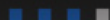


Primer on Safety Data and Analysis Toolbox



The agency improve comprehensive safety program.



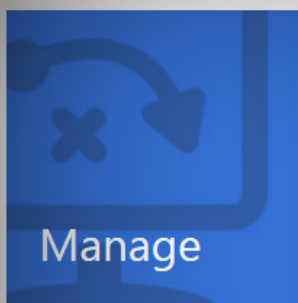
DP Toolbox

Choose from the options the right to enter the toolbox. The Toolbox contains resources that help your organization build a new or strengthen an existing roadway safety data program.

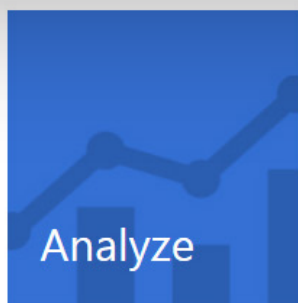
Use the Advanced Search for keyword and category resource search.



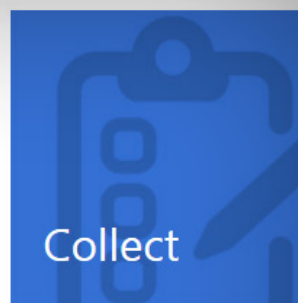
Advanced Search...



Manage



Analyze



Collect



Research

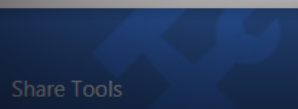
Manage

Managers that understand the costs and benefits of alternative business practices can effectively and efficiently manage the agency's safety program. This section offers information about data-driven decision-making and planning including the costs and benefits of state-of-the-art analysis methods and the data management and governance structures required to support alternative methods. These tools can help managers in developing policies and practices, setting budgets, allocating resources, making safety investments, identifying training needs, and managing a safety program.

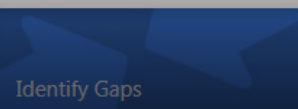


Toolbox Primer

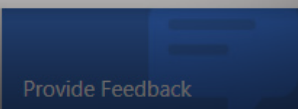
Learn how to use the Toolbox to find an appropriate tool based on specific needs and capabilities.



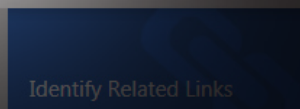
Share Tools



Identify Gaps



Provide Feedback



Identify Related Links

FHWA-SA-15-051

June 2019



U.S. Department of Transportation
Federal Highway Administration



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

<http://safety.fhwa.dot.gov>

NOTICE

This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The U.S. Government assumes no liability for the use of the information contained in this document. This report does not constitute a standard, specification, or regulation.

The U.S. Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear in this report only because they are considered essential to the objective of the document.

QUALITY ASSURANCE STATEMENT

The Federal Highway Administration (FHWA) provides high-quality information to serve Government, industry, and the public in a manner that promotes public understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. FHWA periodically reviews quality issues and adjusts its programs and processes to ensure continuous quality improvement.

ACKNOWLEDGEMENTS

The project team would like to thank the following individuals who served as members on the Federal Highway Administration (FHWA) Office of Safety Technical Working Group for this effort.

OFFICE OF SAFETY TECHNICAL WORKING GROUP

Stuart Thompson, FHWA Office of Safety

Robert Pollack, FHWA Office of Safety

Esther Strawder, FHWA Office of Safety

Karen Scurry, FHWA Office of Safety

Ray Krammes, FHWA Office of Safety Research and Development

Craig Thor, FHWA Office of Safety Research and Development

TECHNICAL DOCUMENTATION PAGE

1. Report No. FHWA-SA-15-051	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Primer on Safety Data and Analysis Toolbox		5. Report Date June 2019	
		6. Performing Organization Code	
7. Author(s) Frank Gross and Geni Bahar		8. Performing Organization Report No.	
9. Performing Organization Name and Address VHB 8300 Boone Boulevard Suite 700 Vienna, VA 22182		10. Work Unit No.	
		11. Contract or Grant No. DTFH61-10-D-00022-T-13005	
12. Sponsoring Agency Name and Address Federal Highway Administration Office of Safety 1200 New Jersey Ave., SE Washington, DC 20590		13. Type of Report and Period Final Primer, June 2019	
		14. Sponsoring Agency Code FHWA	
15. Supplementary Notes The Contracting Officer's Task Manager (COTM) was Stuart Thompson.			
16. Abstract <p>The last two decades have brought significant advancements in data-driven decision-making, including the development and refinement of numerous safety data and analysis tools. For many, this transition to data-driven decision-making represents a change in how they do business. While the new safety data and analysis tools support data-driven decision-making, the identification and selection of an appropriate tool can be a daunting task, particularly for those new to quantitative safety analysis.</p> <p>In response, the Federal Highway Administration (FHWA) initiated a project to develop a Roadway Safety Data and Analysis Toolbox (named Toolbox). The Toolbox fulfills the need for a centralized source of information about the available safety data and analysis tools. The web-based interface helps users to identify appropriate tools based on self-identified needs, capabilities, and resources. Users include anyone in search of a safety data or analysis tool to support data-driven decision-making.</p> <p>This application guide (named Primer) serves as a support document for users of the Toolbox. The Primer will help all users, particularly novice users, to better understand the overall scope and functionality of the Toolbox as well as the roles, responsibilities, and tasks supported by tools in the Toolbox. The Primer guides users through a stepwise process to identify an appropriate tool to support a given task based on their needs and capabilities.</p>			
17. Key Words: Roadway, Safety, Data, Analysis, Toolbox, Primer	18. Distribution Statement No restrictions.		
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 84	22. Price

Form DOT F 1700.7 (8-72) Reproduction of completed pages authorized

TABLE OF CONTENTS

Introduction	I
Purpose.....	I
Intended Audience	I
Primer Organization	I
Using the Primer	2
Roles and Responsibilities	4
Tasks	5
Manage	5
Analyze	8
Collect	10
Research.....	11
Tools.....	12
Explore	12
Refine	12
Select.....	12
Gaps	13
Tutorial	14
Overview of Functions.....	14
Primary Topic Area Search	15
Advanced Search.....	16
Share Tools	17
Identify Gaps	17

Provide Feedback.....	17
Effective Searching.....	18
High-Level (Role-Based) Search	18
Detail-Level (Task-Based) Search.....	21
Quick (Tool-Based) Search	24
Appendix A: Summary of Tools by Task.....	26
Manage.....	26
Analyze	42
Collect	55
Research.....	61
Appendix B: Summary of Existing Tools	70

LIST OF TABLES

Table 1. Toolbox Tags.....	3
Table 2. Roles and Responsibilities by Primary Topic Area.....	4
Table 3. Definition of Tool Types.....	13

LIST OF FIGURES

Figure 1. Screen Shot of Toolbox.....	14
Figure 2. Screen Shot of Advanced Search.....	16
Figure 3. Selecting a Primary Topic Area for High-Level Search.....	19
Figure 4. Exploring Tools from High-Level Search.....	20
Figure 5. Refining Tools from High-Level Search.....	21
Figure 6. Refining Tools from Detail-Level Search.....	23
Figure 7. Search for Tools from the Advanced Search.....	25

LIST OF ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
Accisum	Accident Records Summary and Diagrams
AIMS	Accident Information Management System
BCA	Benefit-Cost Analysis
CARE	Critical Analysis Reporting Environment
CDS	Crashworthiness Data System
CMF	Crash Modification Factor
CIREN	Crash Injury Research and Engineering Network
CODES	Crash Outcome Data Evaluation System
CMAT	Crash Mapping and Analysis Tool
DMBOK	Data Management Body of Knowledge
DOT	Department of Transportation
ECAT	Ohio Economic Crash Analysis Tool
FARS	Fatality Analysis Reporting System
FDE	Fundamental Data Elements
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FTA	Federal Transit Administration
GES	General Estimates System
GIS	Geographic Information System
HPMS	Highway Performance Monitoring System
HSIP	Highway Safety Improvement Program
HSIS	Highway Safety Information System

HSM	Highway Safety Manual
IHSDM	Interactive Highway Safety Design Model
ISATe	Interchange Safety Analysis Tool Enhanced
MCMIS	Motor Carrier Management Information System
MIRE	Model Inventory of Roadway Elements
MIS	Management Information Systems
MMUCC	Model Minimum Uniform Crash Criteria
NCHRP	National Cooperative Highway Research Program
NEMESIS	National EMS Information System
NMVCCS	National Motor Vehicle Crash Causation Study
NTD	National Transit Database
PBCAT	Pedestrian and Bicycle Crash Analysis Tool
PEDSAFE	Pedestrian Safety Guide and Countermeasure Selection System
RSAP	Roadside Safety Analysis Program
RSDP	Roadway Safety Data Program
RSRAP	Resurfacing Safety Resource Allocation Program
SCCOLD	Small Computer COLLision Diagram
SHRP 2	Strategic Highway Research Program 2
SHSP	Strategic Highway Safety Plan
SPF	Safety Performance Function
SPIS	Oregon Safety Priority Index System
SRTS	Safe Routes to School
SSAM	Surrogate Safety Assessment Model
TCAT	Traffic Crash Analysis Tool

TES	Traffic Engineering Software
TRB	Transportation Research Board
TRIS	Transportation Research Information Services
TSP	Transportation Safety Planning
usRAP	United States Road Assessment Program
VZS	Vision Zero Suite

PREFACE

The last two decades have brought significant advancements in data-driven decision-making, including the development and refinement of numerous safety data and analysis tools. For many, this transition to data-driven decision-making represents a change in how they do business. While the new safety data and analysis tools support data-driven decision-making, the identification and selection of an appropriate tool can be a daunting task, particularly for those new to quantitative safety analysis.

In response, the Federal Highway Administration (FHWA) initiated a project to develop a Roadway Safety Data and Analysis Toolbox (named Toolbox). The Toolbox fulfills the need for a centralized source of information about the available safety data and analysis tools. The web-based interface helps users to identify appropriate tools based on self-identified needs, capabilities, and resources. Users include anyone in search of a safety data or analysis tool to support data-driven decision-making.

This application guide (named Primer) serves as a support document for users of the Toolbox. The Primer will help all users, particularly novice users, to better understand the overall scope and functionality of the Toolbox as well as the roles, responsibilities, and tasks supported by tools in the Toolbox. The Primer guides users through a stepwise process to identify an appropriate tool to support a given task based on their needs and capabilities.

INTRODUCTION

PURPOSE

The purpose of this Primer is to provide a support document for users of the Roadway Safety Data and Analysis Toolbox (named Toolbox). The web-based Toolbox provides a centralized source of information about the available safety data and analysis tools. The Toolbox is web-based with a user-guided interface to help users identify an appropriate tool based on self-identified needs, capabilities, and resources. The Primer will help all users, and particularly novice users, to better understand the overall scope and functionality of the Toolbox as well as the roles, responsibilities, and tasks supported by tools in the Toolbox.

INTENDED AUDIENCE

The Primer will support all users of the Toolbox, but particularly novice users. The intended users of the Toolbox include anyone in search of a safety data or analysis tool to support data-driven decision-making. Specific examples include those in search of tools to manage, analyze, collect, and research safety data to support decisions in the safety management process, project development process, systems planning process, or other similar activities.

PRIMER ORGANIZATION

The remainder of the Primer is organized in four general sections: 1) roles and responsibilities, 2) tasks, 3) tools, and 4) tutorial. The following is a general overview of the four sections.

1. Roles and Responsibilities: This section provides a description of the roles and responsibilities supported by tools in the Toolbox. The roles and responsibilities are organized in four primary topic areas: manage, analyze, collect, and research.
2. Tasks: This section identifies specific tasks supported by tools in the Toolbox. The specific tasks align with the roles and responsibilities.
3. Tools: This section provides a general overview of the types of existing safety data and analysis tools in the Toolbox, and identifies specific tools that align with each task.
4. Tutorial: This section provides a tutorial on how to effectively search the Toolbox to identify an appropriate tool for a given task. The tutorial provides examples supported by graphics to help users understand the process of comparing tools and selecting the most appropriate tool for the given task.

USING THE PRIMER

The Primer can help users to:

- Understand the roles and responsibilities supported by tools in the Toolbox.
- Understand the types of data- and analysis-related tasks supported by tools in the Toolbox.
- Understand the range of available tools in the Toolbox.
- Identify and select an appropriate tool for a given task.
- Understand how to identify the data requirements for a given tool.
- Understand how to acquire a given tool (e.g., direct source, web access, etc.).

The Primer guides users through a stepwise process, as follows:

Step 1: The user identifies his/her role and responsibilities based on those presented in the Primer.

Step 2: The user selects a specific task that best describes his/her task to be accomplished.

Step 3: The user reviews a list of relevant safety data and analysis tools based on the self-identified task at hand. The user explores or refines the list of relevant safety data and analysis tools via the Toolbox, following one of two approaches:

- a. Explore: The user explores the various available tools from the Toolbox, reading the detailed summaries for each applicable tool. As part of the exploration, the user will learn about the general types and capabilities of tools to complete their task as well as the system and data requirements to employ the tools. The user then considers his/her existing data capabilities and resources with respect to the specific system and data requirements for each tool in order to select the most applicable tool(s) from the Toolbox.
- b. Refine: The user proceeds to the Toolbox with the intent of refining the potential list of tools. The user may choose this option for one of many reasons (e.g., the list of potential tools is too long to practically explore each one). Table 1 presents a list of high-level categories (referred to as "tags") that are available in the Toolbox as filters to help refine the list of applicable tools. The Primer provides a list of all tools and the applicable tags. The user can identify the relevant tags for each tool and can then enter those tags to search the Toolbox for related tools. The user can apply additional tags as desired to further refine the list of tools.

Note that in some cases, there are no existing tools available to support a given task. In this case, the user may expand their search for related tools. Users are also encouraged to identify gaps and report specific research needs via the Toolbox. Specifically, the Toolbox includes a function, titled [Identify Gaps](#), which allows users to describe tools that would help to fill identified gaps. This function is described in this document in the section titled [Tools](#).

Table 1. Toolbox Tags.

Tags	Options	
Primary Topic Area	M = Manage C = Collect	A = Analyze R = Research
Tool Type	S = Software D = Database <ul style="list-style-type: none"> Analytical Database Information Source 	G = Guide <ul style="list-style-type: none"> Application Guide Information Guide
Safety Management Process	N = Network Screening D = Diagnosis C = Countermeasure Selection	E = Economic Appraisal P = Project Prioritization S = Safety Effectiveness Evaluation
Project Development Process	P = Planning A = Alternatives Development and Analysis	D = Design O = Operations and Maintenance
Data Type	C = Crash I = Injury/Hospital	R = Roadway O = Operations
Data Coverage	N = National	R = Regional/State/Local
Program Type	SHSP = Strategic Highway Safety Plan HSIP = Highway Safety Improvement Program	SRTS = Safe Routes to School TSP = Transportation Safety Planning
Focus Area	RD = Roadway Departure INT = Intersection PB = Pedestrian/Bike	LR = Local/Rural S = Speed
Agency Level	State, Regional, Local	
Analysis Level	Program, Project	
Online Access	Yes, No	
Charge	Free = Public	Fee = Proprietary

ROLES AND RESPONSIBILITIES

Step 1 of the process is to identify a general role and responsibility based on those presented in the Primer.

Table 2 defines the roles and responsibilities related to four primary areas: 1) Manage, 2) Analyze, 3) Collect, and 4) Research. Click on a role and responsibility to hyperlink to a list of related tasks.

Table 2. Roles and Responsibilities by Primary Topic Area.

Area	Roles and Responsibilities
Manage	<ol style="list-style-type: none"> 1. Understand the safety management process and how it supports the project development process. 2. Understand the importance of data-driven decision-making. 3. Understand the value of data. 4. Understand the importance of state-of-the-art data analysis methods. 5. Understand the needs of safety analysts in terms of data elements, data integration, data format, and data query. 6. Understand the needs of data collectors in terms of data entry, data format, and reporting. 7. Understand current data capabilities and potential for improvement. 8. Understand the importance of data integration to support data-driven decision-making in the safety management and project development process. 9. Develop integrated data systems that link data from various sources. 10. Ensure data are accessible by all stakeholders. 11. Assess the completeness and quality of data through regular automated checks and periodic manual checks. 12. Understand the importance of performance tracking for data capabilities, project effectiveness, and program effectiveness.
Analyze	<ol style="list-style-type: none"> 13. Understand the various methods and related strengths and limitations for network screening, diagnosis, countermeasure selection, economic appraisal, project prioritization, and safety effectiveness evaluation. 14. Understand current data analysis capabilities. 15. Employ state-of-the-art techniques to perform data analysis. 16. Identify data needs to enhance current data analysis capabilities.
Collect	<ol style="list-style-type: none"> 17. Understand the needs of safety analysts in terms of data elements, level of detail, and data format. 18. Collect data through existing programs. 19. Identify opportunities to collect additional data through new programs. 20. Employ state-of-the-art techniques to collect high-quality data efficiently and cost-effectively.
Research	<ol style="list-style-type: none"> 21. Develop guides and tools to support the management of safety data and analysis programs. 22. Analyze data to identify priority safety issues and estimate the effectiveness of countermeasures. 23. Refine state-of-the-art techniques to perform data analysis. 24. Develop guides and tools to support data analysis. 25. Enhance data collection and management techniques. 26. Develop guides and tools to support data collection and management.

TASKS

Step 2 of the process is to select a specific task that best describes the task to be accomplished.

The following is a summary of tasks, which are presented as questions under each role and responsibility listed in Step 1. Click on one of the tasks to hyperlink to a list of related tools. Note that for some of the listed tasks, no related tools were identified, and a gap is acknowledged in the Toolbox. As new tools are developed, the Toolbox will be updated, and the gaps will be filled. To help identify gaps and prioritize research needs, users are encouraged to submit comments via the [Identify Gaps](#) function within the Toolbox. Refer to the [Research](#) section of [Appendix A](#) for a list of research needs that were identified during the development of the Toolbox. Research conducted in these areas will help to fill gaps in the Toolbox.

MANAGE

1. Understand the safety management process and how it supports the project development process.
 - a. [What is the relationship between the safety management and project development processes?](#)
2. Understand the importance of data-driven decision-making.
 - a. [How can better data improve the cost effectiveness of our decisions?](#)
3. Understand the value of data.
 - a. [What crash, roadway, traffic, injury, and supplemental data are required to support the safety management process?](#)
 - b. [What crash, roadway, traffic, injury, and supplemental data are required to support the use of state-of-the-art analytical tools \(e.g., Highway Safety Manual\)?](#)
 - c. [What is the value of improving current crash, roadway, traffic, injury, and supplemental data capabilities?](#)
 - d. [How can I justify increasing the budget for data collection and management?](#)
4. Understand the importance of state-of-the-art data analysis methods.
 - a. [What is the benefit that we can anticipate when employing state-of-the-art techniques in lieu of traditional ones?](#)
 - b. [What types of analysis can be conducted based on existing data capabilities?](#)
 - c. [What are the strengths and limitations of various analytical methods \(specifically related to current agency methods\), and how can the limitations be overcome?](#)
 - d. [What data are required to enhance current analytical methods and employ more rigorous methods?](#)
 - e. [What policies are required/desired to support the implementation of state-of-the-art analytical methods?](#)

5. Understand the needs of safety analysts in terms of data elements, data integration, data format, and data query.
 - a. [What types of data do the analysts need and in what format are the data needed?](#)
 - b. [How should the data be linked and available for query?](#)
 - c. [How can we expand or adapt our existing data platform to use new analytical tools?](#)
 - d. [What data platform, data elements, and data format should be adopted to employ state-of-the-art tools such as AASHTOWare Safety Analyst™ or the Highway Safety Manual?](#)
6. Understand the needs of data collectors in terms of data entry, data format, and reporting.
 - a. [What platforms and interfaces are required to facilitate data entry?](#)
 - b. [What reporting capabilities are required to support national, state, local reporting requirements?](#)
7. Understand current data capabilities and potential for improvement.
 - a. [How do I assess current safety data capabilities?](#)
 - b. [What other departments in our agency collect data required to use the state-of-the-art analytical methods?](#)
 - c. [What other agencies in our jurisdiction collect data relevant to road safety data elements?](#)
 - d. [What organization structure needs to be in place to manage all aspects of data collection, management, and evaluation?](#)
 - e. [How do road data collection and data management fit into the agency's asset management structure?](#)
 - f. [How do I develop a policy to support an increasing data capability for the agency in each aspect of road safety management?](#)
 - g. [What tools and equipment are required to initiate and maintain a cost-effective data collection and management program to support all aspects of road safety management?](#)
 - h. [What human resources are needed to initiate and maintain a cost-effective data collection and management program to support all aspects of road safety management?](#)
 - i. [What qualifications are required of agency personnel to serve at positions managing safety data?](#)
 - j. [How do I prioritize needs to improve data capability?](#)
 - k. [What funding sources are available for data enhancements?](#)

8. Understand the importance of data integration to support data-driven decision-making in the safety management and project development process.
 - a. [Would data integration \(internal and external sources\) be cost effective to our agency?](#)
 - b. [What are the most effective ways to support and encourage data integration?](#)
 - c. [What would be the foundation and elements of effective examples of task forces dedicated to data integration within an agency or within a jurisdiction \(among agencies\)?](#)
 - d. [For state-level managers, why is there a need to integrate local data in the state's safety management system, and what is the most effective way to integrate local data in the state's safety management system?](#)
 - e. [For local-level managers, why is there a need to share data with the state?](#)
 - f. [What funding sources are available for data integration?](#)
9. Develop integrated data systems that link data from various sources.
 - a. [Why is it important to link data from various sources?](#)
 - b. [What are the required links among various data sources to use state-of-the-art analytical methods?](#)
 - c. [What tools are available to manage and link data for analysis?](#)
10. Ensure data are accessible by all stakeholders.
 - a. [How do I establish a protocol for effective access to data sources and online analytical tools?](#)
 - b. [What are the security and legal implications of making data publicly available?](#)
11. Assess the completeness and quality of data through regular automated checks and periodic manual checks.
 - a. [What types of quality control checks should be performed on the data?](#)
 - b. [How often should data elements be checked for completeness, accuracy, etc.?](#)
12. Understand the importance of performance tracking for data capabilities, project effectiveness, and program effectiveness.
 - a. [What data are required for performance tracking?](#)
 - b. [How do I track data capabilities?](#)

ANALYZE

13. Understand the various methods and related strengths and limitations for network screening, diagnosis, countermeasure selection, economic appraisal, project prioritization, and safety effectiveness evaluation.

Network Screening

- a. [What are the state-of-the-art network screening methods?](#)
- b. [What data are required to use specific network screening methods?](#)
- c. [What tools are available for network screening and what data do they require from users?](#)
- d. [How do I assess differences among the results of different network screening methods?](#)
- e. [Where do I find SPFs and related information?](#)
- f. [How do I assess the quality of existing SPFs for use in network screening?](#)
- g. [How do I incorporate the results of different network screening methods for more effective selection of sites for potential improvements?](#)

Diagnosis

- h. [What are the state-of-the-art diagnosis methods?](#)
- i. [What data are required to use specific diagnostic methods?](#)
- j. [What tools are available to support diagnosis and what data do they require from the users?](#)

Countermeasure Selection

- k. [What are the state-of-the-art countermeasure selection methods?](#)
- l. [What data are required to use specific countermeasure selection methods?](#)
- m. [What tools are available to support the selection of countermeasures based on results for a given diagnosis, and what data do they require from the users?](#)

Economic Appraisal

- n. [What are the state-of-the-art economic appraisal methods used for safety analysis?](#)
- o. [What data are required for the different economic appraisal methods?](#)
- p. [What tools are available to undertake economic appraisal of potential countermeasures, and what data do they require from the users?](#)
- q. [How do I assess differences among the results of the economic appraisal methods?](#)

Project Prioritization

- r. [What are the state-of-the-art project prioritization methods used for safety analysis?](#)
- s. [What data are required for the different project prioritization methods?](#)
- t. [What tools are available to undertake project prioritization, and what data do they require from the users?](#)
- u. [How do I assess differences among the results of the project prioritization methods?](#)

Safety Effectiveness Evaluation

- v. [What are the state-of-the-art safety effectiveness evaluation methods?](#)
 - w. [What data are required for the different safety effectiveness evaluation methods?](#)
 - x. [What tools are available to assess the safety effectiveness of implemented projects or countermeasures, and what data do they require from the users?](#)
-

I4. Understand current data analysis capabilities.

- a. [How do I assess the data capability of our agency in relation to the required data toward applying the state-of-the-art network screening methods?](#)
 - b. [How can we advance from the state-of-the-practice to the state-of-the-art?](#)
 - c. [How can we maintain the data capability required to carry out annual safety analyses?](#)
 - d. [What data are required for the development of SPFs for network screening procedures?](#)
 - e. [What data are required for the development of SPFs for project level safety analysis?](#)
 - f. [How do we prioritize data needs versus the agency's programs and upcoming projects?](#)
 - g. [How do I determine if our agency should develop SPF calibration factors or develop agency-specific SPFs?](#)
-

I5. Employ state-of-the-art techniques to perform data analysis.

- a. [What are the state-of-the-art techniques?](#)
 - b. [How do I develop SPFs?](#)
 - c. [How do I develop CMFs?](#)
 - d. [What is the benefit that we can anticipate when employing state-of-the-art techniques in lieu of traditional ones?](#)
 - e. [What agencies have experience with the state-of-the-art techniques? Are there national task forces or peer groups to share experiences?](#)
 - f. [How should we position ourselves to stay tuned and prepared to advance with developing techniques?](#)
-

I6. Identify data needs to enhance current data analysis capabilities.

- a. [What data issues might be encountered when employing state-of-the-art techniques?](#)
- b. [How do I demonstrate the data gaps to data managers through the analysis to support our agency's enhancement of data analysis capabilities?](#)
- c. [What data links are needed \(and missing in our agency\) to use the state-of-the-art analytical methods?](#)
- d. [What tools are available for analysis and what data are needed \(and may be missing in our agency\) to be able to use these analytical tools and software programs?](#)
- e. [How do I incorporate the analytical needs to data management's efforts in the agency?](#)
- f. [Are there national data that may complement our agency's data to enhance our analysis capabilities \(such as injured persons/crash type and severity\)?](#)
- g. [What additional types of quality control checks should be put in place?](#)
- h. [How often should data be collected and added to the agency's linked database for timely analysis?](#)

COLLECT

17. Understand the needs of safety analysts in terms of data elements, level of detail, and data format.
- [What types of data do the analysts need and in what format and level of detail are the data needed? In particular, what data are needed to employ state-of-the-art methods and tools \(e.g., Highway Safety Manual\)?](#)
-
18. Collect data through existing programs.
- [What are the options for collecting additional data elements or adding miles of roadway to the existing linear referencing system through existing programs?](#)
 - [How can I encourage decision-makers to collect additional data elements or add miles of roadway to the existing linear referencing system?](#)
 - [How often should individual data elements be collected and/or reviewed?](#)
 - [What are effective structures for an annual traffic and safety data collection and management program?](#)
-
19. Identify opportunities to collect additional data through new programs.
- [What are the options for collecting additional data elements or adding miles of roadway to the existing linear referencing system through new programs?](#)
 - [How can I encourage decision-makers to collect additional data elements or add miles of roadway to the existing linear referencing system?](#)
 - [What tools and equipment are required for effective data collection and management to support each aspect of the safety management process?](#)
 - [What human resources are needed to complement the tools and equipment for data collection and management to support each aspect of the safety management process?](#)
-
20. Employ state-of-the-art techniques to collect high-quality data efficiently and cost-effectively.
- [How can we improve the quality of our data?](#)
 - [What is the most cost-effective method for collecting additional data elements or adding miles of roadway to the existing linear referencing system?](#)
 - [Does the effectiveness of data collection methods change based on existing capabilities \(e.g., availability of a video log or reliable GIS basemap\)?](#)

RESEARCH

21. Develop guides and tools to support the management of safety data and analysis programs.

- a. [What guides and tools are needed to manage safety data and analysis programs?](#)
 - b. [What tools and guides are under development to support the management of safety data and analysis programs?](#)
-

22. Analyze data to identify priority safety issues and estimate the effectiveness of countermeasures.

- a. [What databases are available for analyzing safety issues at the national, regional, state, and local level?](#)
 - b. [What emphasis areas have been adopted in the strategic safety plan, and have the priorities shifted?](#)
 - c. [What performance measures are needed for evaluation?](#)
 - d. [What data analysis programs are in effect for assessing strategic plans?](#)
 - e. [What are the needs related to CMFs, CMFunctions, and general countermeasure effectiveness?](#)
 - f. [What methods are needed to evaluate the safety effects of systemic treatments?](#)
-

23. Refine state-of-the-art techniques to perform data analysis.

- a. [What are the current limitations of the state-of-the-art techniques?](#)
 - b. [What innovative research efforts are currently taking place toward advancement of the state-of-the-art techniques?](#)
 - c. [What analytical techniques are anticipated in the next edition of the HSM?](#)
 - d. [What are the identified research needs, related to refined analytical techniques, included in the national agenda developed by NCHRP 17-48?](#)
-

24. Develop guides and tools to support data analysis.

- a. [What guides and tools are needed for data analysis?](#)
 - b. [What tools and guides are under development to support data analysis?](#)
-

25. Enhance data collection and management techniques.

- a. [What are the innovative data collection and management techniques being used by others?](#)
 - b. [How accurate are the new data collection and management techniques?](#)
 - c. [How cost-effective are the new data collection and management techniques?](#)
 - d. [What surrogate data elements can complement or replace traditional data elements?](#)
-

26. Develop guides and tools to support data collection and management.

- a. [What guides and tools are needed for data collection?](#)
- b. [What tools and guides are under development to support data collection?](#)

TOOLS

Step 3 of the process is to review a list of relevant safety data and analysis tools. The tools correspond to the self-identified role and responsibility (Step 1), and task (Step 2). The user then proceeds to the Toolbox to explore or refine the list of relevant safety data and analysis tools.

Potential tools are listed in [Appendix A](#), sorted by role and responsibility, and task. Based on the selected [Roles and Responsibilities](#) (Step 1), and [Tasks](#) (Step 2), a list of relevant safety data and analysis tools is presented to the user. At this point, the user must choose whether to [Explore](#) or [Refine](#) the list of tools, and finally [Select](#) an appropriate tool.

EXPLORE

In this option, users link directly from the Primer to the relevant tools in the Toolbox to learn more about the tool(s) of interest. Specifically, the user clicks a tool to hyperlink to the detailed summaries in the Toolbox to read more about the general capabilities, system and data requirements, and other information including the availability of each tool. In addition to the specific tools listed in the Primer, users are encouraged to search the Toolbox and the [Transportation Research Information Services](#) (TRIS), using the tags associated with each task. [Appendix B](#) provides a complete list of tools from Version 1.0 of the Toolbox, along with the associated tags.

REFINE

In this option, the [Advanced Search](#) function of the Toolbox is used to apply the associated tags for the task at hand as well as additional filters to refine the list of tools. This option is particularly useful if there are numerous tools available for a given task. [Appendix B](#) provides a complete list of tools from Version 1.0 of the Toolbox, along with the associated tags. Refer to [Appendix B](#) to identify the related tags for a given list of tools and apply those tags in the [Advanced Search](#) function of the Toolbox. Filters are provided in the Toolbox to help refine the search results. One filter to refine the list of relevant tools is “Tool Type,” which is used to identify different types of safety data and analysis tools based on the user interface, content, and purpose. Table 3 identifies the various types of tools along with a description. Other potential filters were identified in Table 1, and are further explained in the [Tutorial](#).

SELECT

In selecting an appropriate tool, users must consider their data capabilities and available resources with respect to the data requirements associated with relevant tools. Specifically, the user should identify the data requirements for potential tools of interest and compare the data requirements to their existing data capabilities. This can help users to identify tools to employ immediately, but can also help to create an implementation plan to increase data capabilities. For example, if there are tools that require additional data beyond existing capabilities, then the user can identify the data gaps, and work with the appropriate data managers and data collectors to enhance current data capabilities.

GAPS

In some cases, there are no tools listed for a given task as none were identified during the development of the Toolbox. These are recognized as current gaps, and as new tools are developed, they will be added to the Toolbox. Users are encouraged to identify gaps and suggest tools and research needed to help fill these gaps via the [Identify Gaps](#) function of the Toolbox. Researchers and research sponsors may be interested in these gaps to help identify and prioritize future projects. Refer to the [Research](#) section of [Appendix A](#) for a list of research needs that were identified during the development of the Toolbox. To provide context and understand the limitations of existing tools, the research needs are presented with links back to the respective tasks listed in Step 2 ([Tasks](#)).

Table 3. Definition of Tool Types.

Tool Type	Description
Database	A tool in the form of a collection of data organized in a manner to facilitate the access, export, and processing for different needs. Some databases (e.g., the Fatality Analysis Reporting System—FARS) are constructed as database management systems, which are designed to interact with the user, allowing for export and analysis of selected subsets of data found in the database. The Toolbox further categorizes databases as “Analytical Data” and “Information Source.” Analytical databases typically include numeric and text values that describe the safety-related characteristics of the system (e.g., crash events and outcomes, roadway attributes, road users, vehicles, and environmental conditions). An information source is typically a centralized database of information such as systems containing publications, training courses, or information on a specific topic (e.g., the Crash Modification Factors (CMF) Clearinghouse).
Guide	A tool in the form of documentation to provide general information or describe the application of a method or procedure. The Toolbox further categorizes guides as “Application” and “Information” guides. An application guide focuses on the process of applying information or methods in practice. An information guide provides general knowledge on a topic (e.g., description of a system, process, or another tool), but is less focused on how the information is used in practice.
Software	A tool in the form of a computer software written to process safety data within specific programmed conditions. Software tools are developed on a specific platform and are used to partly or fully automate components of the safety management process.

TUTORIAL

This section provides a tutorial on how to effectively search the Toolbox to identify an appropriate tool for a given task. The tutorial begins with an overview of the functions of the Toolbox and then provides examples of effective searching to help users understand the process of identifying and comparing tools, and ultimately selecting an appropriate tool for a given task.

OVERVIEW OF FUNCTIONS

The primary function of the Toolbox is to facilitate user-guided searches for roadway safety data and analysis tools. Secondary functions of the Toolbox provide users with a mechanism to share new tools, identify existing gaps, provide feedback, and identify related links. Figure I is a screen shot of the Toolbox. The primary search function includes the four large icons in the upper right ([Manage](#), [Analyze](#), [Collect](#), and [Research](#)) as well as the [Advanced Search](#) icon in the lower left. The secondary functions include the three smaller icons along the bottom ([Share Tools](#), [Identify Gaps](#), and [Provide Feedback](#)). Users can access any of the functions by clicking on the related icon while in the Toolbox. Following Figure I is a brief description of each function.

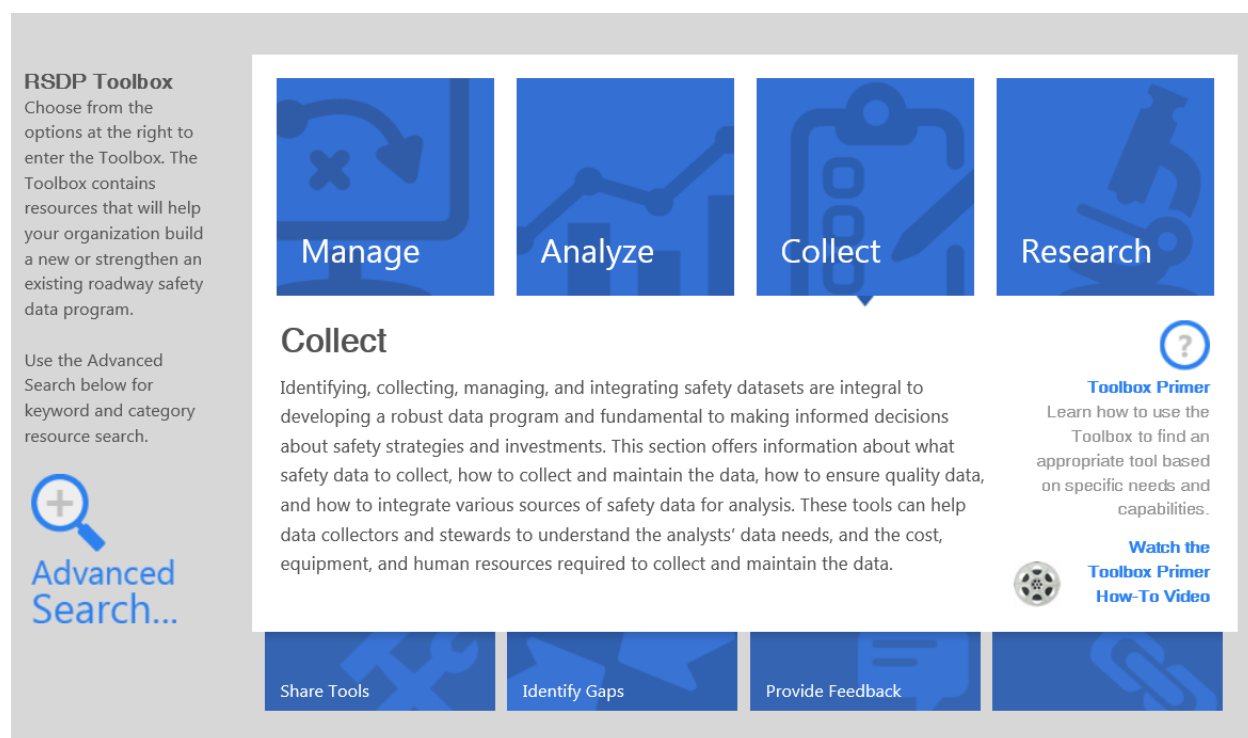
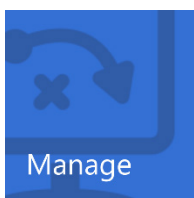


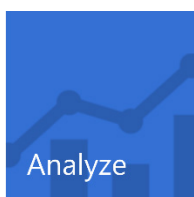
Figure I. Screen Shot of Toolbox.

Primary Topic Area Search

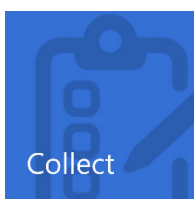
The search by primary topic area is structured as four categories based on the roles and responsibilities described in Step 1 of the Primer. The four primary topic areas are [Manage](#), [Analyze](#), [Collect](#), and [Research](#) as described below. By selecting one of the four areas, users will be brought to a list of all related tools with the option to further refine the list using filters. The primary topic area search and filters are further explained in the section titled, [Effective Searching](#).



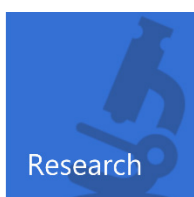
Managers that understand the costs and benefits of alternative business practices can effectively and efficiently manage the agency's safety program. This section offers information about data-driven decision-making and planning including the costs and benefits of state-of-the-art analysis methods and the data management and governance structures required to support alternative methods. These tools can help managers in developing policies and practices, setting budgets, allocating resources, making safety investments, identifying training needs, and managing a safety program.



Agencies with solid safety data programs can use state-of-the-art safety analysis tools to inform decisions in the safety management, planning, programming, and project development processes. This section offers information about the use, strengths, limitations, and data requirements of traditional and state-of-the-art methods. These analysis tools can help agencies get the biggest bang for their dollar.



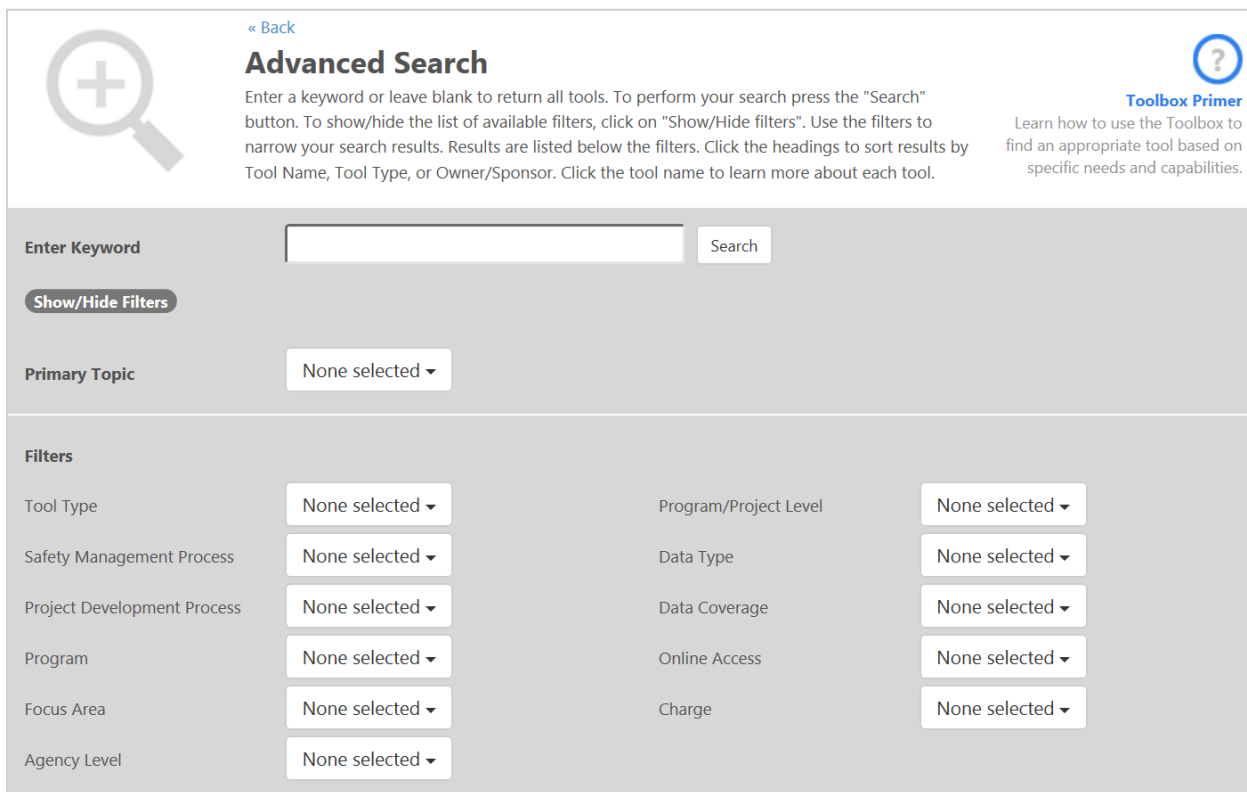
Identifying, collecting, managing, and integrating safety datasets are integral to developing a robust data program and fundamental to making informed decisions about safety strategies and investments. This section offers information about what safety data to collect, how to collect and maintain the data, how to ensure quality data, and how to integrate various sources of safety data for analysis. These tools can help data collectors and stewards to understand the analysts' data needs, and the cost, equipment, and human resources required to collect and maintain the data.



The science of safety continues to evolve, with research supporting continuous improvement of data and analysis techniques. This section offers information about various datasets and state-of-the-art analysis techniques that can help to facilitate safety research.

Advanced Search

The [Advanced Search](#) provides a way for users to bypass the four primary topic areas. Figure 2 is a screen shot of the advanced search page. From the advanced search page, users can generate a list of tools that is not restricted to one of the four primary topic areas. Instead, users enter a keyword to generate a list of tools, and then have the option to apply filters to refine the list. If the keyword search is left blank, then the Toolbox will return the entire list of tools.



« Back

Advanced Search

Enter a keyword or leave blank to return all tools. To perform your search press the "Search" button. To show/hide the list of available filters, click on "Show/Hide filters". Use the filters to narrow your search results. Results are listed below the filters. Click the headings to sort results by Tool Name, Tool Type, or Owner/Sponsor. Click the tool name to learn more about each tool.

Toolbox Primer
Learn how to use the Toolbox to find an appropriate tool based on specific needs and capabilities.

Enter Keyword Search

Show/Hide Filters

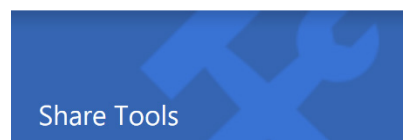
Primary Topic None selected ▼

Filters

Tool Type	None selected ▼	Program/Project Level	None selected ▼
Safety Management Process	None selected ▼	Data Type	None selected ▼
Project Development Process	None selected ▼	Data Coverage	None selected ▼
Program	None selected ▼	Online Access	None selected ▼
Focus Area	None selected ▼	Charge	None selected ▼
Agency Level	None selected ▼		

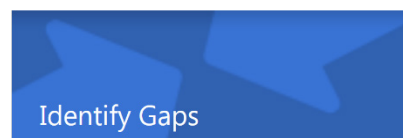
Figure 2. Screen Shot of Advanced Search.

Share Tools



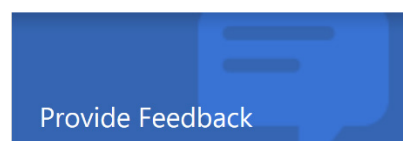
The [Share Tools](#) link allows users to share information on additional tools that could be added to the Toolbox. This link will take users to an online form where they can submit basic information about the proposed tool. Required inputs include the title and description of the tool as well as contact information in case there is a need to follow-up for more details. Optional inputs include: applicability, capabilities, data requirements, capabilities, owner/sponsor, and availability of the tool. Click on the icon to share tools.

Identify Gaps



The [Identify Gaps](#) link allows users to share information on additional tools that are needed, but not currently available in the Toolbox. This link will take users to an online form where they can submit basic information about their needs. Required inputs include a description of the identified gap or need as well as contact information in case there is a need to follow-up for more details. Optional inputs include the desired applicability and capabilities of future tools. The optional inputs will help project sponsors to better understand the specific need. Click on the icon to identify gaps.

Provide Feedback



The [Provide Feedback](#) link allows users to share information about their overall experience with the Toolbox. Through this link, users can report issues with existing functions (e.g., dead hyperlinks) or submit suggestions for enhanced functionality. Required inputs include an indication of the type of entry (i.e., functionality issue or suggestion for improvement) as well as a description of the issue or suggestion. Users may submit entries anonymously, but are encouraged to provide contact information in case there is a need to follow-up for more details. Click on the icon to provide feedback.

EFFECTIVE SEARCHING

The most effective search technique depends on the user's understanding of their role and responsibility, needs, and related tools to accomplish the task at hand. Three search levels are defined to illustrate effective search techniques from various starting points. The following is a brief overview of the three techniques, followed by a detailed discussion and example of each.

1. High-level (role-based): This method is used to identify all tools related to specific roles.
2. Detail-level (task-based): This method is used to identify all tools related to specific tasks.
3. Quick Search (tool-based): This method is used to identify a specific tool by name.

High-Level (Role-Based) Search

Effective role-based searching primarily involves Step 1 (identify roles and responsibilities) and Step 3 (explore or refine the list of relevant tools) of the three-step process outlined in the Primer. In this search technique, an applicable primary topic area is selected to search the Toolbox for all related tools. To identify an applicable topic area, review the roles and responsibilities in Table 2 from the [Roles and Responsibilities](#) section or review the descriptions of the four primary topic areas from the Toolbox. Descriptions of the four primary topic areas are presented above in the [Primary Topic Area Search](#) section. Select the primary topic area that best defines the role and responsibility related to the task at hand. From the Toolbox, click on the selected primary topic area to generate a list of related tools, and proceed to Step 3 (explore or refine the list of relevant tools) of the three-step process.

The tools are presented in the Toolbox by title along with the tool type and owner/sponsor. The list is sorted by title in alphabetical order, but the list can be sorted by the other categories (tool type or owner/sponsor) by clicking on the respective header. Review the entire list of tools or apply additional filters to refine the list. To learn more about a specific tool, simply click on the "Tool Name" to access a more detailed summary. The detailed summary includes the following information.

Tool Name	Name of tool.
Applicability	An indication of related primary topic areas (i.e., manage, analyze, collect, and/or research), and relevant activities with respect to the Highway Safety Manual's Safety Management Process (i.e., network screening, diagnosis, countermeasure selection, economic appraisal, project prioritization, and/or safety effectiveness evaluation).
Overview	A bulleted list of capabilities (i.e., what the tool can help users to accomplish).
Requirements	An indication of the data and system requirements for full use of the tool. If the tool includes various functions, then this section identifies the variations and the respective data and system requirements.
Summary	A high-level description of the tool.
Entity	An indication of the agency or entity responsible for the development and/or maintenance of the tool.
Availability	An indication of the cost (i.e., free or fee) and a reference, such as a link to a website, for further documentation and/or access to the tool.

Example: You have just been hired by a transportation agency as a junior engineer or planner, and told that you will be supporting the Safety Division as a junior analyst. You are relatively new to safety and want to make a good impression on your new team, so you want to learn more about the available tools and methods related to your job (i.e., junior analyst). In this case, you can use the Toolbox to conduct a role-based search for related tools.

Step 1: Identify an applicable primary topic area by reviewing the descriptions of the four primary topic areas in the [Primary Topic Area Search](#) section and/or reviewing the roles and responsibilities in Table 2 from the [Roles and Responsibilities](#) section. In this example, you are defined as a junior analyst, which aligns with the primary topic area “Analyze.” From the Toolbox, click on Analyze, as highlighted in Figure 3, to generate a list of related tools.

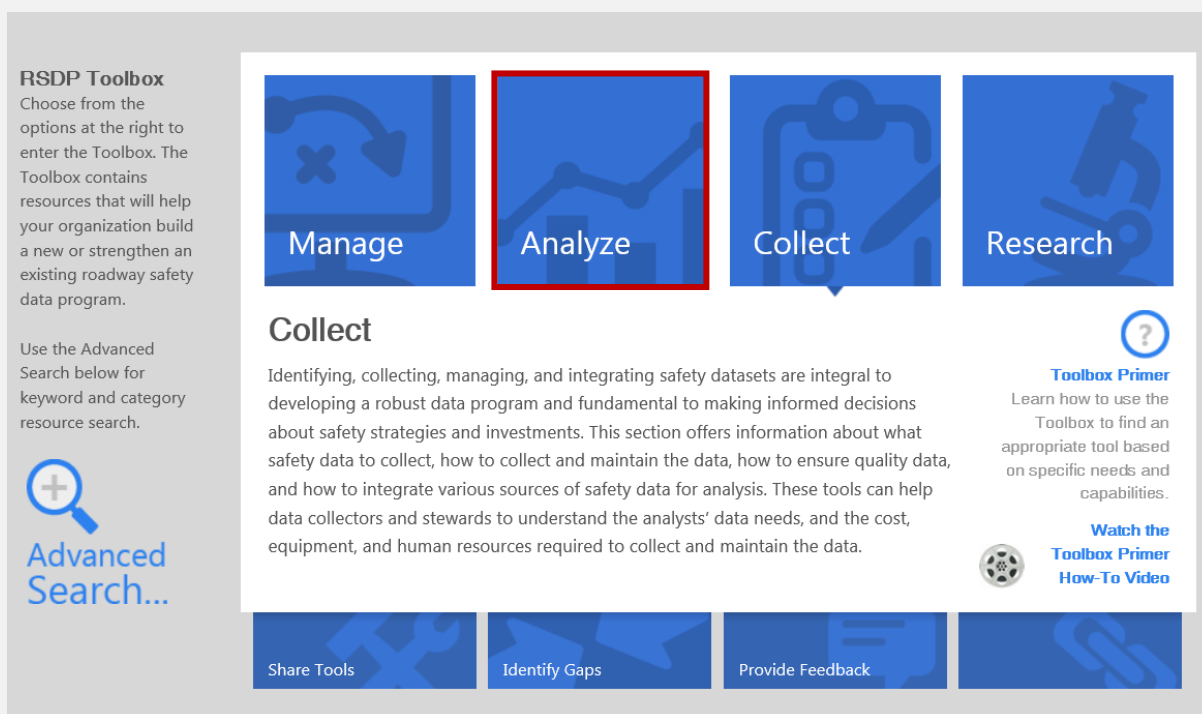


Figure 3. Selecting a Primary Topic Area for High-Level Search.

Step 2: Select a specific task that best describes the task at hand. This step is not applicable in the role-based search because you are interested in generating a list of all relevant tools.

Step 3: Explore or refine the list of tools generated from the Toolbox. As highlighted in Figure 4, there are 77 tools returned from the Toolbox that relate to the primary topic area “Analyze.” In this example, you are interested in learning more about all available tools and methods, so there is no need to further refine the list. Click on the tool names to explore each tool, including an overall summary, specific capabilities, and basic system and data requirements.

« Back

Analyze ?

The resources listed below relate to the **analysis** of roadway safety data. Use the filters to narrow your search results. Results are listed below the filters. Results are listed below the filters. Click the headings to sort results by Tool Name, Tool Type, or Owner/Sponsor. Click the tool name to learn more about each tool.

Toolbox Primer
Learn how to use the Toolbox to find an appropriate tool based on specific needs and capabilities.

Primary Topic 1 selected ▼

Filters

Tool Type	None selected ▼	Program/Project Level	None selected ▼
Safety Management Process	None selected ▼	Data Type	None selected ▼
Project Development Process	None selected ▼	Data Coverage	None selected ▼
Program	None selected ▼	Online Access	None selected ▼
Focus Area	None selected ▼	Charge	None selected ▼
Agency Level	None selected ▼		

Found 77 tools.

Figure 4. Exploring Tools from High-Level Search.

To refine the list of tools, select from the list of filters highlighted in Figure 5, and apply specific tags to narrow the search results. Perhaps you are only interested in reading available guides, and not looking for databases and software. The Tool Type filter can be applied to return only those tools that are guides, removing all database and software tools. As shown in Figure 5, “application guide” and “information guide” are selected as tags from the Tool Type filter, which reduces the list from 77 to 26 tools.

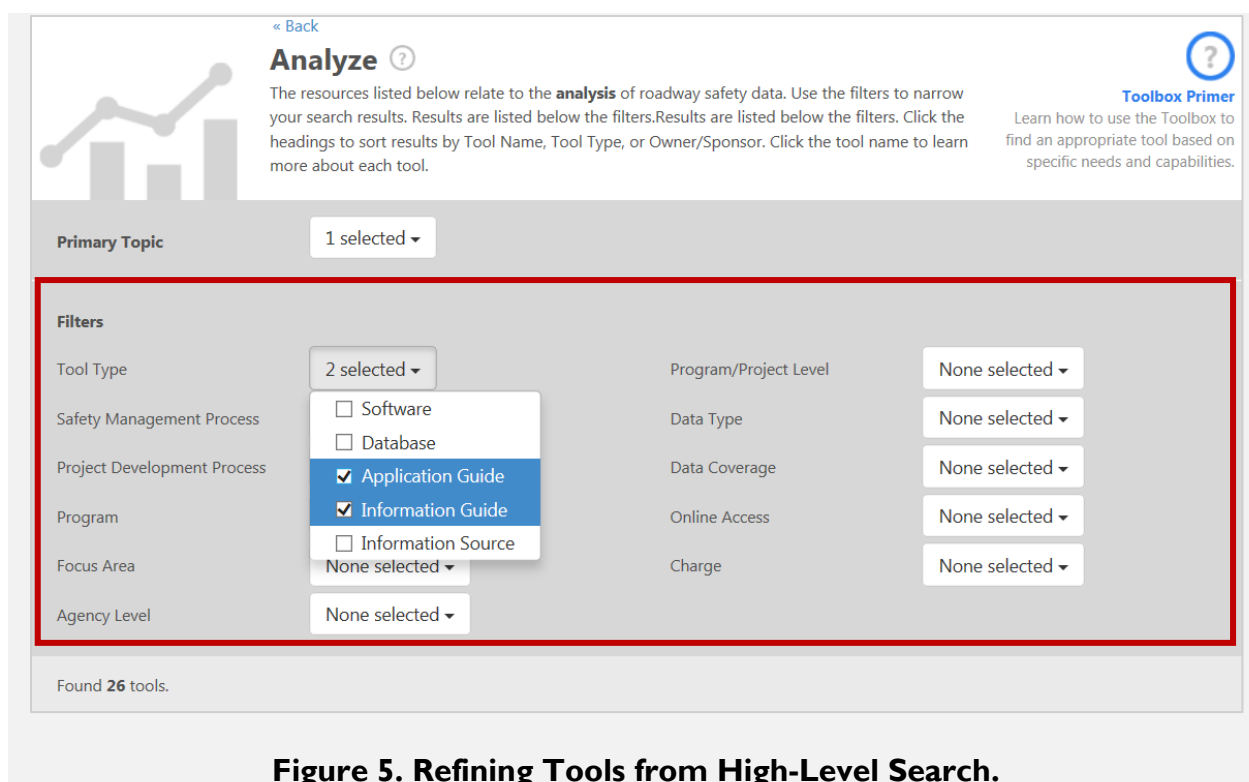


Figure 5. Refining Tools from High-Level Search.

Detail-Level (Task-Based) Search

Effective task-based searching follows the three-step process outlined in the Primer. In this search technique, an applicable role/responsibility is selected from Table 2 in the [Roles and Responsibilities](#) section of the Primer. Click on one of the roles and responsibilities to hyperlink to a list of related tasks. Next, select a specific task that best matches the task at hand to identify a list of related tools. Click on the Tool Name from the Primer to access a detailed summary from the Toolbox.

To refine the list of task-specific tools identified in the Primer, use the [Advanced Search](#) function from the Toolbox. First, generate a similar list of task-specific tools from the Toolbox. Using the [Advanced Search](#) function, enter a keyword or leave the field blank and click "Search." [Note that leaving the keyword field blank will return all tools in the Toolbox.] Next, refer to [Appendix B](#) of the Primer to identify relevant tags for the task-specific tools identified in the Primer. Finally, using the Toolbox filters, apply the tags from [Appendix B](#) and additional tags as desired, to refine the list of task-specific tools. To learn more about a specific tool, simply click on the Tool Name to access a more detailed summary.

Example: An agency is planning to upgrade their roadway inventory data to comply with the Model Inventory Roadway Elements (MIRE) Fundamental Data Elements (FDE). You have been asked to explore the options and relative costs for collecting additional data elements as necessary to meet the MIRE FDE. In this example, you can use the Primer to identify appropriate tools for the given task, and then use the Toolbox to explore or refine the list of applicable tools.

Step 1: Identify an applicable role/responsibility from Table 2 in the [Roles and Responsibilities](#) section of the Primer. There are several potential roles and responsibilities that relate to this task, but the most relevant fall under the primary topic area “Collect.” Depending on your level of familiarity with the MIRE FDE, you may need to learn more about the MIRE FDE (see Step 1 – 2 in the subsection titled, *Unfamiliar with MIRE FDE*) before you identify the options and costs of collecting the relevant data (see Step 1 – 2 in the subsection titled, *Familiar with MIRE FDE*).

Unfamiliar with MIRE FDE

Step 1: If you are unfamiliar with the MIRE FDE, the first role and responsibility is:

[17. Understand the needs of safety analysts in terms of data elements, level of detail, and data format.](#)

Step 2: Select a specific task that best describes the task at hand. The related task is:

[17a. What types of data do the analysts need and in what format and level of detail are the data needed?](#) In particular, what data are needed to employ state-of-the-art methods and tools (e.g., Highway Safety Manual)?

There are several tools available to support this task, including multiple information guides related to MIRE. Review the tools for relevant information about the MIRE FDE, and then proceed to the next subsection titled, *Familiar with MIRE FDE*.

Familiar with MIRE FDE

Step 1: If you are familiar with the MIRE FDE, then two subsequent related roles and responsibilities are:

[18. Collect data through existing programs..](#)

[19. Identify opportunities to collect additional data through new programs..](#)

Step 2: Select a specific task that best describes the task at hand.

The relevant task under [18. Collect data through existing programs](#) is:

[18a. What are the options for collecting additional data elements or adding miles of roadway to the existing linear referencing system through existing programs?](#)

There are several tools available to support this task, including information and application guides related to data collection and integration.

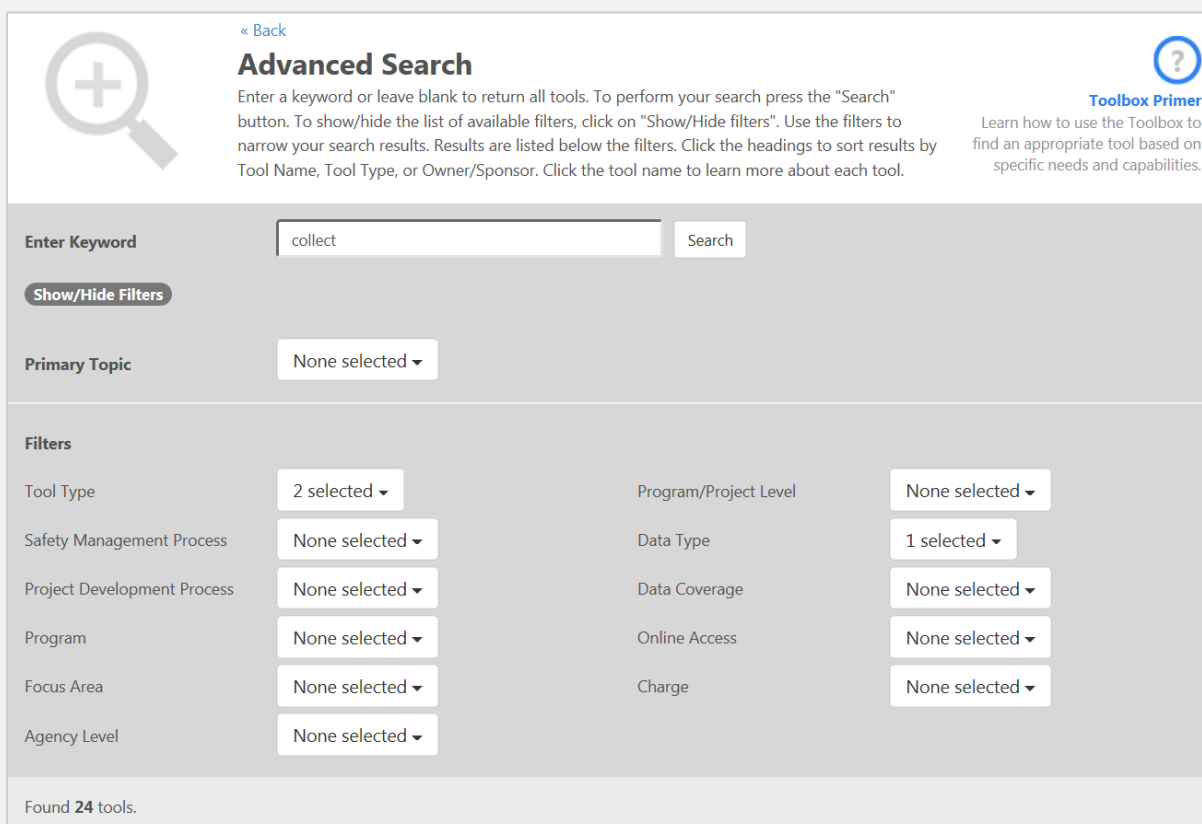
Two relevant tasks under [19. Identify opportunities to collect additional data through new programs](#) are:

[19c. What tools and equipment are required for effective data collection and management to support each aspect of the safety management process?](#)

[19d. What human resources are needed to complement the tools and equipment for data collection and management to support each aspect of the safety management process?](#)

There are several tools available to support these tasks, including information and application guides related to data collection methods, data integration and management systems, and the cost of equipment and personnel required to collect and maintain the data.

Step 3: Explore or refine the list of tools using the Toolbox. From the Primer, click on the tool names to hyperlink to the Toolbox and explore each tool, including an overall summary, specific capabilities, and basic system and data requirements. To refine the list of tools, use the [Advanced Search](#) function of the Toolbox. In this example, the [Advanced Search](#) is used with keyword “collect,” which returns 65 tools. Additional filters are applied to refine the list of tools as shown in Figure 6. The list of tools is reduced from 65 to 24 by applying the Tool Type filter with “application guide” and “information guide,” and also applying the Data Type filter with “roadway.”



« Back

Advanced Search

Enter a keyword or leave blank to return all tools. To perform your search press the "Search" button. To show/hide the list of available filters, click on "Show/Hide filters". Use the filters to narrow your search results. Results are listed below the filters. Click the headings to sort results by Tool Name, Tool Type, or Owner/Sponsor. Click the tool name to learn more about each tool.

[Toolbox Primer](#)
Learn how to use the Toolbox to find an appropriate tool based on specific needs and capabilities.

Enter Keyword: Search

Show/Hide Filters

Primary Topic: None selected ▼

Filters

Tool Type: 2 selected ▼	Program/Project Level: None selected ▼
Safety Management Process: None selected ▼	Data Type: 1 selected ▼
Project Development Process: None selected ▼	Data Coverage: None selected ▼
Program: None selected ▼	Online Access: None selected ▼
Focus Area: None selected ▼	Charge: None selected ▼
Agency Level: None selected ▼	

Found 24 tools.


Figure 6. Refining Tools from Detail-Level Search.

Quick (Tool-Based) Search

Effective tool-based searching relies on the [Advanced Search](#) function of the Toolbox. In this search technique, the [Advanced Search](#) function is used to generate and refine a relevant list of tools. From the Toolbox, access the [Advanced Search](#) function and enter a keyword or leave the field blank and click “Search.” [Note that leaving the keyword field blank will return all tools in the Toolbox.] Using the filters, apply desired tags to refine the list of tools. To learn more about a specific tool, simply click on the Tool Name to access a more detailed summary.

Example: You have just been hired by a transportation agency as a junior engineer or planner, and told that you will be supporting the Safety Division to prepare the annual Highway Safety Improvement Program (HSIP) report. It is explained to you that the HSIP is a Federal reporting requirement to help track the safety performance of the highway system and the overall impact of safety investments. You are relatively new to safety and want to make a good impression on your new team, so you want to learn more about the HSIP and general reporting requirements. In this case, you can use the Toolbox to conduct a tool-based search for information and tools related to the HSIP.

Access the [Advanced Search](#) function of the Toolbox. In this example, you are interested in learning more about the HSIP, so the term “HSIP” or Highway Safety Improvement Program” could be entered in the keyword search. Additionally, let’s assume that you are only interested in reading about available tools at this time, and not looking for related databases and software. In this scenario, the Tool Type filter can be applied to return only those tools that are guides, removing all database and software tools. There are nine tools returned based on the general keyword search for “HSIP” and, as shown in Figure 7, the list of tools is reduced from nine to five when “application guide” and “information guide” are selected as criteria from the Tool Type filter. Click on the tool names to explore each tool and learn more about the HSIP.

[« Back](#)

Advanced Search

Enter a keyword or leave blank to return all tools. To perform your search press the "Search" button. To show/hide the list of available filters, click on "Show/Hide filters". Use the filters to narrow your search results. Results are listed below the filters. Click the headings to sort results by Tool Name, Tool Type, or Owner/Sponsor. Click the tool name to learn more about each tool.

Enter Keyword

HSIP

Search

Show/Hide Filters

Primary Topic

None selected

Filters

Tool Type

2 selected

☐ Software

☐ Database

☒ Application Guide

☒ Information Guide

☐ Information Source

Safety Management Process

Project Development Process

Program

Focus Area

Agency Level

Program/Project Level

Data Type

Data Coverage

Online Access

Charge

None selected

None selected

None selected

None selected

None selected

Found 5 tools.

Tool Name	Tool Type	Owner/Sponsor
Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program	Information Guide	Federal Highway Administration (FHWA)
Guidance Memorandum on Fundamental Roadway and Traffic Data Elements to Improve the Highway Safety Improvement Program	Information Guide	Federal Highway Administration (FHWA)
Highway Safety Improvement Program (HSIP) Manual	Application Guide	Federal Highway Administration (FHWA)
Highway Safety Improvement Program (HSIP) Self-Assessment Tool	Application Guide	Federal Highway Administration (FHWA)
Market Analysis of Collecting Fundamental Roadway Data Elements to Support the Highway Safety Improvement Program	Application Guide	Federal Highway Administration (FHWA)

?

Toolbox Primer

Learn how to use the Toolbox to find an appropriate tool based on specific needs and capabilities.

Figure 7. Search for Tools from the Advanced Search.

APPENDIX A: SUMMARY OF TOOLS BY TASK

Appendix A provides a list of tools by task, which are categorized under the respective role and responsibilities.

MANAGE

- I. Understand the safety management process and how it supports the project development process.
 - a. What is the relationship between the safety management and project development processes?
 - i. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - ii. [Highway Safety Improvement Program \(HSIP\) Self-Assessment Tool](#) [Application Guide]
 - iii. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - iv. [Highway Safety Manual Fact Sheet](#) [Information Guide]
 - v. [Highway Safety Manual Implementation Guide for Managers](#) [Information Guide]
 - vi. [Integrating the Highway Safety Manual into the Highway Project Development Process](#) [Application Guide]
 - vii. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
2. Understand the importance of data-driven decision-making.
 - a. How can better data improve the cost effectiveness of our decisions?
 - i. [Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program](#) [Information Guide]
 - ii. [Data Systems: A Road Safety Manual for Decision-Makers and Practitioners](#) [Application Guide]
 - iii. [Guidance Memorandum on Fundamental Roadway and Traffic Data Elements to Improve the Highway Safety Improvement Program](#) [Information Guide]
 - iv. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - v. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - vi. [Highway Safety Manual Executive Packet](#) [Information Guide]
 - vii. [Market Analysis of Collecting Fundamental Roadway Data Elements to Support the Highway Safety Improvement Program](#) [Application Guide]
 - viii. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
 - ix. [Traffic Records Program Assessment Advisory](#) [Application Guide]

3. Understand the value of data.

- a. What crash, roadway, traffic, injury, and supplemental data are required to support the safety management process?
 - i. [ANSI-D16.1-2007 Manual on Classification of Motor Vehicle Traffic Accidents](#) [Information Guide]
 - ii. [ANSI-D20 Traffic Records Systems Data Dictionary: Release 6.0.0](#) [Information Guide]
 - iii. [Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program](#) [Information Guide]
 - iv. [Data Systems: A Road Safety Manual for Decision-Makers and Practitioners](#) [Application Guide]
 - v. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide]
 - vi. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - vii. [Guidance Memorandum on Fundamental Roadway and Traffic Data Elements to Improve the Highway Safety Improvement Program](#) [Information Guide]
 - viii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - ix. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - x. [Highway Safety Manual Data Needs Guide](#) [Information Guide]
 - xi. [Highway Safety Manual Implementation Guide for Managers](#) [Information Guide]
 - xii. [Market Analysis of Collecting Fundamental Roadway Data Elements to Support the Highway Safety Improvement Program](#) [Application Guide]
 - xiii. [Model Impaired Driving Records Information Systems – Tying Together Data Systems to Manage Impaired Drivers](#) [Application Guide]
 - xiv. [Model Inventory of Roadway Elements \(MIRE\) 2.0](#) [Information Guide]
 - xv. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]
 - xvi. [Model Inventory of Roadway Elements \(MIRE\) Fundamental Data Elements Cost-Benefit Estimation](#) [Information Guide]
 - xvii. [Model Minimum Uniform Crash Criteria \(MMUCC\)](#) [Information Guide]
 - xviii. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
 - xix. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
 - xx. [Traffic Records Program Assessment Advisory](#) [Application Guide]
- b. What crash, roadway, traffic, injury, and supplemental data are required to support the use of state-of-the-art analytical tools (e.g., Highway Safety Manual)?
 - i. [Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program](#) [Information Guide]

- ii. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - iii. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - iv. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - v. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - vi. [Highway Safety Manual Data Needs Guide](#) [Information Guide]
 - vii. [Highway Safety Manual Fact Sheet](#) [Information Guide]
 - viii. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
 - ix. [Safety Performance Function Decision Guide: SPF Calibration vs SPF Development](#) [Information Guide]
 - x. [User's Guide to Develop Highway Safety Manual \(HSM\) Safety Performance Function \(SPF\) Calibration Factors](#) [Application Guide]
- c. What is the value of improving current crash, roadway, traffic, injury, and supplemental data capabilities?
- i. [Benefit-Cost Analysis of Investing in Data Systems and Processes for Data-Driven Safety Programs: Decision-Making Guidebook](#) [Information Guide]
 - ii. [Benefit-Cost Analysis of Investing in Data Systems and Processes for Data-Driven Safety Programs: Project Report](#) [Information Guide]
 - iii. [Market Analysis of Collecting Fundamental Roadway Data Elements to Support the Highway Safety Improvement Program](#) [Application Guide]
 - iv. [Model Inventory of Roadway Elements \(MIRE\) Fundamental Data Elements Cost-Benefit Estimation](#) [Information Guide]
 - v. [Model Minimum Uniform Crash Criteria \(MMUCC\)](#) [Information Guide]
- d. How can I justify increasing the budget for data collection and management?
- i. [Benefit-Cost Analysis of Investing in Data Systems and Processes for Data-Driven Safety Programs: Decision-Making Guidebook](#) [Information Guide]
 - ii. [Benefit-Cost Analysis of Investing in Data Systems and Processes for Data-Driven Safety Programs: Project Report](#) [Information Guide]
 - iii. [Market Analysis of Collecting Fundamental Roadway Data Elements to Support the Highway Safety Improvement Program](#) [Application Guide]
 - iv. [Model Inventory of Roadway Elements \(MIRE\) Fundamental Data Elements Cost-Benefit Estimation](#) [Information Guide]
 - v. [Model Minimum Uniform Crash Criteria \(MMUCC\)](#) [Information Guide]
 - vi. [UPLAN](#) [Software]

4. Understand the importance of state-of-the-art data analysis methods.
 - a. What is the benefit that we can anticipate when employing state-of-the-art techniques in lieu of traditional ones?
 - i. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - ii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iii. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - iv. [Highway Safety Manual Implementation Guide for Managers](#) [Information Guide]
 - v. [Integrating the Highway Safety Manual into the Highway Project Development Process](#) [Application Guide]
 - vi. [Market Analysis of Collecting Fundamental Roadway Data Elements to Support the Highway Safety Improvement Program](#) [Application Guide]
 - vii. [The Art of Appropriate Evaluation: A Guide for Highway Safety Program Managers](#) [Application Guide]
 - b. What types of analysis can be conducted based on existing data capabilities?
 - i. [Data Systems: A Road Safety Manual for Decision-Makers and Practitioners](#) [Application Guide]
 - ii. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - iii. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - iv. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - v. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - vi. [Highway Safety Manual Data Needs Guide](#) [Information Guide]
 - vii. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
 - viii. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
 - ix. [Safety Performance Function Decision Guide: SPF Calibration vs SPF Development](#) [Information Guide]
 - x. [User's Guide to Develop Highway Safety Manual \(HSM\) Safety Performance Function \(SPF\) Calibration Factors](#) [Application Guide]
 - c. What are the strengths and limitations of various analytical methods (specifically related to current agency methods), and how can the limitations be overcome?
 - i. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - ii. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - iii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]

- iv. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - v. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
 - vi. [Safety Performance Function Decision Guide: SPF Calibration vs SPF Development](#) [Information Guide]
 - vii. [The Art of Appropriate Evaluation: A Guide for Highway Safety Program Managers](#) [Application Guide]
- d. What data are required to enhance current analytical methods and employ more rigorous methods?
- i. [Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program](#) [Information Guide]
 - ii. [Data Systems: A Road Safety Manual for Decision-Makers and Practitioners](#) [Application Guide]
 - iii. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - iv. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide]
 - v. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - vi. [Guidance Memorandum on Fundamental Roadway and Traffic Data Elements to Improve the Highway Safety Improvement Program](#) [Information Guide]
 - vii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - viii. [Highway Safety Improvement Program \(HSIP\) Self-Assessment Tool](#) [Application Guide]
 - ix. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - x. [Highway Safety Manual Data Needs Guide](#) [Information Guide]
 - xi. [Model Impaired Driving Records Information Systems – Tying Together Data Systems to Manage Impaired Drivers](#) [Application Guide]
 - xii. [Model Inventory of Roadway Elements \(MIRE\) 2.0](#) [Information Guide]
 - xiii. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
 - xiv. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
 - xv. [Safety Performance Function Decision Guide: SPF Calibration vs SPF Development](#) [Information Guide]
 - xvi. [Traffic Records Program Assessment Advisory](#) [Application Guide]
 - xvii. [User's Guide to Develop Highway Safety Manual \(HSM\) Safety Performance Function \(SPF\) Calibration Factors](#) [Application Guide]

- e. What policies are required/desired to support the implementation of state-of-the-art analytical methods?
 - i. [Highway Safety Manual Implementation Guide for Managers](#) [Information Guide]
 - ii. [Integrating the Highway Safety Manual into the Highway Project Development Process](#) [Application Guide]
-
5. Understand the needs of safety analysts in terms of data elements, data integration, data format, and data query.
- a. What types of data do the analysts need and in what format are the data needed?
 - i. [ANSI-D16.1-2007 Manual on Classification of Motor Vehicle Traffic Accidents](#) [Information Guide]
 - ii. [ANSI-D20 Traffic Records Systems Data Dictionary: Release 6.0.0](#) [Information Guide]
 - iii. [Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program](#) [Information Guide]
 - iv. [Data Systems: A Road Safety Manual for Decision-Makers and Practitioners](#) [Application Guide]
 - v. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - vi. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - vii. [Guidance Memorandum on Fundamental Roadway and Traffic Data Elements to Improve the Highway Safety Improvement Program](#) [Information Guide]
 - viii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - ix. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - x. [Highway Safety Manual Data Needs Guide](#) [Information Guide]
 - xi. [Market Analysis of Collecting Fundamental Roadway Data Elements to Support the Highway Safety Improvement Program](#) [Application Guide]
 - xii. [Model Impaired Driving Records Information Systems – Tying Together Data Systems to Manage Impaired Drivers](#) [Application Guide]
 - xiii. [Model Inventory of Roadway Elements \(MIRE\) 2.0](#) [Information Guide]
 - xiv. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]
 - xv. [Model Inventory of Roadway Elements \(MIRE\) Fundamental Data Elements Cost-Benefit Estimation](#) [Information Guide]
 - xvi. [Model Minimum Uniform Crash Criteria \(MMUCC\)](#) [Information Guide]
 - xvii. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
 - xviii. [Safety Performance Function Decision Guide: SPF Calibration vs SPF Development](#) [Information Guide]

- b. How should the data be linked and available for query?
 - i. [DAMA Guide to the Data Management Body of Knowledge \(DAMA-DMBOK\)](#) [Information Guide]
 - ii. [Development of a Structure for a Model Inventory of Roadway Elements Management Information System \(MIRE MIS\)](#) [Information Guide]
 - iii. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide]
 - iv. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - v. [Model Impaired Driving Records Information Systems – Tying Together Data Systems to Manage Impaired Drivers](#) [Application Guide]
 - vi. [Model Inventory of Roadway Elements \(MIRE\) Management Information System \(MIS\) Lead Agency Data Collection Report](#) [Application Guide]
 - vii. [Model Minimum Uniform Crash Criteria \(MMUCC\)](#) [Information Guide]
 - viii. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
 - ix. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
 - x. [The Crash Outcome Data Evaluation System \(CODES\) and Applications to Improve Traffic Safety Decision-Making](#) [Information Guide]
 - xi. [Traffic Records Program Assessment Advisory](#) [Application Guide]
 - xii. [UPLAN](#) [Software]
- c. How can we expand or adapt our existing data platform to use new analytical tools?
 - i. [DAMA Guide to the Data Management Body of Knowledge \(DAMA-DMBOK\)](#) [Information Guide]
 - ii. [Development of a Structure for a Model Inventory of Roadway Elements Management Information System \(MIRE MIS\)](#) [Information Guide]
 - iii. [Hudson Valley Transportation Management Center Crash Performance Measures](#) [Software]
 - iv. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - v. [Model Impaired Driving Records Information Systems – Tying Together Data Systems to Manage Impaired Drivers](#) [Application Guide]
 - vi. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]
 - vii. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
 - viii. [Plan4Safety](#) [Software]

- d. What data platform, data elements, and data format should be adopted to employ state-of-the-art tools such as AASHTOWare Safety Analyst™ or the Highway Safety Manual?
 - i. [DAMA Guide to the Data Management Body of Knowledge \(DAMA-DMBOK\)](#) [Information Guide]
 - ii. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - iii. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - iv. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - v. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - vi. [Highway Safety Manual Data Needs Guide](#) [Information Guide]
 - vii. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
-
6. Understand the needs of data collectors in terms of data entry, data format, and reporting.
- a. What platforms and interfaces are required to facilitate data entry?
 - i. [DAMA Guide to the Data Management Body of Knowledge \(DAMA-DMBOK\)](#) [Information Guide]
 - ii. [Development of a Structure for a Model Inventory of Roadway Elements Management Information System \(MIRE MIS\)](#) [Information Guide]
 - iii. [Exploration of the Application of Collective Information to Transportation Data for Safety White Paper](#) [Information Guide]
 - iv. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - v. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]
 - vi. [Model Inventory of Roadway Elements \(MIRE\) Management Information System \(MIS\) Lead Agency Data Collection Report](#) [Application Guide]
 - vii. [National Cooperative Highway Research Program \(NCHRP\) Project 08-36, Task 100: Transportation Data Self-Assessment Guide](#) [Application Guide]
 - viii. [National Cooperative Highway Research Program \(NCHRP\) Report 748, Guidelines for the Use of Mobile LIDAR in Transportation Applications](#) [Information Guide]
 - ix. [UPLAN](#) [Software]
 - b. What reporting capabilities are required to support national, state, local reporting requirements?
 - i. [Highway Performance Monitoring System \(HPMS\)](#) [Database]
 - ii. [Traffic Records Program Assessment Advisory](#) [Application Guide]
 - iii. [Traffic Safety Performance Measures](#) [Application Guide]

7. Understand current data capabilities and potential for improvement.

- a. How do I assess current safety data capabilities?
 - i. [Data Systems: A Road Safety Manual for Decision-Makers and Practitioners](#) [Application Guide]
 - ii. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide]
 - iii. [Highway Safety Improvement Program \(HSIP\) Self-Assessment Tool](#) [Application Guide]
 - iv. [National Cooperative Highway Research Program \(NCHRP\) Project 08-36, Task 100: Transportation Data Self-Assessment Guide](#) [Application Guide]
 - v. [Traffic Records Program Assessment Advisory](#) [Application Guide]
- b. What other departments in our agency collect data required to use the state-of-the-art analytical methods?
 - i. [Highway Performance Monitoring System \(HPMS\)](#) [Database]
 - ii. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]
 - iii. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
- c. What other agencies in our jurisdiction collect data relevant to road safety data elements?
 - i. [Data Systems: A Road Safety Manual for Decision-Makers and Practitioners](#) [Application Guide]
 - ii. [Highway Performance Monitoring System \(HPMS\)](#) [Database]
 - iii. [Model Impaired Driving Records Information Systems – Tying Together Data Systems to Manage Impaired Drivers](#) [Application Guide]
 - iv. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]
 - v. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
- d. What organization structure needs to be in place to manage all aspects of data collection, management, and evaluation?
 - i. [DAMA Guide to the Data Management Body of Knowledge \(DAMA-DMBOK\)](#) [Information Guide]
 - ii. [Data Business Plans and Governance Programs – Aligning Transportation Data to Agency Strategic Objectives](#) [Information Guide]
 - iii. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - iv. [Model Impaired Driving Records Information Systems – Tying Together Data Systems to Manage Impaired Drivers](#) [Application Guide]

- v. [National Cooperative Highway Research Program \(NCHRP\) Project 08-36, Task 100: Transportation Data Self-Assessment Guide](#) [Application Guide]
 - vi. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
 - vii. [Traffic Records Program Assessment Advisory](#) [Application Guide]
- e. How do road data collection and data management fit into the agency's asset management structure?
- i. [DAMA Guide to the Data Management Body of Knowledge \(DAMA-DMBOK\)](#) [Information Guide]
 - ii. [Data Business Plans and Governance Programs – Aligning Transportation Data to Agency Strategic Objectives](#) [Information Guide]
 - iii. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - iv. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]
 - v. [National Cooperative Highway Research Program \(NCHRP\) Project 08-36, Task 100: Transportation Data Self-Assessment Guide](#) [Application Guide]
 - vi. [National Cooperative Highway Research Program \(NCHRP\) Report 748, Guidelines for the Use of Mobile LIDAR in Transportation Applications](#) [Information Guide]
 - vii. [UPLAN](#) [Software]
- f. How do I develop a policy to support an increasing data capability for the agency in each aspect of road safety management?
- i. No tools were identified to support this task.
- g. What tools and equipment are required to initiate and maintain a cost-effective data collection and management program to support all aspects of road safety management?
- i. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - ii. [Model Inventory of Roadway Elements \(MIRE\) Data Collection Guidebook](#) [Information Guide]
 - iii. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]
 - iv. [Model Inventory of Roadway Elements \(MIRE\) Management Information System \(MIS\) Lead Agency Data Collection Report](#) [Application Guide]
 - v. [National Cooperative Highway Research Program \(NCHRP\) Project 08-36, Task 100: Transportation Data Self-Assessment Guide](#) [Application Guide]
- h. What human resources are needed to initiate and maintain a cost-effective data collection and management program to support all aspects of road safety management?
- i. [Data Business Plans and Governance Programs – Aligning Transportation Data to Agency Strategic Objectives](#) [Information Guide]

- ii. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - iii. [Market Analysis of Collecting Fundamental Roadway Data Elements to Support the Highway Safety Improvement Program](#) [Application Guide]
 - iv. [Model Inventory of Roadway Elements \(MIRE\) Fundamental Data Elements Cost-Benefit Estimation](#) [Information Guide]
 - v. [Model Inventory of Roadway Elements \(MIRE\) Management Information System \(MIS\) Lead Agency Data Collection Report](#) [Application Guide]
- i. What qualifications are required of agency personnel to serve at positions managing safety data?
- i. [Data Business Plans and Governance Programs – Aligning Transportation Data to Agency Strategic Objectives](#) [Information Guide]
 - ii. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
- j. How do I prioritize needs to improve data capability?
- i. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide]
 - ii. [Guidance Memorandum on Fundamental Roadway and Traffic Data Elements to Improve the Highway Safety Improvement Program](#) [Information Guide]
 - iii. [Model Inventory of Roadway Elements \(MIRE\) 2.0](#) [Information Guide]
 - iv. [National Cooperative Highway Research Program \(NCHRP\) Project 08-36, Task 100: Transportation Data Self-Assessment Guide](#) [Application Guide]
 - v. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
 - vi. [User's Guide to Develop Highway Safety Manual \(HSM\) Safety Performance Function \(SPF\) Calibration Factors](#) [Application Guide]
- k. What funding sources are available for data enhancements?
- i. [Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program](#) [Information Guide]
 - ii. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide]
 - iii. [Model Minimum Uniform Crash Criteria \(MMUCC\)](#) [Information Guide]
 - iv. [A Guide to Federal-Aid Programs and Projects](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying potential funding sources.]
 - v. [Local and Rural Road Safety Program](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying potential funding sources.]

8. Understand the importance of data integration to support data-driven decision-making in the safety management and project development process.
 - a. Would data integration (internal and external sources) be cost effective to our agency?
 - i. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide]
 - ii. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - iii. [Market Analysis of Collecting Fundamental Roadway Data Elements to Support the Highway Safety Improvement Program](#) [Application Guide]
 - iv. [Model Inventory of Roadway Elements \(MIRE\) Fundamental Data Elements Cost-Benefit Estimation](#) [Information Guide]
 - b. What are the most effective ways to support and encourage data integration?
 - i. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - ii. [Model Impaired Driving Records Information Systems – Tying Together Data Systems to Manage Impaired Drivers](#) [Application Guide]
 - iii. [National Cooperative Highway Research Program \(NCHRP\) Project 08-36, Task 100: Transportation Data Self-Assessment Guide](#) [Application Guide]
 - iv. [UPLAN](#) [Software]
 - c. What would be the foundation and elements of effective examples of task forces dedicated to data integration within an agency or within a jurisdiction (among agencies)?
 - i. [Data Business Plans and Governance Programs – Aligning Transportation Data to Agency Strategic Objectives](#) [Information Guide]
 - ii. [Model Impaired Driving Records Information Systems – Tying Together Data Systems to Manage Impaired Drivers](#) [Application Guide]
 - iii. [National Cooperative Highway Research Program \(NCHRP\) Project 08-36, Task 100: Transportation Data Self-Assessment Guide](#) [Application Guide]
 - iv. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
 - v. [Traffic Records Program Assessment Advisory](#) [Application Guide]
 - d. For state-level managers, why is there a need to integrate local data in the state's safety management system, and what is the most effective way to integrate local data in the state's safety management system?
 - i. [Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program](#) [Information Guide]
 - ii. [Model Inventory of Roadway Elements \(MIRE\) Management Information System \(MIS\) Lead Agency Data Collection Report](#) [Application Guide]
 - iii. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]

- e. For local-level managers, why is there a need to share data with the state?
 - i. [Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program](#) [Information Guide]
 - ii. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
- f. What funding sources are available for data integration?
 - i. [Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program](#) [Information Guide]
 - ii. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide]
 - iii. [A Guide to Federal-Aid Programs and Projects](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying potential funding sources.]
 - iv. [Local and Rural Road Safety Program](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying potential funding sources.]

9. Develop integrated data systems that link data from various sources.

- a. Why is it important to link data from various sources?
 - i. [DAMA Guide to the Data Management Body of Knowledge \(DAMA-DMBOK\)](#) [Information Guide]
 - ii. [Data Systems: A Road Safety Manual for Decision-Makers and Practitioners](#) [Application Guide]
 - iii. [Development of a Structure for a Model Inventory of Roadway Elements Management Information System \(MIRE MIS\)](#) [Information Guide]
 - iv. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - v. [Model Impaired Driving Records Information Systems – Tying Together Data Systems to Manage Impaired Drivers](#) [Application Guide]
 - vi. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]
 - vii. [Model Inventory of Roadway Elements \(MIRE\) Management Information System \(MIS\) Lead Agency Data Collection Report](#) [Application Guide]
 - viii. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
 - ix. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
 - x. [The Crash Outcome Data Evaluation System \(CODES\) and Applications to Improve Traffic Safety Decision-Making](#) [Information Guide]

- b. What are the required links among various data sources to use state-of-the-art analytical methods?
 - i. [Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program](#) [Information Guide]
 - ii. [Development of a Structure for a Model Inventory of Roadway Elements Management Information System \(MIRE MIS\)](#) [Information Guide]
 - iii. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - iv. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
 - v. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
 - vi. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
- c. What tools are available to manage and link data for analysis?
 - i. [AASHTOWare Safety Analyst™](#) [Software]
 - ii. [Accident Information Management System \(AIMS\)](#) [Software]
 - iii. [Accident Records Summary and Diagrams \(Accisum\)](#) [Software]
 - iv. [AgileAssets Safety Analyst](#) [Software]
 - v. [Collision Database System \(Crossroads Software\)](#) [Software]
 - vi. [DAMA Guide to the Data Management Body of Knowledge \(DAMA-DMBOK\)](#) [Information Guide]
 - vii. [Deighton dTIMS](#) [Software]
 - viii. [Development of a Structure for a Model Inventory of Roadway Elements Management Information System \(MIRE MIS\)](#) [Information Guide]
 - ix. [ESRI Roads and Highways](#) [Software]
 - x. [Hudson Valley Transportation Management Center Crash Performance Measures](#) [Software]
 - xi. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - xii. [Model Impaired Driving Records Information Systems – Tying Together Data Systems to Manage Impaired Drivers](#) [Application Guide]
 - xiii. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]
 - xiv. [Pedestrian and Bicycle Crash Analysis Tool \(PBCAT\)](#) [Software]
 - xv. [Pedestrian and Bicycle GIS Safety Tools](#) [Software]
 - xvi. [Plan4Safety](#) [Software]
 - xvii. [Resurfacing Safety Resource Allocation Program \(RSRAP\)](#) [Software]
 - xviii. [The Crash Outcome Data Evaluation System \(CODES\) and Applications to Improve Traffic Safety Decision-Making](#) [Information Guide]
 - xix. [Traffic Engineering Software \(TES\)](#) [Software]

- xx. [United States Road Assessment Program \(usRAP\)](#) [Software]
- xxi. [UPLAN](#) [Software]
- xxii. [Vision Zero Suite \(VZS\)](#) [Software]

I 0. Ensure data are accessible by all stakeholders.

- a. How do I establish a protocol for effective access to data sources and online analytical tools?
 - i. [Plan4Safety](#) [Software]
 - ii. [UPLAN](#) [Software]
- b. What are the security and legal implications of making data publicly available?
 - i. [Identification of Liability-Related Impediments to Sharing Section 409 Safety Data Among Transportation Agencies and A Synthesis of Best Practices](#) [Information Guide]

I 1. Assess the completeness and quality of data through regular automated checks and periodic manual checks.

- a. What types of quality control checks should be performed on the data?
 - i. [Crash Data Improvement Program Guidebook](#) [Application Guide]
 - ii. [Data Systems: A Road Safety Manual for Decision-Makers and Practitioners](#) [Application Guide]
 - iii. [Development of a Structure for a Model Inventory of Roadway Elements Management Information System \(MIRE MIS\)](#) [Information Guide]
 - iv. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - v. [Model Performance Measures for State Traffic Records Systems](#) [Application Guide]
 - vi. [National Cooperative Highway Research Program \(NCHRP\) Project 08-36, Task 100: Transportation Data Self-Assessment Guide](#) [Application Guide]
 - vii. [Performance Measures for Roadway Inventory Data Report](#) [Application Guide]
 - viii. [Traffic Records Program Assessment Advisory](#) [Application Guide]
- b. How often should data elements be checked for completeness, accuracy, etc.?
 - i. [Crash Data Improvement Program Guidebook](#) [Application Guide]
 - ii. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - iii. [Model Performance Measures for State Traffic Records Systems](#) [Application Guide]
 - iv. [National Cooperative Highway Research Program \(NCHRP\) Project 08-36, Task 100: Transportation Data Self-Assessment Guide](#) [Application Guide]
 - v. [Performance Measures for Roadway Inventory Data Report](#) [Application Guide]
 - vi. [Traffic Records Program Assessment Advisory](#) [Application Guide]

12. Understand the importance of performance tracking for data capabilities, project effectiveness, and program effectiveness.

a. What data are required for performance tracking?

- i. [Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program](#) [Information Guide]
- ii. [Data Systems: A Road Safety Manual for Decision-Makers and Practitioners](#) [Application Guide]
- iii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
- iv. [Highway Safety Improvement Program \(HSIP\) Self-Assessment Tool](#) [Application Guide]
- v. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
- vi. [Model Performance Measures for State Traffic Records Systems](#) [Application Guide]
- vii. [National Cooperative Highway Research Program \(NCHRP\) Project 08-36, Task 100: Transportation Data Self-Assessment Guide](#) [Application Guide]
- viii. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
- ix. [National Cooperative Highway Research Program \(NCHRP\) Report 666: Target-Setting Methods and Data Management to Support Performance-Based Resource Allocation](#) [Information Guide]
- x. [Performance Measures for Roadway Inventory Data Report](#) [Application Guide]
- xi. [Synthesis of Best Practices for the Development of an Integrated Data and Information Management Approach](#) [Application Guide]
- xii. [The Art of Appropriate Evaluation: A Guide for Highway Safety Program Managers](#) [Application Guide]
- xiii. [Traffic Records Program Assessment Advisory](#) [Application Guide]
- xiv. [Traffic Safety Performance Measures](#) [Application Guide]

b. How do I track data capabilities?

- i. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide]
- ii. [Model Performance Measures for State Traffic Records Systems](#) [Application Guide]
- iii. [National Cooperative Highway Research Program \(NCHRP\) Project 08-36, Task 100: Transportation Data Self-Assessment Guide](#) [Application Guide]
- iv. [Traffic Records Program Assessment Advisory](#) [Application Guide]

ANALYZE

13. Understand the various methods and related strengths and limitations for network screening, diagnosis, countermeasure selection, economic appraisal, project prioritization, and safety effectiveness evaluation.

Network Screening

- a. What are the state-of-the-art network screening methods?
 - i. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - ii. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - iii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iv. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - v. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
 - vi. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
- b. What data are required to use specific network screening methods?
 - i. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - ii. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - iii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iv. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - v. [Monroe County Accident Database Enhancement Project Report](#) [Information Guide]
 - vi. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
 - vii. [Safety Performance Function Decision Guide: SPF Calibration vs SPF Development](#) [Information Guide]
 - viii. [User's Guide to Develop Highway Safety Manual \(HSM\) Safety Performance Function \(SPF\) Calibration Factors](#) [Application Guide]
- c. What tools are available for network screening and what data do they require from users?
 - i. [AASHTOWare Safety Analyst™](#) [Software]
 - ii. [Accident Information Management System \(AIMS\)](#) [Software]
 - iii. [AgileAssets Safety Analyst](#) [Software]
 - iv. [Arizona Local Government Safety Project Analysis Model](#) [Software]
 - v. [Collision Database System \(Crossroads Software\)](#) [Software]
 - vi. [Crash Mapping and Analysis Tool \(CMAT\)](#) [Software]

- vii. [Crash Safety Analysis Tools for ArcGIS 10](#) [Software]
 - viii. [Critical Analysis Reporting Environment \(CARE\)](#) [Software]
 - ix. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - x. [ESRI Roads and Highways](#) [Software]
 - xi. [FHWA GIS Safety Analysis Tools v4.0](#) [Software]
 - xii. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - xiii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - xiv. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - xv. [Hudson Valley Transportation Management Center Crash Performance Measures](#) [Software]
 - xvi. [Illinois Department of Transportation Over-Representation Tool](#) [Software]
 - xvii. [Intersection Magic](#) [Software]
 - xviii. [Ohio Economic Crash Analysis Tool \(ECAT\)](#) [Software]
 - xix. [Oregon Safety Priority Index System \(SPIS\)](#) [Software]
 - xx. [Pedestrian and Bicycle GIS Safety Tools](#) [Software]
 - xxi. [Plan4Safety](#) [Software]
 - xxii. [PLANSafe](#) [Software]
 - xxiii. [Traffic Crash Analysis Tool \(TCAT\)](#) [Software]
 - xxiv. [Traffic Engineering Software \(TES\)](#) [Software]
 - xxv. [United States Road Assessment Program \(usRAP\)](#) [Software]
 - xxvi. [UPLAN](#) [Software]
 - xxvii. [Vision Zero Suite \(VZS\)](#) [Software]
- d. How do I assess differences among the results of different network screening methods?
- i. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - ii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iii. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - iv. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
- e. Where do I find SPFs and related information?
- i. [Highway Safety Manual \(HSM\)](#) [Application Guide]
- f. How do I assess the quality of existing SPFs for use in network screening?
- i. [Safety Performance Function Development Guide: Developing Jurisdiction-Specific SPFs](#) [Application Guide]

- g. How do I incorporate the results of different network screening methods for more effective selection of sites for potential improvements?
 - i. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - ii. [Oregon Safety Priority Index System \(SPIS\)](#) [Software]

Diagnosis

- h. What are the state-of-the-art diagnosis methods?
 - i. [AASHTOWare Safety Analyst™](#) [Software] (Module 2)
 - ii. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - iii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iv. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - v. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
 - vi. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
- i. What data are required to use specific diagnostic methods?
 - i. [AASHTOWare Safety Analyst™](#) [Software] (Module 2 documentation)
 - ii. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - iii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iv. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - v. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
- j. What tools are available to support diagnosis and what data do they require from the users?
 - i. [AASHTOWare Safety Analyst™](#) [Software]
 - ii. [Accident Information Management System \(AIMS\)](#) [Software]
 - iii. [Accident Records Summary and Diagrams \(Accisum\)](#) [Software]
 - iv. [AgileAssets Safety Analyst](#) [Software]
 - v. [Collision Database System \(Crossroads Software\)](#) [Software]
 - vi. [Countermeasures That Work: A Highway Safety Countermeasure Guide for State Highway Safety Offices](#) [Information Guide]
 - vii. [Crash Mapping and Analysis Tool \(CMAT\)](#) [Software]
 - viii. [Critical Analysis Reporting Environment \(CARE\)](#) [Software]
 - ix. [ESRI Roads and Highways](#) [Software]
 - x. [EZplot Traffic Collision Diagram](#) [Software]
 - xi. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - xii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]

- xiii. [Highway Safety Manual \(HSM\)](#) [Application Guide]
- xiv. [Hudson Valley Transportation Management Center Crash Performance Measures](#) [Software]
- xv. [Illinois Department of Transportation Over-Representation Tool](#) [Software]
- xvi. [Interactive Highway Safety Design Model \(IHSDM\)](#) [Software]
- xvii. [Interchange Safety Analysis Tool Enhanced \(ISATe\)](#) [Software]
- xviii. [Intersection Magic](#) [Software]
- xix. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
- xx. [National Cooperative Highway Research Program \(NCHRP\) Report 600: Human Factors Guidelines for Road Systems: *Second Edition*](#) [Information Guide]
- xxi. [Pedestrian and Bicycle Crash Analysis Tool \(PBCAT\)](#) [Software]
- xxii. [Pedestrian and Bicycle GIS Safety Tools](#) [Software]
- xxiii. [Pedestrian Safety Guide and Countermeasure Selection System \(PEDSAFE\)](#) [Software]
- xxiv. [Plan4Safety](#) [Software]
- xxv. [Small Computer COLLision Diagram \(SCCOLD\)](#) [Software]
- xxvi. [Surrogate Safety Assessment Model \(SSAM\)](#) [Software]
- xxvii. [Traffic Crash Analysis Tool \(TCAT\)](#) [Software]
- xxviii. [Traffic Engineering Software \(TES\)](#) [Software]
- xxix. [UPLAN](#) [Software]
- xxx. [Vision Zero Suite \(VZS\)](#) [Software]

Countermeasure Selection

- k. What are the state-of-the-art countermeasure selection methods?
 - i. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - ii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iii. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - iv. [Integrating the Highway Safety Manual into the Highway Project Development Process](#) [Application Guide]
 - v. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
 - vi. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
- l. What data are required to use specific countermeasure selection methods?
 - i. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - ii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iii. [Highway Safety Manual \(HSM\)](#) [Application Guide]

- iv. [Highway Safety Manual Data Needs Guide](#) [Information Guide]
- v. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
- m. What tools are available to support the selection of countermeasures based on results for a given diagnosis, and what data do they require from the users?
 - i. [AASHTOWare Safety Analyst™](#) [Software]
 - ii. [AgileAssets Safety Analyst](#) [Software]
 - iii. [Arizona Local Government Safety Project Analysis Model](#) [Software]
 - iv. [BIKESAFE Bicycle Countermeasure Selection System](#) [Software]
 - v. [CMF Clearinghouse](#) [Database]
 - vi. [CMFs in Practice](#) [Application Guide]
 - vii. [Countermeasures That Work: A Highway Safety Countermeasure Guide for State Highway Safety Offices](#) [Information Guide]
 - viii. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - ix. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - x. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - xi. [Highway Safety Manual Part C Spreadsheets](#) [Software]
 - xii. [Interactive Highway Safety Design Model \(IHSDM\)](#) [Software]
 - xiii. [Interchange Safety Analysis Tool Enhanced \(ISATe\)](#) [Software]
 - xiv. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
 - xv. [National Cooperative Highway Research Program \(NCHRP\) Report 600: Human Factors Guidelines for Road Systems: *Second Edition*](#) [Information Guide]
 - xvi. [Ohio Economic Crash Analysis Tool \(ECAT\)](#) [Software]
 - xvii. [Pedestrian and Bicycle Crash Analysis Tool \(PBCAT\)](#) [Software]
 - xviii. [Pedestrian Safety Guide and Countermeasure Selection System \(PEDSAFE\)](#) [Software]
 - xix. [Roadside Safety Analysis Program \(RSAP\)](#) [Software]
 - xx. [Surrogate Safety Assessment Model \(SSAM\)](#) [Software]
 - xxi. [United States Road Assessment Program \(usRAP\)](#) [Software]
 - xxii. [UPLAN](#) [Software]
 - xxiii. [Vision Zero Suite \(VZS\)](#) [Software]

Economic Appraisal

- n. What are the state-of-the-art economic appraisal methods used for safety analysis?
 - i. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - ii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iii. [Highway Safety Manual \(HSM\)](#) [Application Guide]

- o. What data are required for the different economic appraisal methods?
 - i. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - ii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iii. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - iv. [Highway Safety Manual Data Needs Guide](#) [Information Guide]
- p. What tools are available to undertake economic appraisal of potential countermeasures, and what data do they require from the users?
 - i. [AASHTOWare Safety Analyst™](#) [Software]
 - ii. [AgileAssets Safety Analyst](#) [Software]
 - iii. [Arizona Local Government Safety Project Analysis Model](#) [Software]
 - iv. [CMF Clearinghouse](#) [Database]
 - v. [CMFs in Practice](#) [Application Guide]
 - vi. [Countermeasures That Work: A Highway Safety Countermeasure Guide for State Highway Safety Offices](#) [Information Guide]
 - vii. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - viii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - ix. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - x. [Highway Safety Manual Part C Spreadsheets](#) [Software]
 - xi. [Illinois Benefit-Cost Analysis \(BCA\) Spreadsheet](#) [Software]
 - xii. [Interactive Highway Safety Design Model \(IHSDM\)](#) [Software]
 - xiii. [Interchange Safety Analysis Tool Enhanced \(ISATe\)](#) [Software]
 - xiv. [Ohio Rate of Return Tool](#) [Software]
 - xv. [Ohio Economic Crash Analysis Tool \(ECAT\)](#) [Software]
 - xvi. [Roadside Safety Analysis Program \(RSAP\)](#) [Software]
 - xvii. [United States Road Assessment Program \(usRAP\)](#) [Software]
 - xviii. [UPLAN](#) [Software]
 - xix. [Vision Zero Suite \(VZS\)](#) [Software]
- q. How do I assess differences among the results of the economic appraisal methods?
 - i. [Highway Safety Manual \(HSM\)](#) [Application Guide]

Project Prioritization

- r. What are the state-of-the-art project prioritization methods used for safety analysis?
 - i. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - ii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iii. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - iv. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]

- s. What data are required for the different project prioritization methods?
 - i. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - ii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iii. [Highway Safety Manual \(HSM\)](#) [Application Guide]
- t. What tools are available to undertake project prioritization, and what data do they require from the users?
 - i. [AASHTOWare Safety Analyst™](#) [Software]
 - ii. [AgileAssets Safety Analyst](#) [Software]
 - iii. [Arizona Local Government Safety Project Analysis Model](#) [Software]
 - iv. [ESRI Roads and Highways](#) [Software]
 - v. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - vi. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - vii. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - viii. [Roadside Safety Analysis Program \(RSAP\)](#) [Software]
 - ix. [United States Road Assessment Program \(usRAP\)](#) [Software]
 - x. [UPLAN](#) [Software]
 - xi. [Vision Zero Suite \(VZS\)](#) [Software]
- u. How do I assess differences among the results of the project prioritization methods?
 - i. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - ii. [Resurfacing Safety Resource Allocation Program \(RSRAP\)](#) [Software]

Safety Effectiveness Evaluation

- v. What are the state-of-the-art safety effectiveness evaluation methods?
 - i. [A Guide to Developing Quality Crash Modification Factors](#) [Application Guide]
 - ii. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - iii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iv. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - v. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
 - vi. [Observational Before-After Studies in Road Safety](#) [Application Guide]
 - vii. [Recommended Protocols for Developing Crash Modification Factors](#) [Information Guide]
 - viii. [The Art of Appropriate Evaluation: A Guide for Highway Safety Program Managers](#) [Application Guide]
- w. What data are required for the different safety effectiveness evaluation methods?
 - i. [A Guide to Developing Quality Crash Modification Factors](#) [Application Guide]

- ii. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - iii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iv. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - v. [Highway Safety Manual Data Needs Guide](#) [Information Guide]
 - vi. [Observational Before-After Studies in Road Safety](#) [Application Guide]
 - vii. [Recommended Protocols for Developing Crash Modification Factors](#) [Information Guide]
 - viii. [Safety Performance Function Decision Guide: SPF Calibration vs SPF Development](#) [Information Guide]
 - ix. [The Art of Appropriate Evaluation: A Guide for Highway Safety Program Managers](#) [Application Guide]
- x. What tools are available to assess the safety effectiveness of implemented projects or countermeasures, and what data do they require from the users?
- i. [AASHTOWare Safety Analyst™](#) [Software]
 - ii. [A Guide to Developing Quality Crash Modification Factors](#) [Application Guide]
 - iii. [CMF Clearinghouse](#) [Database]
 - iv. [ESRI Roads and Highways](#) [Software]
 - v. [FHWA GIS Safety Analysis Tools v4.0](#) [Software]
 - vi. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - vii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - viii. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - ix. [Interactive Highway Safety Design Model \(IHSDM\)](#) [Software]
 - x. [Interchange Safety Analysis Tool Enhanced \(ISATe\)](#) [Software]
 - xi. [Observational Before-After Studies in Road Safety](#) [Application Guide]
 - xii. [Recommended Protocols for Developing Crash Modification Factors](#) [Information Guide]
 - xiii. [Surrogate Safety Assessment Model \(SSAM\)](#) [Software]
 - xiv. [The Art of Appropriate Evaluation: A Guide for Highway Safety Program Managers](#) [Application Guide]
 - xv. [Traffic Safety Performance Measures](#) [Application Guide]
 - xvi. [UPLAN](#) [Software]

I4. Understand current data analysis capabilities.

- a. How do I assess the data capability of our agency in relation to the required data toward applying the state-of-the-art network screening methods?
 - i. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - ii. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide]

- iii. [Highway Safety Improvement Program \(HSIP\) Self-Assessment Tool](#) [Application Guide]
 - iv. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - v. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
 - vi. [Safety Performance Function Decision Guide: SPF Calibration vs SPF Development](#) [Information Guide]
 - vii. [User's Guide to Develop Highway Safety Manual \(HSM\) Safety Performance Function \(SPF\) Calibration Factors](#) [Application Guide]
- b. How can we advance from the state-of-the-practice to the state-of-the-art?
- i. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide]
 - ii. [Highway Safety Improvement Program \(HSIP\) Self-Assessment Tool](#) [Application Guide]
 - iii. [Highway Safety Manual Data Needs Guide](#) [Information Guide]
 - iv. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
 - v. [Safety Performance Function Decision Guide: SPF Calibration vs SPF Development](#) [Information Guide]
 - vi. [The Crash Outcome Data Evaluation System \(CODES\) and Applications to Improve Traffic Safety Decision-Making](#) [Information Guide]
 - vii. [User's Guide to Develop Highway Safety Manual \(HSM\) Safety Performance Function \(SPF\) Calibration Factors](#) [Application Guide]
- c. How can we maintain the data capability required to carry out annual safety analyses?
- i. No tools were identified to support this task.
- d. What data are required for the development of SPFs for network screening procedures?
- i. [AASHTOWare Safety Analyst™](#) [Software] (Module I documentation)
 - ii. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - iii. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - iv. [Monroe County Accident Database Enhancement Project Report](#) [Information Guide]
 - v. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
 - vi. [Safety Performance Function Decision Guide: SPF Calibration vs SPF Development](#) [Information Guide]

- vii. [Safety Performance Function Development Guide: Developing Jurisdiction-Specific SPFs](#) [Application Guide]
- e. What data are required for the development of SPFs for project level safety analysis?
 - i. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - ii. [Highway Safety Manual Data Needs Guide](#) [Information Guide]
 - iii. [Safety Performance Function Decision Guide: SPF Calibration vs SPF Development](#) [Information Guide]
- f. How do we prioritize data needs versus the agency's programs and upcoming projects?
 - i. [User's Guide to Develop Highway Safety Manual \(HSM\) Safety Performance Function \(SPF\) Calibration Factors](#) [Application Guide]
- g. How do I determine if our agency should develop SPF calibration factors or develop agency-specific SPFs?
 - i. [Safety Performance Function Decision Guide: SPF Calibration vs SPF Development](#) [Information Guide]

I 5. Employ state-of-the-art techniques to perform data analysis.

- a. What are the state-of-the-art techniques?
 - i. [A Guide to Developing Quality Crash Modification Factors](#) [Application Guide]
 - ii. [CMFs in Practice](#) [Application Guide]
 - iii. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - iv. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - v. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - vi. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - vii. [Integrating the Highway Safety Manual into the Highway Project Development Process](#) [Application Guide]
 - viii. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
 - ix. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
 - x. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
 - xi. [The Art of Appropriate Evaluation: A Guide for Highway Safety Program Managers](#) [Application Guide]

- b. How do I develop SPFs?
 - i. [Safety Performance Function Development Guide: Developing Jurisdiction-Specific SPFs](#) [Application Guide]
- c. How do I develop CMFs?
 - i. [A Guide to Developing Quality Crash Modification Factors](#) [Application Guide]
 - ii. [Recommended Protocols for Developing Crash Modification Factors](#) [Information Guide]
 - iii. [The Art of Appropriate Evaluation: A Guide for Highway Safety Program Managers](#) [Application Guide]
- d. What is the benefit that we can anticipate when employing state-of-the-art techniques in lieu of traditional ones?
 - i. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - ii. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - iii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iv. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - v. [Integrating the Highway Safety Manual into the Highway Project Development Process](#) [Application Guide]
 - vi. [The Art of Appropriate Evaluation: A Guide for Highway Safety Program Managers](#) [Application Guide]
- e. What agencies have experience with the state-of-the-art techniques? Are there national task forces or peer groups to share experiences?
 - i. [NCHRP 17-50 Lead States Initiative for Implementing the Highway Safety Manual](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying peer experience with the HSM.]
 - ii. [National 2009 Safety Performance Function Summit](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying peer experience with SPFs.]
 - iii. [Illinois HSM Lead State Peer to Peer Workshop, November 2010](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying peer experience with the HSM.]
- f. How should we position ourselves to stay tuned and prepared to advance with developing techniques?
 - i. [AASHTO Highway Safety Manual Website](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying updates to the HSM.]

- ii. [Road Safety Professional Capacity Building](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying training, technical assistance, and noteworthy practices related to roadway safety.]

16. Identify data needs to enhance current data analysis capabilities.

- a. What data issues might be encountered when employing state-of-the-art techniques?
 - i. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - ii. [Monroe County Accident Database Enhancement Project Report](#) [Information Guide]
- b. How do I demonstrate the data gaps to data managers through the analysis to support our agency's enhancement of data analysis capabilities?
 - i. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide]
 - ii. [Highway Safety Improvement Program \(HSIP\) Self-Assessment Tool](#) [Application Guide]
 - iii. [Highway Safety Manual Data Needs Guide](#) [Information Guide]
 - iv. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
 - v. [Safety Performance Function Decision Guide: SPF Calibration vs SPF Development](#) [Information Guide]
- c. What data links are needed (and missing in our agency) to use the state-of-the-art analytical methods?
 - i. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - ii. [Highway Safety Manual Data Needs Guide](#) [Information Guide]
 - iii. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
 - iv. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
 - v. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
 - vi. [Safety Performance Function Decision Guide: SPF Calibration vs SPF Development](#) [Information Guide]
 - vii. [The Crash Outcome Data Evaluation System \(CODES\) and Applications to Improve Traffic Safety Decision-Making](#) [Information Guide]

- d. What tools are available for analysis and what data are needed (and may be missing in our agency) to be able to use these analytical tools and software programs?
 - i. See 13 above.
- e. How do I incorporate the analytical needs to data management's efforts in the agency?
 - i. No tools were identified to support this task.
- f. Are there national data that may complement our agency's data to enhance our analysis capabilities (such as injured persons/crash type and severity)?
 - i. [Crashworthiness Data System \(CDS\)](#) [Database]
 - ii. [Fatality Analysis Reporting System \(FARS\)](#) [Database]
 - iii. [Federal Transit Administration \(FTA\) National Transit Database \(NTD\)](#) [Database]
 - iv. [General Estimates System \(GES\)](#) [Database]
 - v. [Highway Performance Monitoring System \(HPMS\)](#) [Database]
 - vi. [Motor Carrier Management Information System \(MCMIS\)](#) [Database]
 - vii. [National EMS Information System \(NEMSIS\)](#) [Database]
 - viii. [National Motor Vehicle Crash Causation Study \(NMVCCS\)](#) [Database]
- g. What additional types of quality control checks should be put in place?
 - i. [Data Systems: A Road Safety Manual for Decision-Makers and Practitioners](#) [Application Guide]
- h. How often should data be collected and added to the agency's linked database for timely analysis?
 - i. [Highway Performance Monitoring System \(HPMS\)](#) [Database]
 - ii. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - iii. [Model Performance Measures for State Traffic Records Systems](#) [Application Guide]
 - iv. [Performance Measures for Roadway Inventory Data Report](#) [Application Guide]

COLLECT

17. Understand the needs of safety analysts in terms of data elements, level of detail, and data format.
- a. What types of data do the analysts need and in what format and level of detail are the data needed? In particular, what data are needed to employ state-of-the-art methods and tools (e.g., Highway Safety Manual)?
 - i. [ANSI-D16.1-2007 Manual on Classification of Motor Vehicle Traffic Accidents](#) [Information Guide]
 - ii. [ANSI-D20 Traffic Records Systems Data Dictionary: Release 6.0.0](#) [Information Guide]
 - iii. [Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program](#) [Information Guide]
 - iv. [Development of Guidance for States Transitioning to New Safety Analysis Tools](#) [Information Guide]
 - v. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide]
 - vi. [FHWA Systemic Safety Project Selection Tool](#) [Application Guide]
 - vii. [Guidance Memorandum on Fundamental Roadway and Traffic Data Elements to Improve the Highway Safety Improvement Program](#) [Information Guide]
 - viii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - ix. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - x. [Highway Safety Manual Data Needs Guide](#) [Information Guide]
 - xi. [Market Analysis of Collecting Fundamental Roadway Data Elements to Support the Highway Safety Improvement Program](#) [Application Guide]
 - xii. [Model Inventory of Roadway Elements \(MIRE\) 2.0](#) [Information Guide]
 - xiii. [Model Inventory of Roadway Elements \(MIRE\) Data Collection Guidebook](#) [Information Guide]
 - xiv. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]
 - xv. [Model Inventory of Roadway Elements \(MIRE\) Fundamental Data Elements Cost-Benefit Estimation](#) [Information Guide]
 - xvi. [Model Minimum Uniform Crash Criteria \(MMUCC\)](#) [Information Guide]
 - xvii. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
 - xviii. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
 - xix. [National Guidelines for the Network Screening of Collision Prone Locations](#) [Application Guide]
 - xx. [Pedestrian and Bicycle Crash Analysis Tool \(PBCAT\)](#) [Software]
 - xxi. [Safety Performance Function Development Guide: Developing Jurisdiction-Specific SPFs](#) [Application Guide]

- xxii. [User's Guide to Develop Highway Safety Manual \(HSM\) Safety Performance Function \(SPF\) Calibration Factors](#) [Application Guide]

18. Collect data through existing programs.

- a. What are the options for collecting additional data elements or adding miles of roadway to the existing linear referencing system through existing programs?
 - i. [Development of a Structure for a Model Inventory of Roadway Elements Management Information System \(MIRE MIS\)](#) [Information Guide]
 - ii. [Exploration of the Application of Collective Information to Transportation Data for Safety White Paper](#) [Information Guide]
 - iii. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - iv. [Model Inventory of Roadway Elements \(MIRE\) Data Collection Guidebook](#) [Information Guide]
 - v. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]
 - vi. [Model Inventory of Roadway Elements \(MIRE\) Management Information System \(MIS\) Lead Agency Data Collection Report](#) [Application Guide]
 - vii. [Monroe County Accident Database Enhancement Project Report](#) [Information Guide]
 - viii. [National Cooperative Highway Research Program \(NCHRP\) Report 748, Guidelines for the Use of Mobile LIDAR in Transportation Applications](#) [Information Guide]
- b. How can I encourage decision-makers to collect additional data elements or add miles of roadway to the existing linear referencing system?
 - i. [Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program](#) [Information Guide]
 - ii. [Benefit-Cost Analysis of Investing in Data Systems and Processes for Data-Driven Safety Programs: Decision-Making Guidebook](#) [Information Guide]
 - iii. [Benefit-Cost Analysis of Investing in Data Systems and Processes for Data-Driven Safety Programs: Project Report](#) [Information Guide]
 - iv. [Data Systems: A Road Safety Manual for Decision-Makers and Practitioners](#) [Application Guide]
 - v. [Guidance Memorandum on Fundamental Roadway and Traffic Data Elements to Improve the Highway Safety Improvement Program](#) [Information Guide]
 - vi. [Market Analysis of Collecting Fundamental Roadway Data Elements to Support the Highway Safety Improvement Program](#) [Application Guide]
 - vii. [Model Inventory of Roadway Elements \(MIRE\) Fundamental Data Elements Cost-Benefit Estimation](#) [Information Guide]
- c. How often should individual data elements be collected and/or reviewed?
 - i. [Highway Performance Monitoring System \(HPMS\)](#) [Database]

- ii. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
- iii. [Model Performance Measures for State Traffic Records Systems](#) [Application Guide]
- iv. [Performance Measures for Roadway Inventory Data Report](#) [Application Guide]
- d. What are effective structures for an annual traffic and safety data collection and management program?
 - i. [DAMA Guide to the Data Management Body of Knowledge \(DAMA-DMBOK\)](#) [Information Guide]
 - ii. [Data Business Plans and Governance Programs – Aligning Transportation Data to Agency Strategic Objectives](#) [Information Guide]
 - iii. [Development of a Structure for a Model Inventory of Roadway Elements Management Information System \(MIRE MIS\)](#) [Information Guide]
 - iv. [Highway Performance Monitoring System \(HPMS\)](#) [Database]
 - v. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - vi. [Model Inventory of Roadway Elements \(MIRE\) Management Information System \(MIS\) Lead Agency Data Collection Report](#) [Application Guide]
 - vii. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
 - viii. [Synthesis of Best Practices for the Development of an Integrated Data and Information Management Approach](#) [Application Guide]
 - ix. [UPLAN](#) [Software]

19. Identify opportunities to collect additional data through new programs.

- a. What are the options for collecting additional data elements or adding miles of roadway to the existing linear referencing system through new programs?
 - i. [Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program](#) [Information Guide]
 - ii. [Development of a Structure for a Model Inventory of Roadway Elements Management Information System \(MIRE MIS\)](#) [Information Guide]
 - iii. [Exploration of the Application of Collective Information to Transportation Data for Safety White Paper](#) [Information Guide]
 - iv. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - v. [Model Inventory of Roadway Elements \(MIRE\) Data Collection Guidebook](#) [Information Guide]
 - vi. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]
 - vii. [Model Inventory of Roadway Elements \(MIRE\) Management Information System \(MIS\) Lead Agency Data Collection Report](#) [Application Guide]
 - viii. [Monroe County Accident Database Enhancement Project Report](#) [Information Guide]

- ix. [National Cooperative Highway Research Program \(NCHRP\) Report 748, Guidelines for the Use of Mobile LIDAR in Transportation Applications](#) [Information Guide]
- b. How can I encourage decision-makers to collect additional data elements or add miles of roadway to the existing linear referencing system?
 - i. [Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program](#) [Information Guide]
 - ii. [Benefit-Cost Analysis of Investing in Data Systems and Processes for Data-Driven Safety Programs: Decision-Making Guidebook](#) [Information Guide]
 - iii. [Benefit-Cost Analysis of Investing in Data Systems and Processes for Data-Driven Safety Programs: Project Report](#) [Information Guide]
 - iv. [Data Systems: A Road Safety Manual for Decision-Makers and Practitioners](#) [Application Guide]
 - v. [Guidance Memorandum on Fundamental Roadway and Traffic Data Elements to Improve the Highway Safety Improvement Program](#) [Information Guide]
 - vi. [Market Analysis of Collecting Fundamental Roadway Data Elements to Support the Highway Safety Improvement Program](#) [Application Guide]
 - vii. [Model Inventory of Roadway Elements \(MIRE\) Fundamental Data Elements Cost-Benefit Estimation](#) [Information Guide]
- c. What tools and equipment are required for effective data collection and management to support each aspect of the safety management process?
 - i. [Development of a Structure for a Model Inventory of Roadway Elements Management Information System \(MIRE MIS\)](#) [Information Guide]
 - ii. [Exploration of the Application of Collective Information to Transportation Data for Safety White Paper](#) [Information Guide]
 - iii. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - iv. [Model Inventory of Roadway Elements \(MIRE\) Data Collection Guidebook](#) [Information Guide]
 - v. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]
 - vi. [Model Inventory of Roadway Elements \(MIRE\) Management Information System \(MIS\) Lead Agency Data Collection Report](#) [Application Guide]
 - vii. [National Cooperative Highway Research Program \(NCHRP\) Report 748, Guidelines for the Use of Mobile LIDAR in Transportation Applications](#) [Information Guide]
 - viii. [Synthesis of Best Practices for the Development of an Integrated Data and Information Management Approach](#) [Application Guide]
 - ix. [The Crash Outcome Data Evaluation System \(CODES\) and Applications to Improve Traffic Safety Decision-Making](#) [Information Guide]

- d. What human resources are needed to complement the tools and equipment for data collection and management to support each aspect of the safety management process?
 - i. [Data Business Plans and Governance Programs – Aligning Transportation Data to Agency Strategic Objectives](#) [Information Guide]
 - ii. [Exploration of the Application of Collective Information to Transportation Data for Safety White Paper](#) [Information Guide]
 - iii. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - iv. [Market Analysis of Collecting Fundamental Roadway Data Elements to Support the Highway Safety Improvement Program](#) [Application Guide]
 - v. [Model Inventory of Roadway Elements \(MIRE\) Fundamental Data Elements Cost-Benefit Estimation](#) [Information Guide]
 - vi. [Model Inventory of Roadway Elements \(MIRE\) Management Information System \(MIS\) Lead Agency Data Collection Report](#) [Application Guide]

20. Employ state-of-the-art techniques to collect high-quality data efficiently and cost-effectively.

- a. How can we improve the quality of our data?
 - i. [ANSI-D16.1-2007 Manual on Classification of Motor Vehicle Traffic Accidents](#) [Information Guide]
 - ii. [ANSI-D20 Traffic Records Systems Data Dictionary: Release 6.0.0](#) [Information Guide]
 - iii. [Crash Data Improvement Program Guidebook](#) [Application Guide]
 - iv. [Data Systems: A Road Safety Manual for Decision-Makers and Practitioners](#) [Application Guide]
 - v. [Development of a Structure for a Model Inventory of Roadway Elements Management Information System \(MIRE MIS\)](#) [Information Guide]
 - vi. [Exploration of the Application of Collective Information to Transportation Data for Safety White Paper](#) [Information Guide]
 - vii. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide]
 - viii. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - ix. [Model Inventory of Roadway Elements \(MIRE\) Data Collection Guidebook](#) [Information Guide]
 - x. [Model Minimum Uniform Crash Criteria \(MMUCC\)](#) [Information Guide]
 - xi. [National Cooperative Highway Research Program \(NCHRP\) Report 748, Guidelines for the Use of Mobile LIDAR in Transportation Applications](#) [Information Guide]
 - xii. [The Crash Outcome Data Evaluation System \(CODES\) and Applications to Improve Traffic Safety Decision-Making](#) [Information Guide]

- b. What is the most cost-effective method for collecting additional data elements or adding miles of roadway to the existing linear referencing system?
 - i. [Development of a Structure for a Model Inventory of Roadway Elements Management Information System \(MIRE MIS\)](#) [Information Guide]
 - ii. [Exploration of the Application of Collective Information to Transportation Data for Safety White Paper](#) [Information Guide]
 - iii. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - iv. [Model Inventory of Roadway Elements \(MIRE\) Data Collection Guidebook](#) [Information Guide]
 - v. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]
 - vi. [Model Inventory of Roadway Elements \(MIRE\) Management Information System \(MIS\) Lead Agency Data Collection Report](#) [Application Guide]
 - vii. [Monroe County Accident Database Enhancement Project Report](#) [Information Guide]
 - viii. [National Cooperative Highway Research Program \(NCHRP\) Report 748, Guidelines for the Use of Mobile LIDAR in Transportation Applications](#) [Information Guide]
- c. Does the effectiveness of data collection methods change based on existing capabilities (e.g., availability of a video log or reliable GIS basemap)?
 - i. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]

RESEARCH

21. Develop guides and tools to support the management of safety data and analysis programs.

- a. What guides and tools are needed to manage safety data and analysis programs?
 - i. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide] [Note: The following table identifies research needs related to the management of safety data and analysis programs based on the FHWA Roadway Safety Data Capabilities Assessment Final Report. These research needs are associated with specific tasks defined in the Primer. Research conducted in these areas will help to fill gaps in the Toolbox.]

Research Needs Related to the Management of Safety Data and Analysis Programs	Hyperlink to Respective Task(s)
Comprehensive data guides to identify the data needs for each stage of the safety management process (i.e., network screening, diagnosis, etc., as per HSM Part B); guides to be developed according to each user's needs.	4.a
Case studies demonstrating the safety impacts of selecting and implementing ineffective measures due to misdiagnosis of the safety concerns, at locations with low priority (due to lack of required data to use state-of-the-art methods).	4.c
Case studies demonstrating the safety impacts of selecting and implementing effective measures at locations with high priority based on the use of state-of-the-art methods.	4.d
Scanning tour documenting successful state implementations of new and expanded policies to implement the state-of-the-art analytical methods (including the HSM).	0
A synthesis of the types of data that safety analysts need and in what format the data are needed aiming to reach data managers with IT background.	6.a
A concise description of the linkages among safety data and the types of queries typically needs by safety analysts aiming to reach data managers with IT background.	0
Case studies of successful expansions or adaptations carried out by state DOTs and other agencies (e.g., to install AASHTOWare Safety Analyst™ or implement IHSDM at a project level) aiming to reach data managers with IT background.	6.c , 6.d
Guide to how to expand or adapt typical state DOT data platforms to use new analytical tools including a stepwise approach.	6.c , 6.d
Guide to how to develop an effective structure for all elements required to apply the state-of-the-art methods including crash, traffic volumes, and roadway inventory.	7.b
Document describing reporting needs to support state and local jurisdictions for possible funding sources and other legislative requirements.	7.b
National scan to develop a guide about what data elements are collected, how often the data elements are updated, and how they are coded and accessed, for each state and local jurisdiction (outside state DOTs).	8.c

Research Needs Related to the Management of Safety Data and Analysis Programs	Hyperlink to Respective Task(s)
Guide describing alternative organization structures for effective data management to meet the requirements of the state-of-the-art methods (for safety management processes and project-specific safety assessments).	<u>8.d</u>
Guide to show how to integrate road data collection and management into a typical asset management system already implemented in most state agencies.	<u>8.e</u>
Guide to how to develop new policies and how to expand existing policies in an agency to expand its data capability including examples of successful such actions.	<u>8.f</u>
Guide to how to develop a cost-effective annual data collection program including the use of complementary tools and frequency of data collection for given road elements, crash data, and traffic counts.	<u>8.f.i</u>
Toolbox of tools and equipment to undertake an on-going data collection and management program.	<u>8.f.i</u>
Complementary human resource guide to the toolbox of tools and equipment (above) to undertake an on-going data collection and management program.	<u>8.h</u>
Complementary human resource guide to the guide (above) to how to develop a cost-effective annual data collection program including the use of complementary tools and frequency of data collection for given road elements, crash data, and traffic counts.	<u>8.h</u>
Guide for transportation agencies at different levels (i.e., state, municipal (large and smaller cities) and MPO/COG) for typical managers dealing with roadway safety.	<u>8.i</u>
Decision tree complementary to (a) toolbox of tools and equipment to undertake an on-going data collection and management program, and (b) to the human resource guide (above) using strategic highway safety plan, planned road expansion and rehabilitation programs, and agency's asset management.	<u>8.j</u>
Document demonstrating the need to integrate data to be able to use the state-of-the-art (based on the HSM and related tools) with clear linkages with the alternative cost-effective combination of tools and equipment to undertake an on-going data collection and management.	<u>9.b</u>
Scanning tour documenting successful state implementations of task forces focused on data collection and management and their integration within the jurisdictional.	<u>9.c</u>
Guide to data managers (possible IT background professionals) of the required links among various data sources to use state-of-the-art analytical methods.	<u>10.b</u>
Guide to data managers (possible IT background professionals) to establish a protocol for effective access to data sources and online analytical tools (refer to effective and successful systems and tools in the country).	<u>11.a</u>
Document to data managers (possible IT background professionals) of the security and legal implications of making data publicly available (refer to effective and successful systems and tools in the country).	<u>11.b</u>
Comprehensive guide to data managers (possible IT background professionals) of the types of quality control checks to be performed when data (crash, traffic volumes, roadway inventory) are integrated for the use of state-of-the-art.	<u>12.a</u>

Research Needs Related to the Management of Safety Data and Analysis Programs	Hyperlink to Respective Task(s)
Comprehensive guide to data managers (possible IT background professionals) on how often and how to check for completeness, accuracy etc. of the integrated data (crash, traffic volumes, roadway inventory) in conjunction with the annual data collection and management established for the agency.	12.b

- b. What tools and guides are under development to support the management of safety data and analysis programs?
 - i. [AASHTO Highway Safety Manual Website](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying updates to the HSM.]
 - ii. [Roadway Safety Data Activities](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying ongoing activities related to safety data and analysis tools.]
 - iii. [Transportation Research Board \(TRB\) Research in Progress Database](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying research in progress.]

22. Analyze data to identify priority safety issues and estimate the effectiveness of countermeasures.

- a. What databases are available for analyzing safety issues at the national, regional, state, and local level?
 - i. [Crash Injury Research and Engineering Network \(CIREN\)](#) [Database]
 - ii. [Crashworthiness Data System \(CDS\)](#) [Database]
 - iii. [Fatality Analysis Reporting System \(FARS\)](#) [Database]
 - iv. [Federal Transit Administration \(FTA\) National Transit Database \(NTD\)](#) [Database]
 - v. [General Estimates System \(GES\)](#) [Database]
 - vi. [Highway Performance Monitoring System \(HPMS\)](#) [Database]
 - vii. [Highway Safety Information System \(HSIS\)](#) [Database]
 - viii. [Motor Carrier Management Information System \(MCMIS\)](#) [Database]
 - ix. [National EMS Information System \(NEMSIS\)](#) [Database]
 - x. [National Motor Vehicle Crash Causation Study \(NMVCCS\)](#) [Database]
 - xi. [Strategic Highway Research Program \(SHRP2\)](#) [Database]
 - xii. [UPLAN](#) [Software]

- b. What emphasis areas have been adopted in the strategic safety plan, and have the priorities shifted?
 - i. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
 - ii. [Toward Zero Deaths](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying national priorities related to roadway safety.]
- c. What performance measures are needed for evaluation?
 - i. [Data Systems: A Road Safety Manual for Decision-Makers and Practitioners](#) [Application Guide]
 - ii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iii. [Highway Safety Improvement Program \(HSIP\) Self-Assessment Tool](#) [Application Guide]
 - iv. [Model Performance Measures for State Traffic Records Systems](#) [Application Guide]
 - v. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
 - vi. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
 - vii. [National Cooperative Highway Research Program \(NCHRP\) Report 666: Target-Setting Methods and Data Management to Support Performance-Based Resource Allocation](#) [Information Guide]
 - viii. [Surrogate Safety Assessment Model \(SSAM\)](#) [Software]
 - ix. [The Art of Appropriate Evaluation: A Guide for Highway Safety Program Managers](#) [Application Guide]
 - x. [Traffic Safety Performance Measures](#) [Application Guide]
- d. What data analysis programs are in effect for assessing strategic plans?
 - i. No tools were identified to support this task.
- e. What are the needs related to CMFs, CMFunctions, and general countermeasure effectiveness?
 - i. [CMF Clearinghouse](#) [Database]
 - ii. [National Cooperative Highway Research Program \(NCHRP\) Report 500 Series](#) [Information Guide]
- f. What methods are needed to evaluate the safety effects of systemic treatments?
 - i. No tools were identified to support this task.

23. Refine state-of-the-art techniques to perform data analysis.

- a. What are the current limitations of the state-of-the-art techniques?
 - i. [A Guide to Developing Quality Crash Modification Factors](#) [Application Guide]
 - ii. [CMF Clearinghouse](#) [Database]
 - iii. [Highway Safety Improvement Program \(HSIP\) Manual](#) [Application Guide]
 - iv. [Highway Safety Manual \(HSM\)](#) [Application Guide]
 - v. [Observational Before-After Studies in Road Safety](#) [Application Guide]
 - vi. [Recommended Protocols for Developing Crash Modification Factors](#) [Information Guide]
 - vii. [Safety Performance Function Development Guide: Developing Jurisdiction-Specific SPFs](#) [Application Guide]
 - viii. [Surrogate Safety Assessment Model \(SSAM\)](#) [Software]
 - ix. [The Art of Appropriate Evaluation: A Guide for Highway Safety Program Managers](#) [Application Guide]
 - x. [User's Guide to Develop Highway Safety Manual \(HSM\) Safety Performance Function \(SPF\) Calibration Factors](#) [Application Guide]
- b. What innovative research efforts are currently taking place toward advancement of the state-of-the-art techniques?
 - i. [AASHTO Highway Safety Manual Website](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying ongoing activities related to the HSM.]
 - ii. [Roadway Safety Data Activities](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying ongoing activities related to safety data and analysis tools.]
 - iii. [Transportation Research Board \(TRB\) Research in Progress Database](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying research in progress.]
- c. What analytical techniques are anticipated in the next edition of the HSM?
 - i. [AASHTO Highway Safety Manual Website](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying ongoing activities related to the HSM.]
- d. What are the identified research needs, related to refined analytical techniques, included in the national agenda developed by NCHRP 17-48?
 - i. [NCHRP Report 756: Highway Safety Research Agenda—Infrastructure and Operations](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying research needs related to safety data and analysis.]

24. Develop guides and tools to support data analysis.

- a. What guides and tools are needed for data analysis?
 - i. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide] [Note: The following table identifies research needs related to the analysis of safety data based on the FHWA Roadway Safety Data Capabilities Assessment Final Report. These research needs are associated with specific tasks defined in the Primer. Research conducted in these areas will help to fill gaps in the Toolbox.]

Research Needs Related to the Analysis of Safety Data	Hyperlink to Respective Task(s)
A synthesis document describing the existing network screening tools with indication of the specific differences and purposes.	14.c
A synthesis document (or a website) describing the existing SPFs developed by different agencies.	14.e
Research to develop a method to incorporate the results of different network screening method for more effective selection of sites.	14.g
Guide document describing the data required for specific diagnostic methods.	14.i
A synthesis document describing the existing diagnosis tools with indication of the specific differences, methods and purposes.	14.j
Guide document describing the data required for specific countermeasure selection methods.	14.l
A synthesis document describing the existing countermeasure selection tools with indication of the specific differences in data, methods and purposes.	14.m
Guide describing the data required for the different economic appraisal methods.	14.o
A synthesis document describing the existing economic appraisal tools with indication of the specific differences in data, methods and purposes.	14.p
Case studies showing the differences of results of economic appraisal methods and recommendations.	14.q
Guide document describing the data required for the different project prioritization methods.	14.s
A synthesis document describing the existing project prioritization tools with indication of the specific differences in data, methods and purposes.	14.t
A synthesis document describing the existing safety effectiveness evaluation tools with indication of the specific differences in data, methods and purposes.	14.x
Toolbox of tools and equipment to undertake an on-going data collection and management program (note: as above for safety managers and decision makers).	15.c
Synthesis of the advantages and effectiveness of carrying out annual safety analyses based on updated and improved data.	15.c
Synthesis of effectiveness of prioritization practices with case studies of different programs and anticipated projects.	15.f

Research Needs Related to the Analysis of Safety Data	Hyperlink to Respective Task(s)
Guide to assist safety analysts to incorporate their needs to the agency data management priorities.	17.d.i

- b. What tools and guides are under development to support data analysis?
 - i. [AASHTO Highway Safety Manual Website](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying ongoing activities related to the HSM.]
 - ii. [Roadway Safety Data Activities](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying ongoing activities related to safety data and analysis tools.
 - iii. [Transportation Research Board \(TRB\) Research in Progress Database](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying research in progress.]

25. Enhance data collection and management techniques.

- a. What are the innovative data collection and management techniques being used by others?
 - i. [DAMA Guide to the Data Management Body of Knowledge \(DAMA-DMBOK\)](#) [Information Guide]
 - ii. [Data Business Plans and Governance Programs – Aligning Transportation Data to Agency Strategic Objectives](#) [Information Guide]
 - iii. [Development of a Structure for a Model Inventory of Roadway Elements Management Information System \(MIRE MIS\)](#) [Information Guide]
 - iv. [Exploration of the Application of Collective Information to Transportation Data for Safety White Paper](#) [Information Guide]
 - v. [Integrating MIRE: Better Data for Better Decisions to Save Lives](#) [Information Guide]
 - vi. [Model Inventory of Roadway Elements \(MIRE\) Data Collection Guidebook](#) [Information Guide]
 - vii. [Model Inventory of Roadway Elements \(MIRE\) Management Information System \(MIS\) Lead Agency Data Collection Report](#) [Application Guide]
 - viii. [MIRE Element Collection Mechanisms and Gap Analysis](#) [Information Guide]
 - ix. [Monroe County Accident Database Enhancement Project Report](#) [Information Guide]
 - x. [National Cooperative Highway Research Program \(NCHRP\) Project 08-36, Task 100: Transportation Data Self-Assessment Guide](#) [Application Guide]

- xi. [National Cooperative Highway Research Program \(NCHRP\) Report 501: Integrated Safety Management Process](#) [Application Guide]
 - xii. [National Cooperative Highway Research Program \(NCHRP\) Report 748, Guidelines for the Use of Mobile LIDAR in Transportation Applications](#) [Information Guide]
 - xiii. [Synthesis of Best Practices for the Development of an Integrated Data and Information Management Approach](#) [Application Guide]
 - xiv. [The Crash Outcome Data Evaluation System \(CODES\) and Applications to Improve Traffic Safety Decision-Making](#) [Information Guide]
 - xv. [UPLAN](#) [Software]
- b. How accurate are the new data collection and management techniques?
 - i. No tools were identified to support this task.
 - c. How cost-effective are the new data collection and management techniques?
 - i. No tools were identified to support this task.
 - d. What surrogate data elements can complement or replace traditional data elements?
 - i. No tools were identified to support this task.

26. Develop guides and tools to support data collection.

- a. What guides and tools are needed for data collection?
 - i. [FHWA Roadway Safety Data Capabilities Assessment Final Report](#) [Information Guide] [Note: The following table identifies research needs related to the collection of safety data based on the FHWA Roadway Safety Data Capabilities Assessment Final Report. These research needs are associated with specific tasks defined in the Primer. Research conducted in these areas will help to fill gaps in the Toolbox.]

Research Needs Related to the Collection of Safety Data	Hyperlink to Respective Task(s)
Toolbox of tools and equipment to undertake an on-going data collection and management program (note: potential expansion of the toolbox listed above for managers, incorporating more in-depth information for data collectors).	19.a , 20.c
Complementary human resource guide to the toolbox of tools and equipment to undertake an on-going data collection and management program (note: as above for managers, incorporating more in-depth information for data collectors).	20.d
Guide to how to develop a cost-effective annual data collection program including the use of complementary tools and frequency of data collection for given road elements, crash data, and traffic counts (note: potentially an expansion to a more in-depth guide to the one listed above for managers).	19.a , 19.c , 22.b , 22.c

Research Needs Related to the Collection of Safety Data	Hyperlink to Respective Task(s)
Guide to how to expand a cost-effective annual data collection program including the use of complementary tools and frequency of data collection for given road elements, crash data, and traffic counts (note: an extension to the guide for the development of such a program; as above for managers).	20.a

- b. What tools and guides are under development to support data collection?
- [AASHTO Highway Safety Manual Website](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying ongoing activities related to the HSM.]
 - [Roadway Safety Data Activities](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying ongoing activities related to safety data and analysis tools.]
 - [Transportation Research Board \(TRB\) Research in Progress Database](#) [Note: this is not a tool as defined by the Toolbox; however, this is a resource for identifying research in progress.]

APPENDIX B: SUMMARY OF EXISTING TOOLS

Appendix B provides the complete list of existing safety data and analysis tools contained in Version 1.0 of the Toolbox. Each tool is accompanied by summary information for high-level categories (referred to as "tags"). Users can quickly review the list of tools or search for a specific tool. If the user identifies a specific tool of interest, then they might also identify the relevant tags and search the Toolbox for all tools with those tags.

Tools for the Toolbox	Primary Topic Area				Tool Type	Data Type	Data Coverage	Safety Management Process Tags	Project Development Process Tags	Program Tags	Focus Area Tags	Target Audience	Application Level	Online Access	Charge
	M	A	C	R											
AASHTOWare Safety Analyst™	•	•	•		S	All	R	All	All	HSIP	All	All	All	No	Fee
A Guide to Developing Quality Crash Modification Factors	•		•		AG	N/A	N/A	C, E, S	A, D, O	HSIP	All	All	All	Yes	Free
Accident Information Management System (AIMS)	•	•			S	C	R	N and D	P, O	HSIP	All	All	All	No	Fee
Accident Records Summary and Diagrams	•	•			S	C	R	D	O	HSIP	All	All	All	No	Fee
AgileAssets Safety Analyst	•	•			S	All	R	N, D, C, E, P	All	HSIP	All	All	All	No	Fee
ANSI-D16.1-2007 Manual on Classification of Motor Vehicle Traffic Accidents	•		•		IG	C	N	All	All	All	All	All	Program	Yes	Free

Tools for the Toolbox	Primary Topic Area				Tool Type	Data Type	Data Coverage	Safety Management Process Tags	Project Development Process Tags	Program Tags	Focus Area Tags	Target Audience	Application Level	Online Access	Charge
	M	A	C	R											
ANSI-D20 Traffic Records Systems Data Dictionary: Release 6.0.0	•		•		IG	All	N	All	All	All	All	All	Program	Yes	Free
Arizona Local Government Safety Project Analysis Model		•			S	N/A	N/A	N, C, E, P	All	HSIP	All	Local	All	No	Free
Background Report: Guidance for Roadway Safety Data to Support the Highway Safety Improvement Program	•		•		IG	R	N	All	All	All	All	All	Program	Yes	Free
Benefit-Cost Analysis of Investing in Data Systems and Processes for Data-Driven Safety Programs: Decision-Making Guidebook	•		•		IG	All	N	All	All	All	All	All	Program	Yes	Free
Benefit-Cost Analysis of Investing in Data Systems and Processes for Data-Driven Safety Programs: Project Report	•		•		IG	All	N	All	All	All	All	All	Program	Yes	Free
BIKESAFE Bicycle Countermeasure Selection System		•			S	N/A	N/A	C	All	HSIP, SRTS	PB	All	All	Yes	Free
CMF Clearinghouse	•		•		IS	N/A	N/A	C, E, S	All	HSIP	All	All	All	Yes	Free

Tools for the Toolbox	Primary Topic Area				Tool Type	Data Type	Data Coverage	Safety Management Process Tags	Project Development Process Tags	Program Tags	Focus Area Tags	Target Audience	Application Level	Online Access	Charge
	M	A	C	R											
CMFs in Practice	•				AG	N/A	N/A	C, E	All	HSIP	All	All	All	Yes	Free
Collision Database System (Crossroads Software)	•	•			S	C	R	N, D	P, O	HSIP	All	All	All	No	Fee
Countermeasures That Work: A Highway Safety Countermeasure Guide for State Highway Safety Offices	•				IG	N/A	N/A	D, C, E	A, D, O	SHSP, HSIP	All	All	All	Yes	Free
Crash Data Improvement Program Guidebook			•		AG	C	N	All	All	All	All	All	Program	Yes	Free
Crash Injury Research and Engineering Network (CIREN)	•		•		D	C, I	R	All	N/A	All	All	Regional	Program	Yes	Free
Crash Mapping and Analysis Tool (CMAT)	•				S	C	R	N, D	All	All	All	All	All	No	Free
Crash Safety Analysis Tools for ArcGIS 10	•				S	N/A	N/A	N	P, O	HSIP	All	All	Program	Yes	Free
Crashworthiness Data System (CDS)	•		•		D	C, I	N	All	P, O	All	All	All	Program	Yes	Free

Tools for the Toolbox	Primary Topic Area				Tool Type	Data Type	Data Coverage	Safety Management Process Tags	Project Development Process Tags	Program Tags	Focus Area Tags	Target Audience	Application Level	Online Access	Charge
	M	A	C	R											
Critical Analysis Reporting Environment (CARE)		•			S	N/A	N/A	N, D	P, O	SHSP, HSIP	All	All	All	Yes	Free
DAMA Guide to the Data Management Body of Knowledge (DAMA-DMBOK)	•		•		IG	All	All	All	All	All	All	All	Program	Yes	Fee
Data Business Plans and Governance Programs – Aligning Transportation Data to Agency Strategic Objectives	•		•		IG	All	All	All	All	All	All	All	Program	Yes	Fee
Data Systems: A Road Safety Manual for Decision-Makers and Practitioners	•		•		AG	All	All	All	All	All	All	All	All	Yes	Free
Deighton dTIMS	•				S	R	R	All	O	HSIP	All	All	Program	Yes	Fee
Development of a Structure for a Model Inventory of Roadway Elements Management Information System (MIRE MIS)			•		IG	R	N	All	All	All	All	All	Program	Yes	Free
Development of Guidance for States Transitioning to New Safety Analysis Tools	•	•	•		IG	N/A	N/A	N	P, O	HSIP	All	All	Program	Yes	Fee

Tools for the Toolbox	Primary Topic Area				Tool Type	Data Type	Data Coverage	Safety Management Process Tags	Project Development Process Tags	Program Tags	Focus Area Tags	Target Audience	Application Level	Online Access	Charge
	M	A	C	R											
ESRI Roads and Highways	•	•			S	All	R	N	P, O	All	All	All	All	No	Fee
Exploration of the Application of Collective Information to Transportation Data for Safety White Paper			•		IG	R	All	All	All	All	All	All	All	Yes	Free
EZplot Traffic Collision Diagram	•				S	N/A	N/A	D	O	HSIP	All	All	Project	No	Fee
Fatality Analysis Reporting System (FARS)	•		•		D	C, I	N	All	All	All	All	All	All	Yes	Free
FHWA GIS Safety Analysis Tools v4.0	•				S	N/A	N/A	N	P, O	HSIP	All	All	All	Yes	Free
FHWA Roadway Safety Data Capabilities Assessment Final Report	•	•			IG	All	N	All	All	All	All	State	All	Yes	Free
FHWA Systemic Safety Project Selection Tool	•				AG	N/A	N/A	N, D, C, E, P	All	HSIP	All	All	All	Yes	Free
Federal Transit Administration (FTA) National Transit Database (NTD)	•		•		D	C, I, O	N	All	All	All	All	All	All	Yes	Free

Tools for the Toolbox	Primary Topic Area				Tool Type	Data Type	Data Coverage	Safety Management Process Tags	Project Development Process Tags	Program Tags	Focus Area Tags	Target Audience	Application Level	Online Access	Charge
	M	A	C	R											
General Estimates System (GES)		•		•	D	C	N	All	All	All	All	All	All	Yes	Free
Guidance Memorandum on Fundamental Roadway and Traffic Data Elements to Improve the Highway Safety Improvement Program	•		•		IG	R	N	All	All	All	All	All	Program	Yes	Free
Highway Performance Monitoring System (HPMS)		•		•	D	R	N	All	All	All	All	All	Program	Yes	Free
Highway Safety Improvement Program (HSIP) Manual	•	•	•	•	AG	N/A	N/A	All	All	All	All	All	All	Yes	Free
Highway Safety Improvement Program (HSIP) Self-Assessment Tool	•	•	•		AG	All	N	All	All	HSIP	All	All	Program	Yes	Free
Highway Safety Information System (HSIS)		•		•	D	C, R, O	R	All	N/A	All	All	All	All	Yes	Free
Highway Safety Manual (HSM)	•	•	•	•	AG	N/A	N/A	All	All	All	All	All	All	No	Fee
Highway Safety Manual Data Needs Guide	•	•	•		IG	N/A	N/A	C, E, S	All	HSIP	All	All	Project	Yes	Free

Tools for the Toolbox	Primary Topic Area				Tool Type	Data Type	Data Coverage	Safety Management Process Tags	Project Development Process Tags	Program Tags	Focus Area Tags	Target Audience	Application Level	Online Access	Charge
	M	A	C	R											
Highway Safety Manual Executive Packet	•				IG	N/A	N/A	All	All	All	All	All	All	Yes	Free
Highway Safety Manual Fact Sheet	•				IG	N/A	N/A	All	All	All	All	All	All	Yes	Free
Highway Safety Manual Implementation Guide for Managers	•				IG	N/A	N/A	All	All	HSIP	All	All	All	Yes	Free
Highway Safety Manual Part C Spreadsheets		•			S	N/A	N/A	C, E	A, D, O	HSIP	All	All	Project	Yes	Free
Hudson Valley Transportation Management Center Crash Performance Measures		•	•	•	S	All	R	N, D	P, O	All	All	All	All	Yes	Free and Fee
Identification of Liability-Related Impediments to Sharing §409 Safety Data Among Transportation Agencies and Synthesis of Best Practices	•		•		IG	C	All	All	All	All	All	All	All	Yes	Free
Illinois Benefit-Cost Analysis (BCA) Spreadsheet		•			S	N/A	N/A	E	A, D, O	HSIP	All	All	Project	Yes	Free

Tools for the Toolbox	Primary Topic Area				Tool Type	Data Type	Data Coverage	Safety Management Process Tags	Project Development Process Tags	Program Tags	Focus Area Tags	Target Audience	Application Level	Online Access	Charge
	M	A	C	R											
Illinois Department of Transportation Over-Representation Tool		•			S	N/A	N/A	N, D	P, O	HSIP	All	All	All	Yes	Free
Integrating the Highway Safety Manual into the Highway Project Development Process	•	•			AG	N/A	N/A	C, E	All	HSIP	All	All	All	Yes	Free
Integrating MIRE: Better Data for Better Decisions to Save Lives	•		•		IG	R	N	All	All	All	All	All	Program	Yes	Free
Interactive Highway Safety Design Model (IHSDM)		•		•	S	N/A	N/A	D, C, E, S	A, D, O	HSIP	All	All	Project	Yes	Free
Interchange Safety Analysis Tool Enhanced (ISATe)		•		•	S	N/A	N/A	D, C, E, S	A, D, O	HSIP	INT	State, Regional	Project	Yes	Free
Intersection Magic		•			S	N/A	N/A	N, D	P, O	HSIP	INT	All	All	Yes	Fee
Market Analysis of Collecting Fundamental Roadway Data Elements to Support the Highway Safety Improvement Program	•		•		AG	R	N	All	All	All	All	All	Program	Yes	Free

Tools for the Toolbox	Primary Topic Area				Tool Type	Data Type	Data Coverage	Safety Management Process Tags	Project Development Process Tags	Program Tags	Focus Area Tags	Target Audience	Application Level	Online Access	Charge
	M	A	C	R											
Model Impaired Driving Records Information Systems – Tying Together Data Systems to Manage Impaired Drivers	•		•		AG	C	N	All	All	All	All	All	Program	Yes	Free
Model Inventory of Roadway Elements (MIRE) 2.0	•		•		IG	R	N	All	All	All	All	All	Program	Yes	Free
Model Inventory of Roadway Elements (MIRE) Data Collection Guidebook			•		IG	R	N	All	All	All	All	All	All	Yes	Free
MIRE Element Collection Mechanisms and Gap Analysis	•		•		IG	R	N	All	All	All	All	All	Program	Yes	Free
Model Inventory of Roadway Elements (MIRE) Fundamental Data Elements Cost-Benefit Estimation	•		•		IG	R	N	All	All	All	All	State	Program	Yes	Free
Model Inventory of Roadway Elements (MIRE) Management Information System (MIS) Lead Agency Data Collection Report	•		•		AG	R	N	All	All	All	INT	All	All	Yes	Free
Model Minimum Uniform Crash Criteria (MMUCC)	•		•		IG	C	N	All	All	All	All	All	Program	Yes	Free

Tools for the Toolbox	Primary Topic Area				Tool Type	Data Type	Data Coverage	Safety Management Process Tags	Project Development Process Tags	Program Tags	Focus Area Tags	Target Audience	Application Level	Online Access	Charge
	M	A	C	R											
Model Performance Measures for State Traffic Records Systems	•		•		AG	All	N/A	All	All	All	All	All	Program	Yes	Free
Monroe County Accident Database Enhancement Project Report		•	•		IG	O	R	N	P, O	All	INT	All	All	Yes	Free
Motor Carrier Management Information System (MCMIS)		•		•	D	C	N	All	P, O	All	All	All	Program	No	Fee
National Cooperative Highway Research Program (NCHRP) Project 08-36, Task 100: Transportation Data Self-Assessment Guide	•		•		AG	All	N	All	All	All	All	All	Program	Yes	Free
National Cooperative Highway Research Program (NCHRP) Report 500 Series	•	•	•	•	IG	All	N	D, C	A, D, O	All	All	All	All	Yes	Free
National Cooperative Highway Research Program (NCHRP) Report 501: Integrated Safety Management Process	•	•	•		AG	N/A	N/A	N, D, C, P, S	All	SHSP	All	All	Program	Yes	Free

Tools for the Toolbox	Primary Topic Area				Tool Type	Data Type	Data Coverage	Safety Management Process Tags	Project Development Process Tags	Program Tags	Focus Area Tags	Target Audience	Application Level	Online Access	Charge
	M	A	C	R											
National Cooperative Highway Research Program (NCHRP) Report 600: Human Factors Guidelines for Road Systems: <i>Second Edition</i>	•	•			IG	N/A	N/A	D, C	A, D, O	All	All	All	All	Yes	Free
National Cooperative Highway Research Program (NCHRP) Report 666: Target-Setting Methods and Data Management to Support Performance-Based Resource Allocation	•		•		IG	All	N/A	All	All	All	All	All	Program	Yes	Free
National Cooperative Highway Research Program (NCHRP) Report 748, Guidelines for the Use of Mobile LIDAR in Transportation Applications			•	•	IG	R	N	All	All	All	All	All	Program	Yes	Free
National EMS Information System (NEMSIS)		•		•	D	I	N	D, C, S	A, D, O	All	All	All	All	Yes	Free
National Guidelines for the Network Screening of Collision Prone Locations	•	•	•		AG	N/A	N/A	N	P, O	HSIP	All	All	Program	No	Fee
National Motor Vehicle Crash Causation Study (NMVCCS)	•		•		D	C	N	D, C	A, D, O	All	All	All	Program	Yes	Free

Tools for the Toolbox	Primary Topic Area				Tool Type	Data Type	Data Coverage	Safety Management Process Tags	Project Development Process Tags	Program Tags	Focus Area Tags	Target Audience	Application Level	Online Access	Charge
	M	A	C	R											
Observational Before-After Studies in Road Safety	•		•		AG	N/A	N/A	S	A, D, O	HSIP	All	All	Project	No	Fee
Ohio Rate of Return Tool	•				S	N/A	N/A	E	A, D, O	HSIP	All	All	Project	Yes	Free
Ohio Economic Crash Analysis Tool (ECAT)	•				S	N/A	N/A	N, C, E	All	HSIP	All	All	Project	Yes	Free
Oregon Safety Priority Index System (SPIS)	•				S	N/A	N/A	N	P, O	HSIP	All	All	Program	Yes	Free
Pedestrian and Bicycle Crash Analysis Tool (PBCAT)	•	•			S	C	R	D, C	A, D, O	HSIP, SRTS	PB	All	Project	Yes	Free
Pedestrian and Bicycle GIS Safety Tools	•	•			S	N/A	N/A	N, D	P, O	HSIP, SRTS	PB	All	All	Yes	Free
Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE)	•				S	N/A	N/A	D, C	A, D, O	HSIP, SRTS	PB	All	All	Yes	Free
Performance Measures for Roadway Inventory Data Report			•		AG	R	N	All	All	All	All	All	All	Yes	Free
Plan4Safety	•	•			S	C, R	R	N, D	P, O	HSIP, SRTS	All	All	All	Yes	Free

Tools for the Toolbox	Primary Topic Area				Tool Type	Data Type	Data Coverage	Safety Management Process Tags	Project Development Process Tags	Program Tags	Focus Area Tags	Target Audience	Application Level	Online Access	Charge
	M	A	C	R											
PLANSAFE	•				S	N/A	N/A	N	P, O	TSP	All	All	Program	Yes	Free
Recommended Protocols for Developing Crash Modification Factors	•		•		IG	N/A	N/A	S	A, D, O	HSIP	All	All	Project	Yes	Free
Roadside Safety Analysis Program (RSAP)	•				S	N/A	N/A	C, E, P	A, D, O	HSIP	RD, LR, S	All	Project	Yes	Free
Resurfacing Safety Resource Allocation Program (RSRAP)	•	•			S	N/A	N/A	C, E, P	A, D, O	HSIP	All	All	All	Yes	Free
Safety Performance Function Decision Guide: SPF Calibration vs SPF Development	•	•	•	•	IG	N/A	N/A	N, S	All	HSIP	All	All	All	Yes	Free
Safety Performance Function Development Guide: Developing Jurisdiction-Specific SPFs	•	•	•		AG	N/A	N/A	N, S	All	HSIP	All	State	Program	Yes	Free
Small Computer COLLision Diagram (SCCOLD)	•				S	N/A	N/A	D	O	HSIP	All	All	Project	No	Fee
Strategic Highway Research Program (SHRP2)	•	•	•		D	C, R	R	D, C, S	All	All	All	All	Program	???	???

Tools for the Toolbox	Primary Topic Area				Tool Type	Data Type	Data Coverage	Safety Management Process Tags	Project Development Process Tags	Program Tags	Focus Area Tags	Target Audience	Application Level	Online Access	Charge
	M	A	C	R											
Surrogate Safety Assessment Model (SSAM)		•		•	S	N/A	N/A	D, C, S	A, D, O	HSIP	All	All	Project	Yes	Free
Synthesis of Best Practices for the Development of an Integrated Data and Information Management Approach	•		•		AG	All	All	All	All	All	All	All	Program	Yes	Free
The Art of Appropriate Evaluation: A Guide for Highway Safety Program Managers	•	•			AG	N/A	N/A	S	A, D, O	All	All	All	All	Yes	Free
The Crash Outcome Data Evaluation System (CODES) and Applications to Improve Traffic Safety Decision-Making		•	•	•	IG	C, I	N	N, D, C, E, S	All	All	All	All	Program	Yes	Free
Traffic Crash Analysis Tool (TCAT)		•			S	C	R	N, D	P, O	HSIP	All	All	All	No	Free/Fee
Traffic Engineering Software (TES)		•	•		S	All	R	N, D	P, O	HSIP	All	All	All	No	Fee
Traffic Records Program Assessment Advisory	•		•		AG	All	R	All	All	All	All	State	Program	Yes	Free

Tools for the Toolbox	Primary Topic Area				Tool Type	Data Type	Data Coverage	Safety Management Process Tags	Project Development Process Tags	Program Tags	Focus Area Tags	Target Audience	Application Level	Online Access	Charge
	M	A	C	R											
Traffic Safety Performance Measures	•	•	•		AG	N/A	N/A	N, D, C, S	All	All	All	All	All	Yes	Free
Transportation Research Information Services (TRIS)	•	•	•	•	IS	All	N	All	All	All	All	All	All	Yes	Free
United States Road Assessment Program (usRAP)		•	•		S	All	R	N, C, E, P	All	HSIP	All	All	Program	Yes	Free
UPLAN	•	•	•	•	S	All	R	All	All	All	All	All	All	No	Unknown
User's Guide to Develop Highway Safety Manual (HSM) Safety Performance Function (SPF) Calibration Factors	•	•	•	•	AG	N/A	N/A	C, E, S	A, D, O	HSIP	All	All	Project	Yes	Free
Vision Zero Suite (VZS)		•	•		S	All	R	N, D, C, E, P	All	HSIP	All	All	All	No	Fee