

Synthesis of Countermeasure Service Life and Crash Severity Costs User Guide

Background

Crash modification factors/functions (CMFs) are a valuable tool that can help identify the most effective countermeasures to improve roadway infrastructure safety. In addition to CMFs, countermeasure service life and crash severity costs are also needed to conduct an economic appraisal or crash based cost benefit analysis of potential countermeasures for implementation. Crash based cost/benefit analyses provide users with a quantitative measure to assist in the decision making process for determining which safety area(s) or countermeasure(s) would be most cost effective for addressing safety concerns and helping to reduce the number and severity of crashes in a particular area. While the CMF Clearinghouse provides an online database of all available CMFs, there is not similar documentation of countermeasure service life and crash severity cost information. Therefore, FHWA conducted a synthesis to identify information used by the states for countermeasure service life and crash severity costs. The results of the synthesis are included in this user guide.

Literature Review

Many states have documentation of countermeasures service life and crash severity costs they use for economic appraisals including crash based cost/benefit analyses. Some of this documentation is made publicly available on State DOT safety websites or published in Highway Safety Improvement Program (HSIP) Manuals or other documentation. A literature review was conducted to identify the various sources of available information. Appendix A includes the results of the literature review. Some states are listed twice in Appendix A as multiple sources of documentation were found. If a state is not listed, the research team was unable to find any pertinent information.

The relevant information identified through the literature review was synthesized in two databases, one for countermeasure service life and the other for crash severity costs. A brief description of the database variables is included in Appendix B. In total, information for 19 states was obtained for countermeasure service life. Countermeasure service life information is available for approximately 345 countermeasures across 18 countermeasure categories. Thirty-one states had documentation of costs used for different crash severities.

Synthesis Results

The results of the synthesis are presented in summary tables that were produced from the countermeasure service life and crash cost severity databases. A description of each summary table is provided below and can be accessed at the [CMF Clearinghouse website](#).

Countermeasure Service Life by State

For countermeasure service life, a summary table was made for each of the 15 countermeasure categories used by the CMF Clearinghouse with an additional three categories to include

countermeasures categorized as “Resurfacing”, “Structures”, or “Other”. If multiple sources for a state were used, they are listed separately. Service lives for countermeasures (names cleaned for uniformity by the research team) populate the cells. Ranges indicate multiple values for a particular countermeasure name either dictated by the state from the available resource or combined by the research team. An example of a range developed from a combination made by the research team can be found in the “Delineation” category. For countermeasure “Install/upgrade pavement markings/delineators” Illinois includes four types of tapes, paints, and markers with service lives varying from one to four years. Thus the value in the summary table for “Install/upgrade pavement markings/delineators” for Illinois is “1-4”. A description of each field in the countermeasure service life summary tables is provided in Table 1 below.

Table 1. Variables for countermeasure service life summary tables

Variable	Definition	Example/Notes
Countermeasure Category	Countermeasure category used by the CMF Clearinghouse	Additional categories added for “Resurfacing”, “Structures”, and “Other”
Countermeasure Name	Name of countermeasure cleaned for uniformity by the research team	“Widen shoulder (paved)”, “Widen paved shoulder (to 5 ft or less)”, “Widen paved shoulders (to > 5 ft)”, and “Widen shoulder width (paved ADT >2K)” were all renamed to “Widen paved shoulder”
State	Abbreviation of state name	
Year	Year of source record	
Source	Name of source with link (if applicable)	Some information was obtained from emails and files sent to the research teams so links are unavailable.
Service Life (populated cells)	Value (or range of values) indicated by state in source	For countermeasure “Install/upgrade pavement markings/delineators” Illinois includes four types of tapes, paints, and markers with service lives varying from one to four years. Thus the value in the summary table for “Install/upgrade pavement markings/delineators” for Illinois is “1-4”.

Crash Severity Costs by State

For crash severity cost, only one summary table was generated from the database. In most cases, states reported crash severity costs using the “KABCO” scale where K indicates a fatal injury, A indicates an incapacitating injury, B indicates a non-incapacitating injury, C indicates a possible injury, and O indicates property damage only. Some states indicated additional or other crash severities which are covered in the “Other Crash Severity” fields. A description of each field in the crash severity cost summary table is provided in Table 2 below.

Table 2. Variables for crash severity cost summary table

Variable	Definition	Example/Notes
State	Abbreviation of state name	
Cost of Fatal Crash (K)	Dollar value of crash severity cost	
Cost of Incapacitating Crash (A)	Dollar value of crash severity cost	
Cost of Non-Incapacitating Crash (B)	Dollar value of crash severity cost	
Cost of Possible Crash (C)	Dollar value of crash severity cost	
Cost of Property Damage Only Crash (O)	Dollar value of crash severity cost	
Cost of Other Crash Severity (1) & (2)	Dollar value of crash severity cost	
Other Crash Severity Description (1) & (2)	Description of crash severity	“Non fatal disabling injury”
Information Source	Name of source (if applicable)	Some information was obtained from emails and files sent to the research teams so source names are unavailable.
Information Source Year	Year of source record	
Link to Source	Link to source (if applicable)	Some information was obtained from emails and files sent to the research teams so source links are unavailable.

Noteworthy Practices

During the course of the synthesis, a few states stood out as having exemplary documentation of countermeasure service life information. Two such examples are California (Figure 1) and Texas (Figure 2). Each provide the name of the countermeasure, a brief description, applicable CMF, service life, cost (if applicable), and crash types addressed. The California document also gives examples of where to use the countermeasure and why it works. These resources are good examples and could be of use to other states in the future development of service life and CMF documentation.

Roadway Countermeasures

Name: Add Segment Lighting		Caltrans CM Number: R1
Where to use: Noted substantial patterns of nighttime crashes. In particular, patterns of rear-end, right-angle, turning or roadway departure collisions on the roadways may indicate that night-time drivers can be unaware of the roadway characteristics. * For Caltrans' statewide Calls-for-Projects: This CM only applies to "night" crashes (all types) occurring within limits of the proposed roadway lighting.		
Why it works: Providing roadway lighting, improves the safety during nighttime conditions by (1) making drivers more aware of the surroundings, which improves drivers' perception-reaction times, (2) enhancing drivers' available sight distances to perceive roadway characteristic in advance of the change, and (3) improving non-motorist's visibility and navigation.		
General Qualities (Time, Cost, Effectiveness): It is expected that projects of this type may be constructed in a year or two and are relatively costly. There are several types of costs associated with providing lighting, including the cost of providing a permanent source of power to the location, the cost for the luminaire supports (i.e., poles), and the cost for routinely replacing the bulbs and maintenance of the luminaire supports. Some locations can result in high B/C ratios, but due to higher costs, these projects often result in medium to low B/C ratios.		
	General Use	Values for Caltrans Statewide Programs (Calls-for-Projects)
Crash Types Addressed:	Night, All	Night (All types)
Crash Reduction Factor:	18 - 69 %	35% (with an expected life of 20 years)

Figure 1. Source: Local Roadway Safety – A Manual for California’s Local Road Owners Version 1.1, April 2013

100 Codes — Signing and Signals

Signing and Signals

101	Install Warning/Guide Signs	
	Definition:	Provide advance signing for unusual or unexpected roadway features where no signing existed previously.
	Reduction Factor (%):	20
	Service Life (Years):	6
	Maintenance Cost:	N/A
	Preventable Crash:	(Vehicle Movements/Manner of Collision = 20–22 or 30) OR (Roadway Related = 2, 3 or 4)

Figure 2. Source: Texas DOT HSIP Work Codes Table (Revised 5/1/2013)

Summary

It is important for researchers and practitioners to have as much information as possible when selecting which countermeasures to use to improve roadway infrastructure safety and reduce the number and severity of crashes. Crash based cost/benefit analyses are a great tool for states to use to determine which countermeasures would be most cost effective in improving safety for roadway users. Countermeasure service life and crash severity cost information are necessary pieces to conduct these analyses. The results of this synthesis will provide researchers and practitioners with additional information to conduct economic appraisals of potential countermeasures.

Appendix A: Literature Review Sources

Results of literature review for countermeasure service life

State	Resource Name	Resource Source	Link
AK	Alaska Highway Safety Improvement Program Handbook (April 2014)	FHWA website	http://dot.alaska.gov/stwddes/dcstraffic/pop_hsip.shtml
AZ	The Arizona Highway Safety Improvement Program Manual (March 2010)	Google search	http://azmemory.azlibrary.gov/cdm/ref/collection/statepubs/id/19841
CA	Local Roadway Safety - A Manual for California's Local Road Owners (April 2013)	FHWA website	http://www.dot.ca.gov/hq/LocalPrograms/HSIP/Documents/hsip/CA_SM4LROv11.pdf
CT	Power Point ("Other State's Service Life Summary - 050214)	North Carolina DOT	
IL	Appendix F Safety Improvements - Service Life	FHWA website	http://www.dot.il.gov/safetyEng/01092008_Appendix_F.pdf
IL	Illinois DOT staff email response to listserv	Illinois DOT	
IN	Power Point ("Other State's Service Life Summary - 050214)	North Carolina DOT	
IA	Iowa's Traffic Safety Analysis Manual (January 2012)	North Carolina DOT	http://www.intrans.iastate.edu/reports/traffic_safety_analysis_manual.pdf
KY	Power Point ("Other State's Service Life Summary - 050214)	North Carolina DOT	
KY	Kentucky DOT staff email response to listserv	Kentucky DOT	
MN	Minnesota HSIP Program Criteria	Google search	http://www.dot.state.mn.us/trafficing/safety/funding/pdf/2013-14%20HSIP%20Program%20Final.pdf
MO	Manual on Identification, Analysis and Correction of High Crash Locations (HAL manual)	FHWA	http://www.modot.org/safety/Safety_Engineering/documents/Hal%20Manual.pdf
NV	State Highway Preservation Report (Feb 2013)	Google search	http://www.nevadadot.com/uploadedFiles/NDOT/About_NDOT/NDOT_Divisions/Planning/2013%20State%20Highway%20Preservation%20Report.pdf
NY	4-Service Life_Capital Recovery Factors (New York, Rob Limoges).xlsx	New York DOT	
NC	NCDOT service life document (Attachment 2 - Service Life.xls)	North Carolina DOT	
OH	Power Point ("Other State's Service Life Summary - 050214)	North Carolina DOT	http://www.dot.state.oh.us/Divisions/Planning/SPPM/SystemsPlanning/Pages/HSM_DataAnalysis.aspx

State	Resource Name	Resource Source	Link
OK	Power Point ("Other State's Service Life Summary - 050214)	North Carolina DOT	
OR	Oregon Department of Transportation Traffic Manual 2013 Edition	Google search	http://www.oregon.gov/ODOT/HWY/TRAFFIC-ROADWAY/docs/pdf/traffic_manual_13.pdf
SC	Power Point ("Other State's Service Life Summary - 050214)	North Carolina DOT	
TX	Texas Department of Transportation Highway Safety Improvement Program (HSIP) Work Codes Table (5/1/13)	FHWA website	http://ftp.dot.state.tx.us/pub/txdot-info/trf/hsipworkcodetable.pdf

Results of literature review for crash severity costs used by the States

State	Resource Name	Resource Source	Link
AK	Alaska Highway Safety Improvement Program Handbook	FHWA website	http://dot.alaska.gov/stwddes/dcstraffic/pop_hsip.shtml
AZ	The Arizona Highway Safety Improvement Program Manual	Google search	http://azmemory.azlibrary.gov/cdm/ref/collection/statepubs/id/19841
CA	Local Roadway Safety: A Manual for California's Local Road Owners	FHWA website	http://www.dot.ca.gov/hq/LocalPrograms/HSIP/Documents/hsip/CA_SM4LROv11.pdf
CO	Colorado DOT email to FHWA	FHWA	
DE	Delaware uses national crash costs	FHWA	
ID	Idaho Traffic Crashes 2013	Google search	itd.idaho.gov/ohs/2013Data/Analysis2013Final.pdf
IL	2011 Illinois Crash Facts and Statistics	Google search	www.idot.illinois.gov/Assets/uploads/files/Transportation-System/Resources/Safety/Crash-Reports/crash-facts/2011_Crash_Facts.pdf
IN	The Economic Impact of Motor Vehicle Crashes, 2000 (DOT HS 809 446)	Google search	http://www.nhtsa.gov/DOT/NHTSA/Communication%20&%20Consumer%20Information/Articles/Associated%20Files/EconomicImpact2000.pdf
IA	Effectiveness of Roadway Safety Improvements Final Report	North Carolina DOT	
KS	Kansas DOT memo to FHWA	FHWA	
KY	Cost of Kentucky Traffic Collisions	Kentucky DOT	
LA	Louisiana DOT staff email response to listserv (Average Cost per Person)	Louisiana DOT	http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Multimodal/Highway_Safety/Pages/Highway_Safety_Analysis_Toolbox.aspx [
LA	Louisiana DOT staff email response to listserv (Including Loss of Quality	Louisiana DOT	http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Multimodal/Highwa

State	Resource Name	Resource Source	Link
	of Life)		y_Safety/Pages/Highway_Safety_Analysis_Toolbox.aspx [
MI	More Michigan Crash Facts/2013 Cost of Crashes	FHWA	http://publications.michigantrafficcrashfacts.org/2013/1yr_2.pdf
MN	Highway Safety Improvement Program State of Minnesota Program Criteria Metro District	Google search	http://www.dot.state.mn.us/trafficing/safety/funding/pdf/2013-14%20HSIP%20Program%20Final.pdf
MO	Crash Costs in Missouri (excel spreadsheet)	FHWA	
NE	Nebraska Cost Estimate for Alcohol-Related Motor-Vehicle Crashes in 2012	Google search	http://www.transportation.nebraska.gov/nohs/pdf/alccosts.pdf
NV	Nevada DOT staff email response to listserv	Nevada DOT	
NH	New Hampshire DOT Highway Safety Improvement Program Manual and Guidance	FHWA	
NM	New Mexico Traffic Crash Annual Report 2011 (Human Capital Costs per Crash)	Google search	http://www.unm.edu/~dgrint/reports/annual/ar2011.pdf
NM	New Mexico Traffic Crash Annual Report 2011 (Comprehensive Costs per Crash)	Google search	http://www.unm.edu/~dgrint/reports/annual/ar2011.pdf
NY	NYS DOT - Safety Information Management System	Google search	https://www.dot.ny.gov/divisions/operating/osss/highway-repository/2012_13AvrAccCosSev.pdf
OR	Excel Spreadsheet "Benefit-Cost form in Microsoft Excel"	Google search	http://www.oregon.gov/ODOT/HWY/TRAFFIC-ROADWAY/Pages/highway_safety_program.aspx
PA	2013 Pennsylvania Crash Facts & Statistics	Google search	ftp://ftp.dot.state.pa.us/public/Bureau/HighwaySafety/Web%20Development/Crash%20Facts%20Book/2013_CFB_linked.pdf
SC	South Carolina Traffic Collision Fact Book 2009	Google search	http://www.scdps.gov/ohs/2009TrafficCollisionFactBook.pdf
SD	South Dakota DOT staff email response to listserv (Average Economic Cost by Injury Severity)	South Dakota DOT	http://www.nsc.org/news_resources/injury_and_death_statistics/Pages/EstimatingtheCostsofUnintentionalInjuries.aspx
SD	South Dakota DOT staff email response to listserv (Average Comprehensive Cost by Injury Severity)	South Dakota DOT	http://www.nsc.org/news_resources/injury_and_death_statistics/Pages/EstimatingtheCostsofUnintentionalInjuries.aspx

State	Resource Name	Resource Source	Link
TX	Comparison of Motor Vehicle Traffic Deaths, Vehicle Miles, Death Rates, and Economic Loss 2003-2013	Google search	http://ftp.dot.state.tx.us/pub/txdot-info/trf/crash_statistics/2013/2013-a.pdf
VA	Virginia DOT staff email response to listserv	Virginia DOT	
WV	West Virginia DOT email to FHWA	FHWA	
WI	2012 Wisconsin Traffic Crash Facts	Google search	http://www.dot.wisconsin.gov/safety/motorist/crashfacts/docs/crashfacts2012.pdf

Appendix B: Database Variables

The following variables are included in the countermeasure service life database:

- Countermeasure name used by the State
- Countermeasure name cleaned for uniformity by the research team (to make summary tables easier to understand)
 - Example: “Widen shoulder (paved)”, “Widen paved shoulder (to 5 ft or less)”, “Widen paved shoulders (to > 5 ft)”, and “Widen shoulder width (paved ADT >2K)” were all renamed to “Widen paved shoulder”
- Countermeasure category used by the State
- Countermeasure category used by the CMF Clearinghouse (to allow for consistency between the countermeasure service life database and the CMF Clearinghouse)
 - Example: The countermeasures in the example above were categorized as “Roadway”, “Roadway Work”, or “Pavement Improvement” by the state and were re-categorized as “Shoulder treatments” to be consistent with the categories in the CMF Clearinghouse.
- Estimated service life
- State
- Information source
- Information source year
- Link to source
- Notes

The following variables are included in the crash severity cost database:

- State
- Cost of fatal crash (K)
- Cost of incapacitating injury crash (A)
- Cost of non-incapacitating injury crash (B)
- Cost of possible injury crash (C)
- Cost of property damage only crash (O)
- Cost of other crash severity (1)
- Other crash severity description (1)
 - Example: “Non fatal disabling injury”
- Cost of other crash severity (2)
- Other crash severity description (2)
- Cost derived from (State, NSC, etc)
- Cost derived from notes
- Information source
- Page number
- Information source date
- Information source year
- Link to source
- Notes