

Practical Limitations

Misapplication of CMFs



Frank Gross, VHB

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I will talk about...

- Keys to proper application
- Common limitations
- Practical solutions

The key to proper application is to identify the applicability of the CMF.

- Crash type
- Crash severity
- Site condition (e.g., area type)

Treatment: Install Traffic Signal			
CMF	Crash Type	Crash Severity	Area Type
0.78 ¹	All	All	All
0.85 ²	All	All	Rural
0.83 ²	All	All	Urban
0.62 ²	All	Fatal	All
1.15 ²	All	PDO	All
1.48 ²	Rear-end	All	All
0.71 ²	Angle	All	All
1.58 ³	Rear-end	All	Rural
0.23 ³	Angle	All	Rural
1.38 ⁴	Rear-end	Fatal/Injury	Urban
0.33 ⁴	Angle	Fatal/Injury	Urban

1. Gan et al., 2005

2. Pernia et al., 2002

3. Harkey et al., 2008

4. McGee et al., 2003

Common limitations include:

- Too many CMFs
- Too few CMFs
- Two or more treatments

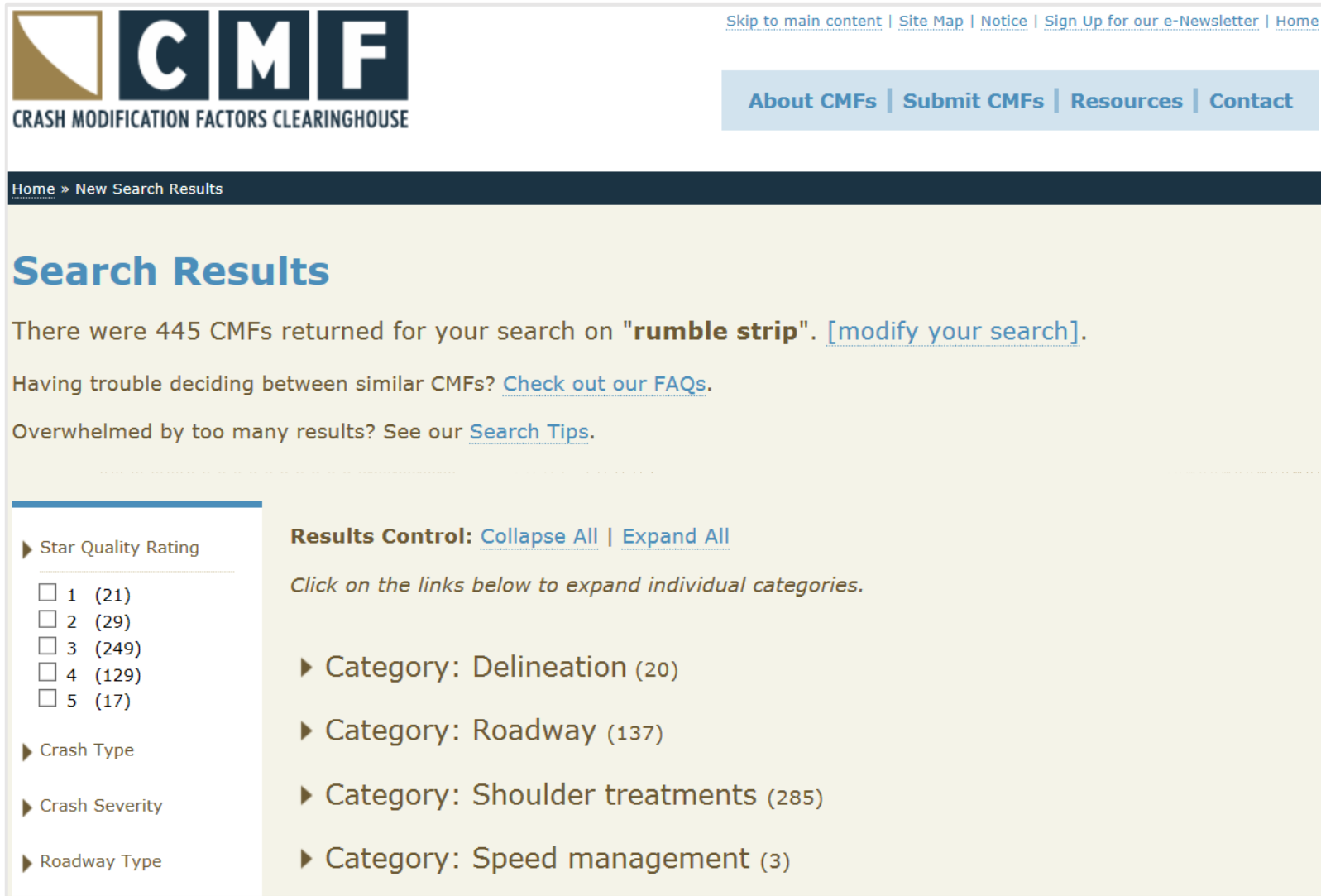
There are too many CMFs so I'll just use the most favorable one.

- ~~Gaming the system?~~
- Using data to support funding request
- Ultimately trying to improve safety



Niccolò Machiavelli: *Courtesy of Wiki*

There are too many CMFs so I'll just use the most favorable one.



The screenshot shows the CMF Clearinghouse website. At the top left is the logo for the Clearinghouse, consisting of a square with a diagonal line and the letters 'CMF' in large, bold, dark blue font, with 'CRASH MODIFICATION FACTORS CLEARINGHOUSE' in smaller text below. To the right of the logo is a navigation bar with links: 'Skip to main content | Site Map | Notice | Sign Up for our e-Newsletter | Home'. Below this is a light blue button with the text 'About CMFs | Submit CMFs | Resources | Contact'. A dark blue breadcrumb trail reads 'Home » New Search Results'. The main heading is 'Search Results' in large blue font. Below the heading, the text states: 'There were 445 CMFs returned for your search on "rumble strip". [modify your search].' It also includes links for 'Check out our FAQs.' and 'Search Tips.'. A 'Results Control' section offers 'Collapse All' and 'Expand All' options, with a note: 'Click on the links below to expand individual categories.'. On the left side, there are filter categories: 'Star Quality Rating' (with checkboxes for 1-5 and counts), 'Crash Type', 'Crash Severity', and 'Roadway Type'. On the right side, there are category filters: 'Category: Delineation (20)', 'Category: Roadway (137)', 'Category: Shoulder treatments (285)', and 'Category: Speed management (3)'.

CMF
CRASH MODIFICATION FACTORS CLEARINGHOUSE

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Home » New Search Results

Search Results

There were 445 CMFs returned for your search on "rumble strip". [\[modify your search\]](#).

Having trouble deciding between similar CMFs? [Check out our FAQs.](#)

Overwhelmed by too many results? See our [Search Tips.](#)

Results Control: [Collapse All](#) | [Expand All](#)

Click on the links below to expand individual categories.

- ▶ Category: Delineation (20)
- ▶ Category: Roadway (137)
- ▶ Category: Shoulder treatments (285)
- ▶ Category: Speed management (3)


▶ Star Quality Rating

- 1 (21)
- 2 (29)
- 3 (249)
- 4 (129)
- 5 (17)


▶ Crash Type

▶ Crash Severity

▶ Roadway Type



There are too many CMFs so I'll just use the most favorable one.



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Search Results

There were 16 CMFs with star ratings returned for this filter selection. [\[modify your search\]](#)

Having trouble deciding between similar CMFs? [Check out our FAQs.](#)

Star Quality Rating

- 1 (0)
- 2 (0)
- 3 (0)
- 4 (14)
- 5 (2)

▶ Crash Type

▶ Crash Severity


▶ Roadway Type

▶ Area Type

Results Control: [Collapse All](#) | [Expand All](#)

Click on the links below to expand individual categories.

- ▼ Category: Roadway (4)
 - ▼ Subcategory: Roadway rumble strips (4)
 - ▶ Countermeasure: Install edgeline rumble strips
 - ▶ Countermeasure: Install edgeline rumble strips on roadways with a shoulder width of 5 feet or greater



There are too many CMFs so I'll just use the most favorable one.

▼ Countermeasure: Install edgeline rumble strips

CMF	CRF (%)	Quality	Crash Type	Crash Severity	Area Type	Reference	Comments
0.67	33	★★★★★	Run off road	Fatal,Serious injury,Minor injury	Rural	Torbic et al., 2009	The authors collected data on ... [read more]
0.61	39	★★★★★	Run off road	Fatal,Serious injury,Minor injury	Rural	Torbic et al., 2009	The authors collected data on ... [read more]


▼ Countermeasure: Install edgeline rumble strips on roadways with a shoulder width of 5 feet or greater

CMF	CRF (%)	Quality	Crash Type	Crash Severity	Area Type	Reference	Comments
0.34	66	★★★★★	Run off road	Fatal,Serious injury,Minor injury	Rural	Torbic et al., 2009	The authors collected data on ... [read more]
0.57	43	★★★★★	Run off road	Fatal,Serious injury,Minor injury	Rural	Torbic et al., 2009	The authors collected data on ... [read more]

There are too few CMFs, so I'll just pick one that is close.



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Search Results

There were 4 CMFs with star ratings returned for this filter selection. [\[modify your search\]](#)

Having trouble deciding between similar CMFs? [Check out our FAQs.](#)

Star Quality Rating

- 1 (0)
- 2 (0)
- 3 (0)
- 4 (3)
- 5 (1)

Crash Type


Crash Severity

- All (0)
- Fatal (3)
- Serious injury (2)
- Minor injury (2)
- Property damage only

Results Control: [Collapse All](#) | [Expand All](#)

Click on the links below to expand individual categories.

- ▼ **Category: Intersection geometry (4)**
 - ▼ **Subcategory: Turn lanes (4)**
 - ▶ Countermeasure: Painted channelization of both major and minor roads
 - ▶ Countermeasure: Physical channelization of both major and minor roads
 - ▶ Countermeasure: Provide a right-turn lane on one major-road approach



There are too few CMFs, so I'll just pick one that is close.

▼ Category: Intersection geometry (4)

▼ Subcategory: Turn lanes (4)

▶ Countermeasure: Painted channelization of both major and minor roads

▶ Countermeasure: Physical channelization of both major and minor roads

▼ Countermeasure: Provide a right-turn lane on one major-road approach

CMF	CRF (%)	Quality	Crash Type	Crash Severity	Area Type	Reference	Comments
0.91 [B]	9	★★★★★	All	Fatal, Serious Injury, Minor Injury	All	Harwood et al., 2002	Countermeasure name changed to match ... [read more]
0.77 [B]	23	★★★★☆	All	Fatal, Serious Injury, Minor Injury	All	Harwood et al., 2002	Countermeasure name changed to match ... [read more]

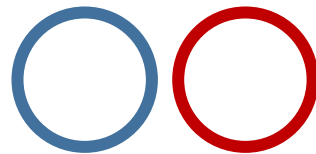
How do you handle a situation in which there is no CMF for the contemplated countermeasure?

- a) Move on: no benefit computed for the countermeasure.
- b) Select something close: use a CMF for a similar countermeasure.
- c) Make it up: use engineering judgment to estimate the relative effect of the countermeasure.
- d) Other: please describe.

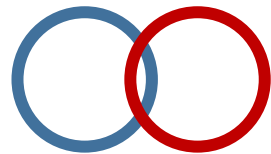
Can't you simply multiply CMFs for two or more treatments?

- Sometimes, but not always

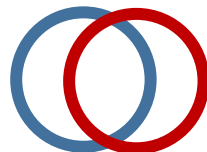
$$\text{CMF} \times \text{CMF} = ?$$



Reasonable estimate



Minor over-estimation



Severe over-estimation

Can't you simply multiply CMFs for two or more treatments?

- Can you multiply these two CMFs?

Strategies	CMF	Target Crashes
STOP AHEAD pavement markings	0.88	Fatal/Injury
Flashing beacon on top of existing stop signs	0.42	Angle

Practical Solutions

- Estimate impacts independently and then combine results

Strategies	CMF	Target Crashes	Annual Benefit	Present Value of Benefit
STOP AHEAD pavement markings	0.88	Fatal/Injury	\$2,206	\$9,551
Flashing beacon on top of existing stop signs	0.42	Angle	\$13,219	\$102,073

Practical Solutions

- Develop guideline for selecting/applying CMFs
- Develop spreadsheet for B/C analysis

Proposed Improvement	CMF Value	Applicable Crash Types	Applicable Crash Severities	Include CMF in Final Analysis? (yes/no)
1. Install traffic signal	0.23	Angle	All	yes
	0.4	Left turn	All	yes
	1.58	Rear end	All	yes
2. Install left-turn lane	0.52	All	All	no
	0.42	All	K, A, B+C	yes
3. Install roundabout	0.29	All	All	no
	0.13	All	K, A, B+C	yes

Do you have guidelines for selecting CMFs?

- a) Yes: flexible to allow users to select from the Clearinghouse.
- b) Yes: prescriptive list of CMFs for all to use (limited variance).
- c) No: currently a free-for-all.

Wrap-up

- Practice data-driven decision-making
- CMFs have limitations
- Deal with it

Modification Factors

The CMFs in Practice series is an excellent resource for transportation professionals. The series addresses important safety exceptions, which are essential for allowing

- John E. Wright, P.E., Director, Highway Design & Construction, Indiana Department of Transportation

Nationwide, transportation professionals are using crash modification factors (CMFs) to estimate how the design of a roadway countermeasure can affect crashes. In the CMFs in Practice series, road safety professionals share ways in which CMFs are being used, and discuss the information in making educated decisions in the field.

Five separate guides document the use of CMFs in:

- Roadway Safety Management
- Road Safety Audits
- Development and Analysis of Alternatives
- Design Decisions and Exceptions
- Value Engineering

Each guide in the series includes a step-by-step process for how CMFs can be applied in a specific context, a real-world application of CMFs, discussion of the benefits of applying CMFs, and opportunities to overcome common challenges.

ROADWAY SAFETY MANAGEMENT

When used in the roadway safety management process, CMFs help teams select countermeasures and justify them with an economic evaluation. A case study from Michigan's Targeted Affordable Roadway Solution (TARS) program shows how targeted critical safety and congestion issues were identified across the state. Study teams identify potential safety issues, along with a list of potential countermeasures, then applied to help justify and prioritize them. CMFs are used by decision-makers to identify the most effective and eventually leading to more safety-focused countermeasures.

ROAD SAFETY AUDITS

CMFs can be applied in the Road Safety Audit (RSA) process to quantify the safety effects of treatment alternatives. CMFs were applied by the Michigan Department of Transportation (MDOT) on a RSA. In their report, the RSA team identified the most effective countermeasure and quantified the crash reduction based on the CMF for each countermeasure, and the cost of the analysis can be used when

Thank you!

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