using more advanced methods.

STEP 6 **Select Countermeasure.**

Compare the crash reductions calculated in Step 5 for all countermeasures identified in Step 1. Use this comparison to select a countermeasure for the location.

Final Note. It is important to remember that a CMF is only an estimated value of the crash reduction potential of a treatment. Actual crash reductions may vary. The standard error for a CMF can be used to estimate the range of effectiveness one might expect from implementing the countermeasure.

For more information on using CMFs, visit the CMF Clearinghouse at http://www.cmfclearinghouse.org.

8 CMFs in Practice. Federal Highway Administration. Washington, D.C. (2014). Accessible at: http://safety.fhwa.dot.gov/tools/crf/resources/cmfs/.

SCENARIO: STEP 3 & 4

Using chevrons as an example, the agency selected the CMFs most like their project location. Since the majority of crashes are a combination of wet and dry ROR crashes, and nighttime crashes are not a major contributor, the agency narrowed its list to **two CMFs.** The agency made its **final selection** based on the study's Star Rating, even though this CMF had a higher value (indicating lower effectiveness).

	CMF	Site Characteristics	Crash Type	Star Rating
Chevrons	0.78 CMF ID: 2440	Two-lane, rural	Nighttime ROR	★★★★
Chevrons	0.94 CMF ID: 2437	Two-lane, rural	ROR	★★★★
Chevrons	0.41 CMF ID: 1899	Two lane, all	Wet	★★★

The agency performed the same analysis process to choose CMFs for edge lines and HFST.

SCENARIO: STEP 5

The CMFs the agency identified for each countermeasure are applicable to all severity levels. To calculate the expected number of crashes after implementation, the agency multiplied the CMF values for edge lines and chevrons by the total number of ROR crashes. Since the HFST CMF was developed for wet crashes, the agency multiplied this CMF value by the total number of wet crashes. It then added this value to the remaining dry ROR crashes to produce an estimate of the expected number of crashes after HFST implementation.

Countermeasure	CMF	Crash Type	Total # of Crash Expected after Countermeasure Implementation
Edge Lines	0.87 CMF ID: 1948	ROR	10 x 0.87 = **9 crashes**
Chevrons	0.94 CMF ID: 2437	ROR	10 x 0.94 = **9 crashes**
HFST	0.41 CMF ID: 7901	Wet Road	4 x 0.48 = 2 wet crashes 2 wet + 6 dry = **8 crashes**

SCENARIO: STEP 6

If strictly considering crash reductions, the agency may choose HFST, as it has the lowest CMF value (highest effectiveness). However, agencies frequently compare the initial and life cycle costs associated with the treatments before making a final selection. While HFST has the greatest safety benefit and is ideal for treating wet crashes, it is significantly more expensive than the other two options. In a real-world situation, an agency may choose to use an incremental approach, starting with edge lines, then applying chevrons. If wet crashes persist, then HFST may be worth the cost.

U.S. Department of Transportation
Federal Highway Administration

Every Day Counts (EDC), a State-based initiative of FHWA's *Center for Accelerating Innovation*, works with State, local and private sector partners to encourage the adoption of proven technologies and innovations aimed at shortening and enhancing project delivery.