State Policies and Procedures on Use of the Highway Safety Manual

September 2016

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Safe Roads for a Safer Future
Investment in roadway safety saves lives

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16. Abstract

The 2010 publication of the Highway Safety Manual (HSM), 1st Edition, by the American Association of State Highway and Transportation Officials (AASHTO) was an important milestone in advancing the quality of safety analyses supporting highway investment decision making. One impediment to progress that will be addressed in this informational report is the lack of State policy on the use of the HSM in those processes. The States participating in the HSM Implementation Pooled-Fund Study (TPF-5(255)) identified the need for a compilation and synthesis of existing State policies and development of sample policy and procedures language covering a range of activities in which use of the HSM would be beneficial. The *State Policies and Procedures on Use of the Highway Safety Manual* Informational Report was created to present sample language as generalized statements adapted from noteworthy examples of existing language in State DOT manuals and policies. For States in which integrating the HSM into typical agency practices has been slower than desired, the informational report provides a starting point that can accelerate efforts to develop and adopt policies and procedures to support implementation of the HSM.

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Highway Safety Manual, policy, procedure, transportation planning, programming, design, engineering, design exception, operations, maintenance, safety management, predictive method, Louisiana, Washington

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

3R—Resurfacing, restoration, and rehabilitation

AJR—Access Justification Reports

AASHTO—American Association of State Highway Transportation Officials

B/C—Benefit/cost

CMF—Crash Modification Factor

DelDOT—Delaware Department of Transportation

DOT—Department of Transportation

ECAT—Economic Crash Analysis Tool

EIS—Environmental Impact Statement

FHWA—Federal Highway Administration

FDOT—Florida Department of Transportation

GDOT—Georgia Department of Transportation

HSIP—Highway Safety Improvement Program

HSM—Highway Safety Manual

IDOT—Illinois Department of Transportation

INDOT—Indiana Department of Transportation

IHSDM—Interactive Highway Safety Design Model

ISATe—Enhanced Interchange Safety Analysis Tool

ICA—Intersection Control Analysis

ICE—Intersection Control Evaluation

LADOTD—Louisiana Department of Transportation and Development

LHSC—Louisiana Highway Safety Commission

LSP—Louisiana State Police

MUTCD—Manual of Uniform Traffic Control Devices

MoDOT—Missouri Department of Transportation

NCHRP—National Cooperative Highway Research Program

NEPA—National Environmental Policy Act

NHDOT—New Hampshire Department of Transportation

NYSDOT—New York State Department of Transportation

ODOT—Ohio Department of Transportation

PennDOT—Pennsylvania Department of Transportation

PRR—Preservation/rehabilitation/replacement

RSA—Road Safety Assessment

SRI—Safer Roads Index

SPF—Safety Performance Function

SHSP—Strategic Highway Safety Plan

TIA—Traffic Impact Analyses

TRB—Transportation Research Board

VDOT—Virginia Department of Transportation

WSDOT—Washington State Department of Transportation

WSP—Washington State Patrol

WTSC—Washington Traffic Safety Commission

INTRODUCTION

OVERVIEW

The 2010 publication of the Highway Safety Manual (HSM), 1st Edition, by the American Association of State Highway and Transportation Officials (AASHTO) was an important milestone in advancing the quality of safety analyses supporting highway investment decisionmaking. AASHTO, Federal Highway Administration (FHWA), the National Cooperative Highway Research Program (NCHRP), the Transportation Research Board (TRB), and State Departments of Transportation (DOT) have worked collaboratively to support implementation of the HSM. As part of this collaborative effort, FHWA worked with AASHTO and participating States to organize the HSM Implementation Pooled-Fund Study which is funding this project. The objective of this pooled fund study is to develop tools and materials that advance implementation of the HSM.

State DOTs report good progress in implementing HSM concepts and methods within their safety management processes. They report slower progress, however, in project development processes (for example, planning, programming, environmental processes, design, construction, operations, and maintenance). One impediment to progress that will be addressed in this informational report is the lack of State policy on the use of the HSM in those processes.

The States participating in the HSM Implementation Pooled-Fund Study identified the need for a compilation and synthesis of existing State policies and development of sample policy and procedures language covering a range of activities in which use of the HSM would be beneficial. Within this report, the “sample” language is presented as generalized statements adapted from noteworthy examples of existing language in State DOT manuals and policies. For States in which integrating the HSM into typical agency practices has been slower than desired, information presented herein will provide a starting point that can accelerate efforts to develop and adopt policies and procedures to support implementation of the HSM. It is not the expectation or intent that States would use the sample language verbatim, rather that they would use it as a template which they could customize.

More than 60 HSM-related State agency documents were gathered and reviewed during the development of this report. A majority of the documents focus on planning and programming, engineering and design, operations and maintenance, and roadway safety management processes. These documents were gathered from a compiled list of sources identified by FHWA, the project team, and the Pooled-Fund Study States.

From this compilation of source documents, the project team identified and extracted noteworthy examples of HSM-related policies and procedures language, as well as example applications to use as the basis for development of the sample language presented in this informational report.

ORGANIZATION OF THE REPORT

The main body of this report is organized as follows:

- **Section 2: Sample Language—**This section provides noteworthy examples or applications of State DOTs policy and procedures language and accompanying sample policy and procedures language. This information is provided for:
  - Planning and Programming.
  - Engineering and Design.
  - Operations and Maintenance.
  - Roadway Safety Management Process.
- **Section 3: Case Studies—**This section provides case studies from two States and their experiences incorporating HSM-based language in policy or manuals.

SAMPLE LANGUAGE TERMINOLOGY

With State DOTs at different levels of HSM implementation, the sample language in this informational report is presented in the format of "shall," "should," and "may" conditions. The FHWA Manual of Uniform Traffic Control Devices (MUTCD) is an excellent example of the application of the "may," "should," and "shall" concept and is used as the basis to define these conditions.[1] The following is a description of each of these three categories:

[1] U.S. Department of Transportation, Federal Highway Administration, Manual on Uniform Traffic Control Devices, 2009 Edition, p. 10. See http://mutcd.fhwa.dot.gov/index.htm.

- **Shall—**The verb "shall" is typically used as a statement of required or mandatory application of the HSM or a specific component of the HSM. The verbs "must" and "will" are synonyms for "shall."
- **Should—**The verb "should" is typically used as a statement of recommended, but not mandatory, practice in typical situations. The verbs "recommend" and "consider" are synonyms for "should."
- **May—**The verb "may" is typically used as a statement of practice that is a permissive action and bears no requirement or recommendation. The verbs "can" and "could" are synonyms to "may."

When considering the strength of sample language, use of the words "may" or "should" implies choice; however, this informational guide is not prescribing language but rather offering examples.

POLICY STATEMENTS AND GUIDANCE/PROCEDURE LANGUAGE FORMAT

In the development of sample language, the overall intent of the language must be considered. In this informational report supporting development of sample language for State practices, there are two categories of language presented: policy statements and guidance/procedure language. A policy statement provides a basis for and the principles undergirding the policy. Policy statements indicate why actions are to be completed rather than how to complete them. The guidance/procedure language contains more descriptions of the topic and generally provides directions, advice, and information.

Throughout the report, for each topic area the report provides a description of the topic or process along with a noteworthy State DOT example or application (if available) and sample language in the form of a policy statement followed by procedures information. This approach is shown throughout the report in the following format:

- Process (transportation planning, programming, design, design exception, etc.).

  This section provides a description of the topic area and essential characteristics of the specified process/program. This section also may describe an opportunity to use the HSM to evaluate safety performance throughout the process steps.

- Noteworthy example(s):

  This section describes a noteworthy example of current policy or procedures language or example application from a State DOT. The example is specific to the section topic (i.e., planning and programming, engineering and design, operations and maintenance, roadway safety management process).

  - A noteworthy example labeled as an "Example Application" is a description of how the HSM is used by the identified State DOT within a policy or guidance document.
  - A noteworthy example labeled as "Example Language" is a direct quote or extraction of the information from the State DOT's policy and/or guidance documents.

- Sample policy language.

  The sample policy language is a template describing a direction for using the HSM for the topic area and begins with the phrase, "It is the policy of the Department."

- Sample procedures language.

  The sample procedures language is a template describing how to implement a policy using the HSM and begins with the phrase, "To implement this policy." This information may include a responsible position/office and/or use of specific HSM chapters, methods, or tools.

SAMPLE LANGUAGE

OVERVIEW

The report provides noteworthy examples or applications of policy or procedures statements along with the sample language. The selected State Department of Transportation (DOT) examples or applications cover specific areas in the project development process, including planning and programming, engineering and design, operations, and maintenance, and roadway safety management processes.

HIGHWAY SAFETY MANUAL IN PLANNING AND PROGRAMMING

Federal requirements state that safety must be explicitly considered in the transportation planning process. In addition, Federal legislation requires that transportation agencies prepare strategic highway safety plans, long-range transportation plans, and other statewide plans. Integrating safety into long-term system plans (20-year plans) provides highway agencies with the ability to set the vision, goals, and strategies to proactively develop transportation systems that will result in fewer fatalities and serious injuries. Near-term planning (5- to 10-year project planning) also provides the opportunity to plan and program projects to address known safety issues or integrate safety features into projects focused on other transportation services such as mobility, maintenance, connectivity, or access. The programming process allocates funds to projects according to an ongoing cycle–often a four-year cycle at the State level. Analysis methods identified in the Highway Safety Manual (HSM) can be used to support decisionmaking in the long-term planning process, project-planning process, and project-prioritization process.

Long-Range Transportation Planning

The long-range transportation planning process can broadly be defined as having the following elements:

- **Data collection and analysis** to identify needs, priorities, policies, programs, and projects.
- **Goals and objectives** to frame those needs and priorities and establish evaluation criteria.
- **Performance measures and targets** to evaluate alternatives and track progress towards the goals and objectives.

- **Project analysis, prioritization, and programming** to identify the mix of projects that meet the goals and objectives of the plan and help to make progress towards the performance target.
- **Evaluation** to understand the extent to which safety performance for the transportation system, modes, or behaviors is changing and where future investments can be made.[2]

Descriptive safety data analyses can be used to establish goals, objectives, and performance measures for a long-range transportation plan. Also, safety data is an important component of the examination of current conditions for a transportation system. As explained in the HSM, descriptive analyses summarize and tabulate information about crashes such as crash frequency, severity, or type using crash counts.[3] Forecasting safety performance of a transportation network can be done using network-level safety forecasting methods provided in the HSM; however, the models would have to be very comprehensive to match the scale of most State and urban transportation networks. As planning activities become more project specific (near-term planning or programming activities), the HSM Part C predictive method and/or Crash Modification Factors (CMF) in the HSM become more relevant.

Noteworthy Example

- **Example Application:** The Ohio Department of Transportation (ODOT) used their AASHTOWare Safety Analyst model to develop the Access Ohio 2040 long-range transportation plan. Future vehicle miles traveled from the State travel demand model were combined with crash data from the statewide AASHTOWare Safety Analyst model to predict the future safety impacts of alternative networks. Source: Ohio Department of Transportation, "Access Ohio, 2040," February 2013, Page 27. See http://www.dot.state.oh.us/Divisions/Planning/SPR/StatewidePlanning/access.ohio/Pages/default.aspx.[4]

[2] See U.S. Department of Transportation, Federal Highway Administration, Performance Based Planning and Programming Guidebook, September 2013.

[3] American Association of State Highway and Transportation Officials, Highway Safety Manual, 1st Edition, 2010, p. 5-2.

[4] All hyperlinks provided in this document were accessed by the authors on August 16, 2016.

Sample Policy Language

It is the policy of the Department that HSM methods shall (should/may) be used in long-range plans to identify projects, programs, or policies that support safety goals and objectives in the plan.

Sample Guidance/Procedure Language

To implement this policy, the HSM methodologies shall (should/may) be used in the long-range transportation planning process. Descriptive analyses summarizing statewide and/or regional crash trends (e.g., crashes by type, urban or rural, behavior) can provide information about the types of projects which might drive down fatalities and serious injuries. State or regionwide safety prediction models can be developed and used to estimate future safety conditions and evaluate alternative transportation system scenarios.

Near-Term Transportation Planning and Programming

In near-term transportation planning and programming, projects are assessed, project alternatives are considered and defined, project purpose and need are developed, and projects are prioritized and programmed (i.e., funding is committed for design and construction).[5] The HSM can be readily integrated into the near-term planning and programming process to incorporate consideration of the safety performance of various roadway features, as well as comparing one project to another for prioritization.

For example, the Illinois Department of Transportation (IDOT) Safer Roads Index (SRI) uses HSM concepts in its transportation programming process; Virginia Department of Transportation (VDOT) is using planning-level CMFs in its project funding prioritization process through its Smart Scale program; and Louisiana Department of Transportation and Development (LADOTD) has a fact sheet linking its project development process to types of safety analyses methods from the HSM.

Noteworthy Examples

- **Example Application:** The Illinois Department of Transportation enhanced its approach to incorporating safety into IDOT's overall transportation management process by establishing the SRI and Safety Tiers for State-maintained routes. The goal is to improve the integration of quantitative safety performance in transportation project planning and programming. The SRI is now being used in planning and programming and

[5] The section "Near-Term Transportation Planning and Programming" does not provide an exhaustive list of near-term planning and programming activities.

is being considered alongside pavement condition and bridge condition factors to improve selection and prioritization of transportation projects. More information about the Safer Roads Index can be found at http://www.idot.illinois.gov/transportation-system/safety/roadway/index.

- **Example Application:** The Virginia Department of Transportation's Smart Scale established a project prioritization and scoring process to improve transparency of projects selected for funding. Safety is one of six factors and each factor has several measures. The safety measures identify the number of fatal and severe injury crashes and rate of fatal and severe injury crashes. VDOT developed a set of planning-level CMFs for use in the prioritization process. More information about Smart Scale can be found at http://www.virginiahb2.org/about/default.asp. A presentation about the planning-level CMFs used in the prioritization process can be found at http://www.virginiahb2.org/documents/hb2_planning_level_cmfs_201508_final.pdf.

- **Example Application:** The Louisiana Department of Transportation and Development has a "Highway Safety Manual Project Applications" fact sheet containing guidance regarding which methods from the HSM should be used for different parts for the LADOTD project development process. Among other items, the fact sheet recommends the HSM Part C predictive method or CMFs for planning-level project or corridor studies to evaluate alternatives. More information can be found at http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Multimodal/Highway_Safety/Misc%20Documents/Louisiana%20Fact%20Sheet%20Project%20Map.pdf.

Sample Policy Language

It is the policy of the Department to select and implement projects that help the State achieve its safety goals with consideration given to the cost effectiveness of the potential projects and funding constraints. The HSM shall (should/may) be used to evaluate project alternatives and prioritize projects to quantitatively consider safety performance in the near-term planning and programming process.

Sample Guidance/Procedure Language

To implement this policy, the HSM methodologies shall (should/may) be used to integrate quantitative safety analysis in the near-term planning and programming of funding for transportation projects. Quantitative safety analysis allows for safety performance to be estimated and therefore tradeoffs between alternatives or across projects defined. Safety (i.e., number and severity of crashes) can be considered alongside other performance measures such as capacity, environmental impacts, right-of-way impacts, or construction costs. The HSM Part C predictive method and/or CMFs can be used to estimate the changes in crash frequency or severity associated with different roadway alternatives. The tradeoffs can be considered in the form of the number of crashes, the number of fatalities or severe injuries, or the economic costs of the crashes.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires examination of potential impacts to the social and natural environment when considering proposed transportation projects involving Federal funds or requiring Federal approval.[6] There are three major categories of NEPA assessment: Categorical Exclusions (listed or documented), Environment Assessments, and Environmental Impact Statements.[7] The HSM Part C predictive method and CMFs readily support the evaluation of alternatives that are under consideration in the NEPA process. Examples of HSM-related language in State DOT NEPA procedures were not identified in this project; possible language is presented below.

Sample Policy Language

It is the policy of the Department that safety shall be a consideration in the NEPA project alternatives evaluation and documentation. The existing crash conditions and estimated number and severity of crashes associated with the no-build and build alternatives shall (should/may) be estimated using HSM methods. The outcomes of the quantitative safety analyses shall be considered and documented.

Sample Guidance/Procedure Language

To implement this policy, safety can be meaningfully integrated into the NEPA process by estimating changes in crash frequency or severity associated with different alternatives being investigated. Changes in crash frequency or severity due to different roadway features shall (should/may) be estimated using the HSM Part C predictive method and/or CMFs.

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[6] U.S. Department of Transportation, Federal Highway Administration, “Integrating Road Safety Into NEPA Analysis; A Practitioners Primer,” June 2011 (see http://safety.fhwa.dot.gov/tsp/fhwasa1136/fhwasa1136.pdf, Page 3).

[7] U.S. Department of Transportation, Federal Highway Administration, “Integrating Road Safety Into NEPA Analysis; A Practitioners Primer,” June 2011 (see http://safety.fhwa.dot.gov/tsp/fhwasa1136/fhwasa1136.pdf, page 4).

HIGHWAY SAFETY MANUAL IN ENGINEERING AND DESIGN

Within the process of delivering a roadway project for construction, engineering-and more specifically engineering design—consumes a large share of the effort and time required. The design process can be an iterative effort starting from a high-level concept to more detailed design and analysis, resulting in a complete final design of the facility. This report focuses on integrating the HSM into three categories of engineering and design:

- Preliminary Engineering.
- Design Process.
- Design Exception Process.

Preliminary Engineering

Preliminary engineering encompasses a wide range of practices with a roadway project. In this informational report, preliminary engineering is narrowly centered on activities that would be considered during the concept or scoping phases of a project prior to design. Example language related to preliminary engineering was discovered through the research for this report only in the following areas:

- Project-Level Traffic Impact Analyses (TIA).
- Access Justification Reports (AJR).

Project-Level Traffic Impact Analyses

As part of the preliminary engineering process, project-level traffic impact analyses are an excellent opportunity to use the HSM to evaluate safety performance.

Noteworthy Example

- **Example Language:** Washington State Department of Transportation (WSDOT)—The minimum contents of a Traffic Impact Analysis report are listed in the Traffic Analysis Procedures Manual and Development Services Manual. The depth and detail of content under each element varies in relation to the scale and complexity of the project. Traffic safety components of the report are: Traffic Analysis part (d)(7)—Safety performance analysis (see chapter 321 and the Traffic Analysis Procedures Manual) and Conclusions and Recommendations part (e)(2)—Predicted safety performance with and without mitigation measures. The Sustainable Highway Safety Policy directs WSDOT to use effective and efficient resources, like the HSM, to achieve the goals of the Washington State Strategic Highway Safety Plan: Target Zero. Source: Washington State Department of Transportation (WSDOT), Engineering and Regional Operations Development Division, Design Office, "Design Manual" (M 22 01.12. November), 2015. See http://www.wsdot.wa.gov/publications/manuals/fulltext/M22-01/320.pdf.

Sample Policy Language

It is the policy of the Department for traffic impact analyses to include a safety performance assessment. For the decisionmaking process within preliminary engineering activities, these analyses provide valuable information to evaluate the safety performance regarding changes to access the roadway system, the roadway design, and the resulting traffic impacts. The HSM shall (should/may) be used in traffic impact analyses to evaluate the safety performance associated with modifications to the roadway.

Sample Procedures Language

To implement this policy a Traffic Impact Analysis shall be prepared during the preliminary engineering phase of a project and shall include an assessment of safety performance as a key component of the TIA. In this analysis, CMFs are a useful tool that shall (should/may) be used to estimate the anticipated safety impacts of the proposed roadway modifications or design.

In addition to the CMFs, the HSM Part C predictive method is a valuable tool in this assessment process and shall (should/may) be used to compare the safety performance with or without proposed modifications for the design of the highway.

Interstate System Access Change Request

As part of the process to change access to the Interstate highway system, the FHWA's decision to approve new or revised access points to the Interstate highway system requires documentation of the impacts of the proposed access. The Interstate System Access Change Request is used to describe the formal request made to FHWA by a State DOT. With this process, the FHWA's interest is to ensure all new or revised access points:

- Are considered using a decisionmaking process that is based on information and analysis of the planning, environmental, design, safety, and operational affects [sic] of the proposed change.

- Support the intended purpose of the Interstate System.

- Do not have an adverse impact on the safety or operations of the Interstate System and connecting local roadway network or other elements of the transportation system.
- Are designed to acceptable standards.[8]

As part of this FHWA policy, requests for a proposed change in access must include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute and accommodate traffic.[9] The HSM can be used to complete the required safety performance assessment.

Noteworthy Examples

- **Example Language:** Florida Department of Transportation (FDOT)—The objective of this safety analysis is to examine the effects of the proposed new access or modified access on the performance of the facility. As such, the safety analysis should proactively aim at reducing or correcting potential safety problems in the planning and design phase of the projects before they are constructed. For build alternatives analysis the Requester may use new tools for quantitative analysis of safety performance to predict crashes and compare the safety performance of the alternatives. Safety analysis tools that may be used are the Highway Safety Manual published in 2010 and enhanced Interchange Safety Analysis Tool (ISATe). Additional tools that can be used to perform Safety Analysis are Interactive Highway Safety Design Model (IHSDM) and SafetyAnalyst.[10] Source: Florida Department of Transportation, "FDOT Interchange Access Request—User's Guide," 2013. See http://www.dot.state.fl.us/planning/systems/programs/SM/intjus/pdfs/Final2013IARUG.pdf.

- **Example Language:** Illinois Department of Transportation (IDOT)—The Access Justification Report (AJR) should include the following: Highway Safety Analysis. Use the 2014 Supplement to the Highway Safety Manual (HSM), or the Enhanced Interchange Safety Analysis Tool (ISATe), for the needed safety analysis. Source: Illinois Department of Transportation, "New or Revised Interstate Access Approval," 2015. See http://www.idot.illinois.gov/assets/uploads/files/doing-business/manuals-split/design-and-environment/bde-manual/chapter%2037%20interchanges.pdf.

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[8] U.S. Department of Transportation, Federal Highway Administration, "FHWA Interstate System Access Informational Guide," August 2010, p. 3 (FHWA Access Guide). See http://www.fhwa.dot.gov/design/interstate/pubs/access/access.pdf.

[9] FHWA Access Guide, p. 82.

[10] "SafetyAnalyst" refers to AASHTOWare Safety Analyst.

- **Example Language:** Washington State Department of Transportation—Identify and document the predicted safety performance of the proposed access point revision proposal(s), including the freeway section, speed change lanes, ramps, collector/distributor (c-d) lanes, ramp terminal intersections, and the adjacent affected local surface system, including segments and intersections. Document the predicted safety performance of the freeway section using the Highway Safety Manual (to access ISATe), speed change lanes, ramps, c-d lines, ramp terminal intersections, and the adjacent affected local surface system, including segments and intersections within the study limits for each of the proposed "no-build," "build," and possibly other scenarios and alternatives as determined by the support team. Source: Washington State Department of Transportation (WSDOT), Engineering and Regional Operations Development Division, Design Office, "Design Manual" (M 22 01.12. November), 2015. See http://www.wsdot.wa.gov/publications/manuals/fulltext/M22-01/550.pdf.

Sample Policy Language

It is the policy of the Department to protect the functionality of the Interstate system and preserve the investment made in the system. With all proposed new or modified access to the Interstate system, an access justification report shall be completed and safety performance shall be an evaluation consideration in the report. The objective of an access justification safety analysis is to examine the effects of the proposed new access or modified access on the safety performance of the facility. This safety analysis is a proactive approach to address potential safety impacts identified in the planning and design phase of the project. When completing the safety analysis, HSM methods shall (should/may) be used to evaluate the safety performance of project design alternatives.

Sample Procedures Language

To implement this policy the Interstate access justification report shall include a quantitative assessment of the safety impacts of the proposed access modification. This quantitative assessment shall (should/may) use the HSM Part C predictive method to evaluate predicted safety performance of the proposed access change, including the freeway section, speed change lanes, ramps, collector/distributor lanes, ramp terminal intersections, and the adjacent affected local surface system, including segments and intersections.

The Interactive Highway Safety Design Model (IHSDM), Enhanced Interchange Safety Analysis Tool (ISATe), and/or HSM spreadsheets are available tools that can be used to support this safety performance assessment. In addition, CMFs from the CMF Clearinghouse and/or State-specific CMFs developed by the Department can be used in the safety performance assessment.

Design Process

Design manuals provide the practices and methods for developing and documenting the design of improvements to the transportation network. The highway design process involves the application of engineering principles to meet each project's objectives in the best overall public interest. Application of these principles requires considering and balancing social, economic, and environmental issues to achieve a safe and efficient transportation system. The design manual supplements the engineering analyses and judgment that is applied to project design. It provides uniform procedures for documenting and implementing design decisions.

Noteworthy Examples

- **Example Language:** Washington State Department of Transportation—The HSM and associated analysis tools have been developed to aid decisionmaking and documentation in the project development process. It helps quantify safety performance implications of decisions in project development and provides a basis for predicting and documenting the potential safety performance of those decisions. Safety analysis tools may be appropriate for design decisions to analyze and document the safety performance of design alternatives and design element dimensioning decisions, including cross section design element dimensioning and other countermeasures treatment options. Source: Washington State Department of Transportation, Engineering and Regional Operations Development Division, Design Office, "Design Manual" (M 22 01.12. 321.06 November), 2015. See http://www.wsdot.wa.gov/publications/manuals/fulltext/M22-01/321.pdf.

- **Example Language:** Pennsylvania Department of Transportation (PennDOT)—A safety assessment, including the potential safety benefits shall be discussed if the proposed improvements will contribute to a reduced number and/or severity of crashes. Consider using American Association of State Highway Transportation Officials' (AASHTO) Highway Safety Manual (HSM) to calculate crash frequencies to quantify the substantive safety performance of the alternatives. Source: Pennsylvania Department of Transportation, "District Highway Safety Guidance Manual," (Publication PUB 638 (12-14)). December 2014. See www.dot.state.pa.us/public/pubsforms/Publications/PUB%20638.pdf.

- **Example Language:** Georgia Department of Transportation (GDOT)—"Design Policy Manual 2015—Roundabout Feasibility Study." A feasibility study must be prepared for all proposed roundabouts. The objective of the feasibility study is to document the decisionmaking process which demonstrates that a roundabout is (or is not) the most appropriate intersection control form. A feasibility study should include the following components: section 2, Safety Assessment: include a tabulated analysis of intersection crash data for the five most recent years for which data is available and a comparison to statewide intersection averages. Crash reductions factors should be obtained either from the FHWA Report No. FHWA-SA-08-01,1 Desktop Reference for Crash Reduction Factors or the Crash Modification Factors Clearinghouse Web site at http://www.cmfclearinghouse.org/. Further information regarding safety and roundabouts is presented in chapter 5 of NCHRP 672 and in the AASHTO Highway Safety Manual. Source: Georgia Department of Transportation, "Design Policy Manual," 2015. See http://www.dot.ga.gov/PartnerSmart/DesignManuals/DesignPolicy/GDOT-DPM.pdf.

- **Example Language:** Washington State Department of Transportation—The Secretary's Executive Order E1085, "Sustainable Highway Safety Program," directs engineers to base project-level decisions on safety analysis of specific locations and corridors and focus on proven lower-cost targeted countermeasures at specific locations that optimize the return on investment of safety dollars. Sustainable Safety is therefore an essential part of successful Practical Design implementation. It provides the process and methods to incorporate safety performance assessment and peer review into Performance-Based Practical Design. Sustainable Safety allows the planner, engineer, and decisionmaker, to identify and quantify the safety performance of alternatives during project development. Source: Washington State Department of Transportation (WSDOT), Engineering and Regional Operations Development Division, Design Office, "Design Manual," (M 22 01.12. 321.01. November), 2015. See http://www.wsdot.wa.gov/publications/manuals/fulltext/M22-01/321.pdf.

Sample Policy Language

It is the policy of the Department that the HSM shall (should/may) be used to evaluate the safety performance of the roadway design. Using the HSM to determine design tradeoffs (higher-than-minimum standards or lower-than-full standards) will meet the intent of the design manual for determining recommended values or range of values for the roadway design.

Sample Procedures Language

To implement this policy, the designer shall (should/may) evaluate using the HSM the safety performance of the proposed design elements as part of the decisionmaking process determining the presence and dimensions of the proposed design features. The HSM Part C predictive method and/or CMFs are resources available to complete this assessment. The sources of CMFs are the HSM Part D, the CMF Clearinghouse, and/or State-specific CMFs developed by the Department.

The documentation of safety analyses supporting (or informing) design decisions is the responsibility of the office completing the design. Components of this documentation include the safety analyses used, and a safety impact comparison of design alternatives. Also, by performing predictive safety analysis and incorporating existing crash history when appropriate, the designer shall (should/may) conduct a safety performance assessment to identify the contributing factors and determine the appropriate countermeasures to include in the design based on these factors.

The Interactive Highway Safety Design Model (IHSDM), Enhanced Interchange Safety Analysis Tool (ISATe), and/or HSM spreadsheets are available tools that can be used to support the safety performance assessment.

As a component of the safety analysis documentation, the designer shall (should/may) complete an economic assessment to support evaluation of different design alternatives. For this documentation, the HSM chapter 7—Economic Appraisal identifies various methods that shall (should/may) be used for the economic analysis, including benefit/cost (B/C), net present value, and cost effectiveness analysis.

Design Exception Process

The design exception process provides an excellent opportunity to expand HSM policy and guidance/procedure language as well as overall HSM implementation outside of the Highway Safety Improvement Process or other typical safety programs. This "process" term should be considered to be inclusive of design exceptions, design variances, design waivers, or other terms used in State DOT documents.

Noteworthy Examples

- **Example Language:** Ohio Department of Transportation (ODOT)—Design exception documentation will be based upon the analysis of the three-year crash history performed at the time of scoping. Projects can use the Safety Analyst Locations for Design Exception Process Maps or Spreadsheet to perform this analysis. Alternatively, one may complete the calculations included in AASHTO's Highway Safety Manual with Ohio-specific proportional tables and calibration factors. ODOT has developed a spreadsheet tool to aid in completing the HSM calculations called the Economic Crash Analysis Tool (ECAT). Source: Ohio Department of Transportation, "Design Controls and Exceptions," January 2014. See https://www.dot.state.oh.us/Divisions/Engineering/Roadway/DesignStandards/roadway/Pages/locationanddesignmanuals.aspx.

- **Example Language:** Missouri Department of Transportation (MoDOT)—If the design exception request involves safety-related features that are adequately addressed in the AASHTO Highway Safety Manual, then documentation of the exception should include a safety analysis as described in the manual. In general, this safety analysis should compare the expected number of crashes for the facility with the design exception to the expected number of crashes of the facility without the design exception. Currently, not all safety-related features are explicitly addressed in the Highway Safety Manual. A list of features currently addressed by the manual include: lane width, shoulder width, shoulder type, center line rumble strips, horizontal alignment (length, radius), grade, roadside hazard rating, fixed objects, driveway density, median width, side slope, lighting, intersection skew angle, and turn lanes. Not all features in the manual are addressed for each facility type. Source: Missouri Department of Transportation, "Design Exception Process," 2015. See http://epg.modot.org/index.php?title=131.1_Design_Exception_Process.

- **Example Language:** Pennsylvania Department of Transportation—Confidential Safety Study. The purpose is to evaluate the traffic crash history within the project limits to determine what, if any, existing highway safety concerns are present, and then identify how these safety concerns would be addressed by the proposed project using the design exception and by using full-design criteria. Refer to Publication 638, District Highway Safety Guidance Manual for information on the Highway Safety Manual (HSM) and evaluating the impact of changes in design elements on safety performance. Source: Pennsylvania Department of Transportation (PennDOT), Publication 10X (DM-1X); Appendix P—Design Exceptions, 2015. See https://www.dot.state.pa.us/public/PubsForms/publications/pub%2010/Pub10X_Cover.pdf.

Sample Policy Language

It is the policy of the Department that all projects will be designed to meet the existing and future traffic needs in the most economical manner with emphasis on safety, operations, and maintainability. Particular attention with project design must be given to the controlling criteria for design. If any of the controlling design criteria cannot be met, a formal design exception is required. If the design exception involves features that are adequately addressed in the HSM, then the evaluation analysis and documentation shall (should/may) be completed using the methodologies described in the HSM.

Sample Guidance/Procedure Language

To implement this policy the HSM shall (should/may) be used to evaluate the safety performance of a design modification to controlling design criteria. Documentation of the safety performance is key in addressing this policy for the design exception process. From a safety perspective, this documentation should examine contributing factors of crashes as well as the relationship between the roadway features being considered in the design exception and these contributing factors. The design exception documentation using the HSM is intended to discuss the safety performance of the full design feature versus the feature designed as indicated in the design exception.

The safety assessment included in the documentation shall include, at a minimum, a crash history, crash rates, and crash frequencies of the project location. The HSM is an excellent resource for evaluating the impact to safety performance of changes in the controlling design criteria. The HSM Part C predictive method and/or CMFs shall (should/may) be used in a comparative analysis of the predicted crash frequency with or without the proposed change in project design.

To support the safety performance evaluation, a number of commercially available products and tools developed by State DOTs or by the FHWA are available. The Interactive Highway Safety Design Model (IHSDM) and/or HSM spreadsheets are examples of available tools that can be used for the safety performance assessment. Also, Safety Performance Functions (SPF) and CMFs from the CMF Clearinghouse and/or State-specific CMFs developed by the Department can be used in the safety performance assessment.

Additionally, to document the economic assessment of the design change, chapter 7 of the HSM contains methods, including benefit/cost (B/C), net present value, and cost effectiveness, that can be used for the economic analysis documentation.

HIGHWAY SAFETY MANUAL IN OPERATIONS AND MAINTENANCE

There are some specific areas within Operations and Maintenance where the HSM can be applied; however, there are limited specific examples that are available to develop sample policy or guidance language. Noteworthy examples along with sample language within each of the following areas are presented:

- Traffic Operations.
- Resurfacing, Restoration, and Rehabilitation (3R) Projects.

Traffic Operations

The objective of traffic operations activities is to optimize the performance of existing infrastructure through implementation of processes and projects to preserve capacity and address safety performance of the transportation system. This report focuses on integrating the HSM into two categories of traffic operations activities:

- Intersection Control Evaluation.
- Traffic Impact Analyses.

Intersection Control Evaluation

State and local transportation agencies are actively implementing intersection designs beyond the conventional signalized intersection or stop-controlled intersection. A few examples of these designs are roundabouts, diverging diamond interchanges, and continuous flow intersections. To address the need to provide an objective process to evaluate and select between intersection control alternatives, a number of State DOTs are developing Intersection Control Evaluation (ICE) policies and procedures. The goal of ICE is to provide a performance-based decisionmaking process, and the HSM is a valuable resource to complete the safety performance analysis within the ICE process. California, Georgia, Indiana, Minnesota, Washington, and Wisconsin all have developed ICE policies and procedures.

Specific to traffic signals, the Delaware Department of Transportation (DelDOT) Traffic Design Manual (2015) requires that a Traffic Signal Justification Study include an assessment of the safety implications of installing a new traffic signal, modifying an existing traffic signal, or removing an existing traffic signal.

Noteworthy Examples

- **Example Application:** The Washington State Department of Transportation includes in its Intersection Control Analysis (ICA) an assessment of current conditions associated with the project location. A component of this assessment is an analysis of crash history using the HSM methodologies to determine the expected and predicted crash frequencies of the proposed intersection alternatives. Source: Washington State

Department of Transportation (WSDOT), Engineering and Regional Operations Development Division, Design Office, "Design Manual" (M 22 01.12. November), 2015. See http://www.wsdot.wa.gov/publications/manuals/fulltext/M22-01/1300.pdf.

- **Example Language:** Delaware Department of Transportation—A Traffic Signal Justification Study should include an assessment of the safety implications of installing a new traffic signal, modifying an existing traffic signal, or removing an existing traffic signal. The HSM should be consulted to assist in performing the safety assessment. DelDOT's preferred method for conducting the safety assessment is to use the "predictive method" from the HSM to estimate anticipated crash frequency. It is DelDOT's preference that a comparative analysis be performed using SPF's to compare the base (no improvements) scenario with the scenario that considers all proposed improvements. Additionally, the analyst should compare the SPF results with actual crash data, if available. Source: Delaware Department of Transportation, "Traffic Design Manual," 2015. See http://deldot.gov/information/pubs_forms/manuals/traffic_design/2015/2015_chapter_4.pdf#search=traffic%20design%20manual.

Sample Policy Language

It is the policy of the Department to use the Intersection Control Evaluation (ICE) to assess intersection alternatives and according to the most recent adopted edition of the Manual on Uniform Traffic Control Devices (MUTCD). The ICE shall include an assessment of the safety performance of the intersection alternatives. The HSM shall (should/may) be used to assist in performing the safety assessment.

Sample Procedures Language

To implement this policy, when completing the ICE process, the HSM Part C predictive method and/or CMFs shall (should/may) be used to evaluate the safety performance of the proposed intersection projects and to provide better decisionmaking information for project selection and funding prioritization.

In addition, when considering operational changes such as signal timing or modifying intersections to include left-turn and/or right-right turn lanes or lighting upgrades, the HSM Part C predictive method and/or CMFs shall (should/may) be used to evaluate the safety performance of these modifications.

Traffic Impact Analyses

According to the Traffic Engineering Handbook, traffic impact analyses (TIA), also known as traffic impact studies, are widely used to estimate the travel impacts of new or expanded land development as part of the approvals process.[11]

Noteworthy Example

- **Example Language:** New York State Department of Transportation (NYSDOT)—Crash Modification Factors and Crash Reduction Factors (CRF) are an excellent tool to use to estimate the expected crash reduction and/or the expected safety benefits associated with various countermeasures. These may be useful in identifying the appropriate countermeasures based on the existing resources available for a project. Source: New York State Department of Transportation, "Traffic Impact Study for DOT Projects," August 2014. See https://www.dot.ny.gov/divisions/engineering/design/dqab/dqab-repository/.

Sample Policy Language

It is the policy of the Department that requests for roadway access connections include a traffic impact analysis (TIA). The TIA shall include a safety performance assessment. These analyses provide essential information for the decisionmaking process to evaluate the safety performance regarding changes to access the roadway system and the resulting traffic impacts. The HSM shall (should/may) be used to evaluate the safety performance associated with modifications to the roadway.

Sample Procedures Language

To implement this policy a traffic impact analysis shall be prepared for developments which desire access to the highway and shall include an assessment of traffic safety impact as a key component of the analysis. In this analysis, CMFs are a useful tool that shall (should/may) be used to estimate the anticipated safety impacts of the proposed roadway modifications.

In addition to the CMFs, the HSM Part C predictive method is a valuable tool in this assessment process and shall (should/may) be used to compare the safety performance with or without proposed modifications for access to the highway.

[11] Institute of Traffic Engineers, "Traffic Engineering Handbook, Seventh Edition," January 2016, page 188.

Resurfacing, Restoration, and Rehabilitation Projects

Preservation and maintenance is one of the final stages of the project development process. It is important for protecting the roadways investment and maintaining the existing transportation system in a state of good repair. Opportunities to implement the HSM methods include resurfacing, restoration, and rehabilitation (3R) projects and can include only resurfacing and/or restoration projects as well as maintenance activities. Some areas where the HSM can be used include geometric changes, shoulder and roadside improvements, traffic control, and guidance enhancement, and surface condition upgrades.

Noteworthy Example

- **Example Application:** The Louisiana Department of Transportation and Development produced the Guidance for Safety Improvements for PRR Projects (LADOTD, 2010) as the policy for preservation/rehabilitation/replacement (PRR) projects in Louisiana. This policy was developed to ensure baseline safety improvements are required to be considered in the project development process. A Safety Assessment Process Checklist must be completed based on three years of crash data to identify locations with overrepresentation of crash frequency or crash types for each PRR project. The HSM is listed as a resource to complete this safety assessment. Source: Louisiana Department of Transportation and Development, "Guidance for Safety Improvements for PRR Projects," 2010. See http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Engineering/Road_Design/Systems_Preservation/Documents/Guidance%20for%20Safety%20Improvements%20for%20PRR%20Projects%2009_30_10.pdf.

Sample Policy Language

It is the policy of the Department that 3R projects are designed and constructed with due consideration of appropriate levels of traffic operations, safety, and maintenance. All 3R projects shall include an estimate of the safety benefits of the proposed treatments. The HSM shall (should/may) be used to estimate the safety impacts. The safety impacts of the treatment shall be included in the project documentation.

Sample Procedures Language

To implement this policy, when completing the safety assessment for the 3R project documentation and dependent on the scale of the project, the HSM Part C predictive method and/or CMFs shall (should/may) be used to evaluate the proposed project for funding.

In addition, if safety countermeasures are considered for inclusion in the 3R project, the HSM Part C predictive method and/or CMFs shall (should/may) be used to evaluate the safety performance of these countermeasures, and the results of the analysis shall be included in the project documentation.

ROADWAY SAFETY MANAGEMENT PROCESS

Many if not all States have documented policies and procedures for implementing the Highway Safety Improvement Program (HSIP). These policies and procedures provide information on the State safety project selection and prioritization process, crash-cost estimates and benefit/cost analysis methodology (including project service life), and forms for applying for State HSIP funds. States also develop a variety of manuals for explaining how to conduct safety investigations that support the HSIP process. The roadway safety management process shown in figure 1 is the traditional approach taken to safety investigations. Methods in the HSM advance the roadway safety management process by providing quantifiable, repeatable, reliable results for each step in the roadway safety management process. Arizona, Illinois, Indiana, Minnesota, New Hampshire, Rhode Island, and Washington all have included HSM methods or software consistent with the HSM as part of their policy and procedures for HSIP management and implementation.

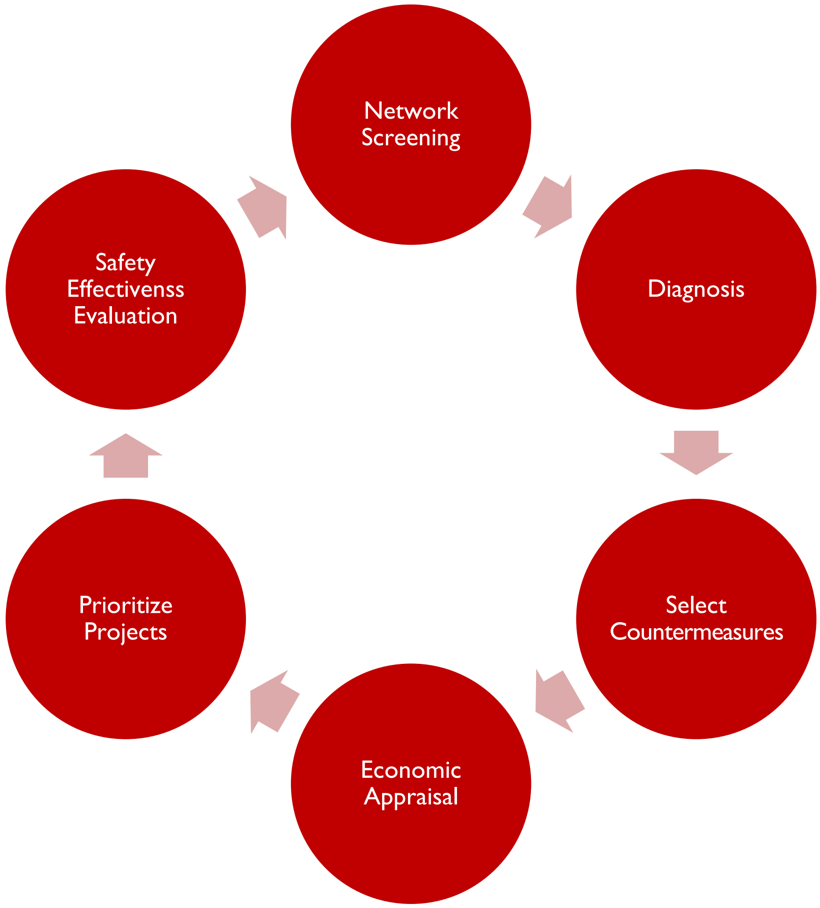

Figure 1. Chart. Roadway safety management process.

(Source: Cambridge Systematics, Inc.)

Noteworthy Examples

- **Example Application:** The New Hampshire Department of Transportation (NHDOT) HSIP policy states that AASHTOWare Safety Analyst is used to prioritize HSIP projects and requires that cost effectiveness and expected reduction, in the form of a CMF or crash frequency, be tracked for all HSIP projects. Source: New Hampshire Department of Transportation, "Highway Safety Improvement Program: Manual and Guidance," December 2013. See http://www.nh.gov/dot/org/projectdevelopment/highwaydesign/hwysafetyimprovements/documents/hsip_nhguidance_122013.pdf.

- **Example Application:** The Washington State Department of Transportation design manual states that the tools available for use in selecting recommended countermeasures include the HSM, AASHTOWare Safety Analyst, Road Safety Assessments (RSA), HSM prediction models, and the CMF Clearinghouse. Source: Washington State Department of Transportation, Engineering and Regional Operations Development Division, Design Office, "Design Manual," (M22 01.12 November), 2015. *See* http://www.wsdot.wa.gov/publications/manuals/fulltext/M22-01/321.pdf.

- **Example Application:** The Rhode Island Department of Transportation (RIDOT) HSIP policy requires that the latest CMFs presented in the HSM and the CMF Clearinghouse be applied to estimate the expected safety benefits of various countermeasures. Source: Rhode Island Department of Transportation, "Planning, Implementation, and Program Effectiveness of Rhode Island's Highway Safety Improvement Program—Fiscal Year 2013." 2013. *See* http://www.dot.ri.gov/documents/community/safety/Highway_Safety_Improvement_Program.pdf.

- **Example Application:** The Illinois Department of Transportation HSIP recommends the HSM Part C predictive method and CMFs as tools for evaluating safety projects. Illinois-specific safety performance functions (SPF) and calibration factors are available. Applicants must use benefit/cost analysis and CMFs from the HSM or the CMF Clearinghouse to demonstrate effectiveness of projects. Source: Illinois Department of Transportation, Highway Safety Improvement Program, 2015. http://www.idot.illinois.gov/transportation-system/local-transportation-partners/county-engineers-and-local-public-agencies/funding-opportunities/highway-safety-improvement-program.

- **Example Application:** The Indiana Department of Transportation (INDOT) HSIP guidance recommends a B/C ratio at or above 2.0 based on acceptable CMFs and an accurate total project cost estimate. In all cases, 1.0 is the minimum acceptable B/C ratio. Source: Indiana Department of Transportation. "Highway Safety Improvement Program Local Project Selection Guidance," March 2013. *See* www.in.gov/indot/files/LocalHSIPProjectSelectionGuidance.pdf.

- **Example Application:** The Arizona Department of Transportation (ADOT) HSIP policy indicates before-and-after studies of safety improvement projects compare various features and characteristics of the subject location before construction and after. Information derived from the evaluation process, such as reliable CMFs and an evaluation of the efficacy and benefits of projects, are critical to the planning process and to the success of the HSIP in Arizona. Source: Arizona Department of Transportation, "Highway Safety Improvement Program Manual," May 2015. *See* https://www.azdot.gov/business/engineering-and-construction/traffic/traffic-safety/arizona-highway-safety-improvement-program.

Sample Policy Language

It is the policy of the Department to use HSM methods to quantify safety performance as part of the State roadway safety management process and HSIP process to reduce fatal and serious injury crashes.

Sample Procedures Language

To implement this policy, activities within the HSIP process shall include network screening, diagnosis and countermeasure selection, economic appraisal, predicted changes to crash frequency and severity, and project prioritization. The HSM shall (should/may) be used to evaluate safety performance in the following manner:

- **HSM chapter 4—**Network Screening methods shall (should/may) be used to prioritize sites for specified safety improvements. To the extent available data permit, a network screening performance measure that accounts for regression-to-the-mean bias shall (should/may) be used.

- **HSM chapter 5—**Diagnosis and chapter 6—Countermeasure selection shall (should/may) be used in the improvement evaluation process to study crash patterns and contributing factors and identify potential countermeasures to reduce crash frequency or severity. When project characteristics allow, the HSM Part C predictive method shall (should/may) be used to evaluate the safety impacts of alternatives under consideration. Anticipated changes in crash frequency and severity, as determined by the HSM Part C predictive method and/or CMFs, shall be used as a factor in project selection or prioritization.

- **HSM chapter 7—**Economic Appraisal provides methods that shall (should/may) be used for estimating economic impacts (benefits and costs) of alternative treatments and selecting or prioritizing improvements using benefit/cost (B/C), net present value, or cost effectiveness analysis.

- **HSM chapter 8—**Project Prioritization methods shall (should/may) be used within this programming process if considering implementation of countermeasures over a roadway system or with multiple locations.

- **HSM chapter 9—**Safety Effectiveness Evaluation shall (should/may) be used to evaluate the effectiveness of improvements implemented using HSIP funds.

The Department provides safety analysis tools that shall (should/may) be used for these evaluations. The tools are consistent with the principles and methodologies within the HSM. There are a number of commercially available products, products developed by States, and products developed by FHWA that can be used.

SUMMARY

Although State DOTs have made good progress in implementing HSM concepts and methods within the safety management processes, expanding the reach of the HSM into other DOT processes such as planning and programming, project development, operations, and maintenance has been limited. To address an identified impediment to progress, the States participating in the HSM Implementation Pooled-Fund Study identified the need for a compilation and synthesis of existing State policies and development of sample policy and procedures language covering a range of activities in which use of the HSM would be beneficial.

The sample policy and procedures language is presented as an adaptation from noteworthy examples of existing language or applications in State DOT policies and manuals. Research for this informational report identified noteworthy State DOT examples covering a wide range of agency practices. These examples do not address all of the practices where the HSM could be used in the State DOTs, however. The sample language presented is based on processes for which some States already have language and/or processes or Pooled Fund Study States specifically requested sample language.

The sample policy language within this report provides State DOTs with an opportunity to develop policy language directing the use of the HSM in specific agency activities. To further this effort, the sample procedures language contains more descriptions, advice, and information of the HSM methodologies that State DOTs can use as a template for their own procedures documents.

For States in which the process of integrating the HSM into typical agency practices has been slower than desired, the information presented will provide a starting point that can accelerate efforts to develop and adopt policies and procedures to support implementation of the HSM. The sample language is intended to serve as a template that State DOT staff could adapt for use in their policies and manuals. State DOT staff can tailor the sample language to fit their agency's goals and objectives to expand implementation of the HSM.

CASE STUDIES

Highway Safety Manual (HSM) Implementation Pooled Fund Study States also requested information on how other States went about incorporating HSM-related language into their policy and procedures documents. This section presents as case studies the approaches taken by Louisiana and Washington.

LOUISIANA[12]

In Louisiana, the traffic safety effort is driven by the State's "Destination Zero Deaths" mission, and the Strategic Highway Safety Plan (SHSP) is the vehicle to achieve this mission.

The Louisiana Department of Transportation and Development developed Louisiana's SHSP in partnership with the Louisiana State Police (LSP) and the Louisiana Highway Safety Commission (LHSC). The plan identifies infrastructure and operations as one of the four emphasis areas the HSM as an important strategic guide. Specifically, the HSM implementation steps were identified as the following:

- Develop an Implementation Plan for adopting the HSM as a guideline for Louisiana Department of Transportation and Development (LADOTD) project safety analysis.
- Conduct HSM training courses to ensure practitioners are able to integrate the HSM into daily project.
- Planning, programming, and engineering activities.
- Evaluate and compare State crash, roadway, and traffic volume data availability to HSM data needs.

LADOTD safety staff determined that the support of the Department of Transportation and Development (DOTD) leadership was an essential component for successful implementation of the HSM within the DOTD business units. Successful implementation also depended on having a champion within the agency who was

With the Secretary's complete support and the business unit leaders of the HSM Implementation Team focused on using the HSM…"it was accepted this is the way we do it now. This thought guides the institutionalization of the HSM in its use and in our policies." – Dan Magri, LADOTD

[12] Interviews with April Renard, LADOTD, May 26, 2016 and Dan Magri, LADOTD, June 9, 2016.

committed to the HSM implementation effort and to promoting use of the HSM at all levels of the agency. For LADOTD, the Highway Safety Administrator is the HSM champion. In addition, the LADOTD Secretary provided support for HSM integration into the agency's business units.

High-profile fatalities generally capture executive staff attention, especially when stakeholders contact the Secretary. Any time the Secretary needed information on a particular fatal crash, LADOTD safety staff took the opportunity to speak about the SHSP and Destination Zero Deaths initiatives. The Secretary supported these initiatives by assigning district employees to participate in regional safety coalitions throughout the State. In addition, the Secretary spoke of safety as LADOTD's number one priority and took the opportunity to address safety with engineering as a part of a multidisciplinary approach. Today, the LADOTD includes safety in the Department's vision and mission statements and views the HSM as a vital component in fulfilling the vision and mission to improve safety in Louisiana.

Given the Secretary's interest in safety and involvement with American Association of State Highway Transportation Officials (AASHTO), she was named as the chair of the AASHTO Safety Management Subcommittee. As the subcommittee's leader, she recognized the evolution in the science of safety and supported the effort to fully implement the HSM in the LADOTD and nationally.

As specified in the SHSP, LADOTD established an HSM Implementation Plan and an HSM Implementation Team comprised of representatives from the Federal Highway Administration (FHWA), the Local Technical Assistance Program (LTAP), and several business units within LADOTD.

After AASHTO published the HSM in the spring of 2010, LADOTD, with the support of FHWA, conducted its first two HSM training courses in October 2010 to ensure practitioners were able to integrate the HSM into project planning, programming, and engineering. Following this initial training, two additional training sessions were conducted, one in December 2010 and one in April 2011.

An important aspect of the implementation process was the use of the HSM on the I-12 to Bush project. The Army Corps of Engineers asked LADOTD for input on the Environmental Impact Statement (EIS) regarding the potential safety performance of the different proposed alignments. This effort showed the benefits of the HSM and created agency enthusiasm and engagement regarding the use of the HSM throughout the agency.

"The use of the HSM grew organically from a single project to widespread use and continues to grow with fundamental changes to policies and manuals." – April Renard, LADOTD

Together, these factors allowed for continued and supported growth in the implementation of the HSM. For LADOTD, using the HSM preceded and informed changes to the supporting policy and guidance documents. As the HSM use grew incrementally with project development, the HSIP, and the design exception process, HSM-based policy and guidance language evolved and continues to be incorporated in these types of document. It is recognized by LADOTD leadership that continued institutionalization of the HSM requires the HSM-based language be an explicit component of its current policy and guidance documents.

WASHINGTON[13]

In 2000, Washington State was the first State in the U.S. to adopt a zero-deaths based philosophy by creating the Target Zero initiative. As a leader in early adoption and innovation, the State was one of the first to consider implementation of the HSM across its planning, programming, and project development process.

According to the Washington State Strategic Highway Safety Plan, the vision of Target Zero is to reduce traffic fatalities and serious injuries to zero by 2030. For this effort, the Washington State Department of Transportation (WSDOT) partnered with the Washington State Patrol (WSP) and Washington Traffic Safety Commission (WTSC) and other organizations throughout the State.

"Within the Department, need provides opportunity. With HSM language in our policies and guidance documents regarding our approach to quantifying safety performance, we are able to highlight implementation and use of the HSM." – John C. Milton, WSDOT

In conjunction with Target Zero providing a vision for traffic safety, WSDOT recognized that safety was only one aspect of its entire program and tradeoffs would be necessary given the budget constraints that the department faced. Accordingly, WSDOT launched several initiatives to implement the principles of "practical solutions." Practical solutions focused on designing projects based on performance of design criteria for the context and needs of a given location while limiting right-of-way and environmental impacts. These initiatives centered on decisionmaking processes that were data driven and performance based, including quantitative safety analysis and evaluating risk of crashes.

For WSDOT, several significant components emerged, leading to incorporation of HSM-based language in critical documents, in particular the Design Manual, as well as the following:

[13] Interview with John C. Milton, Washington State Department of Transportation, June 8, 2016.

- AASHTO publication of the HSM in 2010.
- Federal Moving Ahead for Progress in the 21st Century (MAP-21) and Fixing America's Surface Transportation (FAST) Acts.
- Secretary's Executive Order E 1085, Sustainable Highway Safety Program.
- Secretary's Executive Order E 1096, Agency Emphasis and Expectations.
- Secretary's Executive Order E 1090, Moving Washington Forward: Practical Solutions.

Sustainable Safety is an approach to transportation safety at WSDOT that uses "…tools and procedures based on accepted science, data, and proven practice" in accordance with Secretary's "Executive Order E 1096, Agency Emphasis and Expectations," to target safety needs and "deliver the right solutions at the right time and at the right location." Practical Solutions is an approach to making project decisions that focuses on resolving the project need for the least cost without adversely impacting safety performance. Sustainable Safety is the approach adopted for resolving safety performance issues within WSDOT's Practical Solutions as directed in both E 1096 and the Secretary's "Executive Order E 1090, Moving Washington Forward: Practical Solutions."[14]

Throughout this undertaking, WSDOT recognized that it is necessary to have an internal champion who is responsible for leading HSM implementation. The Director of Quality Assurance and Transportation System Safety accepted this role, along with partners in planning, programming, design, and traffic operations. In addition, as evidenced by the Secretary's Executive Orders, there is strong executive leadership and support for the HSM within the organization.

At the time of HSM publication WSDOT did not implement formal training on the HSM. The agency did, however, develop pilot courses for quantitative safety analysis, and now more formal training is being deployed. This effort included HSM training, sustainable safety, and human factors training. This training effort will augment the success WSDOT realized through small and deliberate HSM implementation steps and growing skills through on-the-job application of quantitative safety analyses.

For WSDOT, this confluence of the HSM publication and Secretary's Executive Orders allowed for near simultaneous change in all manuals and guidance while initiating implementation of the HSM. Within WSDOT, updating the Design Manual was a significant contribution to the

[14] Washington State Department of Transportation, Design Manual M 22-01.12, November 2015, page 321-1.

institutionalization and widespread use of the HSM throughout the agency. The support of the Chief Engineer, State Design Engineer, State Traffic Engineer, and the Director of Multimodal Planning was critical to this success.

SUMMARY

Several common themes were identified in the course of the review of these two State's programs that may provide guidance to other States implementing the HSM and incorporating HSM-based language into State DOT policies and guidance documents.

Theme 1—Zero-Deaths Based Plans, Strategies, and Strategic Highway Safety Plans

The HSM provides a science-based data-driven safety-performance-based approach to achieve the vision of reaching zero deaths and to support the SHSPs. An essential component of this effort is to continually drive HSM implementation and institutionalization of the HSM by incorporating language in supporting policy and guidance documents.

Theme 2—Champions for Highway Safety Manual

A dedicated champion for implementing the HSM and guiding the changes in manuals and policy is important. In addition, executive-level support and leadership across agency business units provides for greater success in integrating the HSM into the agency's processes and incorporating it into policies and guidance.

Theme 3—Need Provides Opportunity

In both States, small implementation steps led to success with the HSM; however, the process to include HSM-based language in policies and manuals differs for each. For Louisiana, incremental HSM implementation led to incremental changes in policy and guidance. In Washington, large-scale changes in philosophy and direction, including the use of HSM, led to widespread change in manuals and executive orders. The inclusion of HSM-based language in these documents sets the stage for institutionalization of the HSM.

APPENDIX

HIGHWAY SAFETY MANUAL TOOLS

The section "Sample Language" of this document referenced several Highway Safety Manual (HSM) tools. The following list identifies these tools and provides links to obtain more information about these tools and their uses.

Table 1. Highway Safety Manual tools.

Tool	Link
AASHTOWare Safety Analyst	http://www.safetyanalyst.org.
Interactive Highway Safety Design Model (IHSDM)	http://www.fhwa.dot.gov/research/tfhrc/projects/safety/comprehensive/ihsdm/
Interchange Safety Analysis Tool enhanced (ISATe)	http://www.highwaysafetymanual.org/Pages/tools_sub.aspx#2
Highway Safety Manual spreadsheets	http://www.highwaysafetymanual.org/Pages/tools_sub.aspx#2
Crash Modification Factor Clearinghouse	http://www.cmfclearinghouse.org/

SOURCE INFORMATION AND LINKS

The section "Sample Language" of this document listed specific State Departments of Transportation documents as sources accompanying a noteworthy example. The following list identifies the sources of information used in this informational report. A source may be shown in more than one category.

Planning and Programming		
Long-Term Transportation Planning		
State	**Resource**	**Link**
Ohio Department of Transportation (ODOT)	Access Ohio 2040	http://www.dot.state.oh.us/Divisions/Planning/SPR/StatewidePlanning/access.ohio/Pages/default.aspx
Near-term Transportation Planning and Programming		
State	**Resource**	**Link**
Illinois Department of Transportation (IDOT)	Safer Roads Index	http://www.idot.illinois.gov/transportation-system/safety/ roadway/index
Louisiana Department of Transportation and Development (LADOTD)	Highway Safety Manual Project Applications fact sheet	http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Multimodal/Highway_Safety/Misc%20Documents/Louisiana%20Fact%20Sheet%20Project%20Map.pdf
Virginia Department of Transportation (VDOT)	Smart Scale	http://www.virginiahb2.org/about/default.asp http://www.virginiahb2.org/documents/hb2_planning_level_cmfs_201508_final.pdf

Engineering and Design		
Preliminary Engineering—Project-Level Traffic Impact Analyses		
State	**Resource**	**Link**
Washington State Department of Transportation (WSDOT)	Design Manual. M 22 01.12	http://www.wsdot.wa.gov/publications/manuals/fulltext/M22-01/320.pdf
Preliminary Engineering—Access Justification Reports		
State	**Resource**	**Link**
Florida Department of Transportation (FDOT)	Interchange Access Request User's Guide	http://www.dot.state.fl.us/planning/systems/programs/SM/intjus/pdfs/Final2013IARUG.pdf
Illinois Department of Transportation (IDOT)	Revised Interstate Access Approval	http://www.idot.illinois.gov/assets/uploads/files/doing-business/manuals-split/design-and-environment/bde-manual/chapter%2037%20interchanges.pdf
Washington State Department of Transportation (WSDOT)	Design Manual. M 22 01.12	http://www.wsdot.wa.gov/publications/manuals/fulltext/M22-01/550.pdf

Design Process		
State	**Resource**	**Link**
Georgia Department of Transportation (GDOT)	Design Policy Manual Revision 4.10	http://www.dot.ga.gov/PartnerSmart/DesignManuals/DesignPolicy/GDOT-DPM.pdf
Pennsylvania Department of Transportation (PennDOT)	District Highway Safety Guidance Manual. Publication PUB 638 (12-14)	www.dot.state.pa.us/public/pubsforms/Publications/PUB%20638.pdf
Washington State Department of Transportation (WSDOT)	Design Manual. M 22 01.12	http://www.wsdot.wa.gov/publications/manuals/fulltext/M22-01/321.pdf
Design Exceptions		
State	**Resource**	**Link**
Missouri Department of Transportation (MoDOT)	Design Exception Process	http://epg.modot.org/index.php?title=131.1_Design_Exception_Process
Ohio Department of Transportation (ODOT)	Design Controls and Exceptions	https://www.dot.state.oh.us/Divisions/Engineering/Roadway/DesignStandards/roadway/Pages/locationanddesignmanuals.aspx
Pennsylvania Department of Transportation (PennDOT)	Pennsylvania Department of Transportation Design Manual. Publication 10X (DM-1X). Appendix P Design Exceptions	https://www.dot.state.pa.us/public/PubsForms/publications/pub%2010/Pub10X_Cover.pdf

Operations and Maintenance		
Traffic Operations—Intersection Control Evaluation		
State	**Resource**	**Link**
Washington State Department of Transportation (WSDOT)	Design Manual. M 22 01.12	http://www.wsdot.wa.gov/publications/manuals/fulltext/M22-01/1300.pdf
Delaware Department of Transportation (DelDOT)	2015 Traffic Design Manual	http://deldot.gov/information/pubs_forms/manuals/traffic_design/2015/2015_chapter_4.pdf#search=traffic%20design%20manual
Traffic Operations—Traffic Impact Analyses		
State	**Resource**	**Link**
New York State Department of Transportation (NYSDOT)	Traffic Impact Study for Department of Transportation (DOT) Projects	https://www.dot.ny.gov/divisions/engineering/design/dqab/dqab-repository/
Resurfacing, Restoration, and Rehabilitation Projects		
State	**Resource**	**Link**
Louisiana Department of Transportation and Development (LADOTD)	Guidance for Safety Improvements for Preservation/rehabilitation/replacement (PRR) Projects	http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Engineering/Road_Design/Systems_Preservation/Documents/Guidance%20for%20Safety%20Improvements%20for%20PRR%20Projects%2009_30_10.pdf

Roadway Safety Management Process		
State	**Resource**	**Link**
Arizona Department of Transportation (ADOT)	Highway Safety Improvement Program Manual	https://www.azdot.gov/business/engineering-and-construction/traffic/traffic-safety/arizona-highway-safety-improvement-program
Illinois Department of Transportation (IDOT)	Highway Safety Improvement Program	http://www.idot.illinois.gov/transportation-system/local-transportation-partners/county-engineers-and-local-public-agencies/funding-opportunities/highway-safety-improvement-program
Indiana Department of Transportation (INDOT)	Highway Safety Improvement Program Local Project Selection Guidance	www.in.gov/indot/files/LocalHSIPProjectSelectionGuidance.pdf
New Hampshire Department of Transportation (NHDOT)	Highway Safety Improvement Program: Manual and Guidance	http://www.nh.gov/dot/org/projectdevelopment/highwaydesign/hwysafetyimprovements/documents/hsip_nhguidance_122013.pdf
Rhode Island Department of Transportation (RIDOT)	Planning, Implementation, and Program Effectiveness of Rhode Island's Highway Safety Improvement Program—Fiscal Year 2013	http://www.dot.ri.gov/documents/community/safety/Highway_Safety_Improvement_Program.pdf
Washington State Department of Transportation (WSDOT)	Design Manual. M 22 01.12	http://www.wsdot.wa.gov/publications/manuals/fulltext/M22-01/321.pdf

ADDITIONAL SOURCES

Additional documents referencing the HSM were discovered in the research for this informational report and may provide valuable information for the development of guidance, procedure, or policy language for agencies.

Highway Safety Manual User Guides		
State	**Resource**	**Link**
Florida Department of Transportation (FDOT)	2015 FDOT Highway Safety Manual User Guide	http://www.dot.state.fl.us/safety/11A-SafetyEngineering/TransSafEng/strategicplandocs/2015FDOTHSMUserGuide.pdf
Georgia Department of Transportation (GDOT)	Applying the HSM to Georgia	http://g92018.eos-intl.net/eLibSQL14_G92018_Documents/12-15.pdf
Illinois Department of Transportation (IDOT)	American Association of State Highway Transportation Officials (AASHTO) Highway Safety Manual Illinois User Guide	http://www.idot.illinois.gov/assets/uploads/files/transportation-system/memos-&-letters/safety/hsm_il_userguide_11062014.pdf
Louisiana Department of Transportation and Development (LADOTD)	Highway Safety Manual Project Applications	http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Multimodal/Highway_Safety/Misc%20Documents/Louisiana%20Fact%20Sheet%20Project%20Map.pdf
Nevada Department of Transportation (NVDOT)	Nevada Project Safety Process	http://www.zerofatalitiesnv.com/wp-content/uploads/2015/10/Nevada_PSP_HSM_2015.pdf

Strategic Highway Safety Plans		
State	**Resource**	**Link**
Nebraska Department of Roads (NDOR)	Nebraska Strategic Highway Safety Plan	http://www.transportation.nebraska.gov/traffeng/shsp/shsp-current.pdf
South Dakota Department of Transportation (SDDOT)	South Dakota Strategic Highway Safety Plan	http://www.sddot.com/transportation/highways/traffic/safety/docs/FinalSHSP.pdf
Virginia Department of Transportation (VDOT)	Virginia 2012—2016 Strategic Highway Safety Plan	http://www.virginiadot.org/info/resources/va_2012_shsp_final.pdf
Systemic Safety Guidelines		
State	**Resource**	**Link**
Illinois Department of Transportation (IDOT)	Illinois Systemic Safety Improvements Analysis, Guidelines and Procedures	http://www.idot.illinois.gov/Assets/uploads/files/Transportation-System/Manuals-Guides-&-Handbooks/Safety/Systemic%20Safety%20Improvements%20Analysis,%20Guidelines%20and%20Procedures.pdf
Analysis Procedure Manual		
State	**Resource**	**Link**
Oregon Department of Transportation (ODOT)	Analysis Procedure Manual Version 2	http://www.oregon.gov/ODOT/TD/TP/APM/APMv2_Ch4.pdf
Design Exception		
State	**Resource**	**Link**
South Dakota Depart of Transportation (SDDOT)	South Dakota Design Process	http://www.sddot.com/business/design/docs/rd/rdmch02.pdf

Practical Design		
State	**Resource**	**Link**
Washington State Department of Transportation (WSDOT)	Practical Planning and Design Leads to Low-Cost Transportation Solutions	http://www.wsdot.wa.gov/publications/fulltext/LegReports/PracticalDesignReport.pdf
Design Manual—Points of Access		
State	**Resource**	**Link**
Pennsylvania Department of Transportation (PennDOT)	Pennsylvania Department of Transportation Design Manual. Publication 10X (DM-1X). Appendix Q Points of Access	https://www.dot.state.pa.us/public/PubsForms/publications/pub%2010/Pub10X_Cover.pdf
Design Manual—Roadside Safety		
State	**Resource**	**Link**
Washington State Department of Transportation (WSDOT)	Design Manual. M 22 01.12	http://www.wsdot.wa.gov/publications/manuals/fulltext/M22-01/1600.pdf
Design Manual—Roundabouts		
State	**Resource**	**Link**
Wisconsin Department of Transportation (WIDOT)	Wisconsin fd-11-26	http://wisconsindot.gov/rdwy/fdm/fd-11-26.pdf
Intersection Decision Guide		
State	**Resource**	**Link**
Indiana Department of Transportation (INDOT)	Indiana Intersection Decision Guide	http://www.in.gov/indot/files/ROP_IntersectionDecisionGuide.pdf

Local Road Safety Manual		
State	**Resource**	**Link**
California Department of Transportation (Caltrans)	Local Roadway Safety Manual	http://www.dot.ca.gov/hq/LocalPrograms/HSIP/Documents/hsip/CA_SM4LROv11.pdf

Traffic Operations Manual		
State	**Resource**	**Link**
North Dakota Department of Transportation (NDDOT)	NDDOT Traffic Operations Manual	https://www.dot.nd.gov/divisions/programming/docs/trafficops.pdf

For More Information:

http://safety.fhwa.dot.gov

FHWA, Office of Safety

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