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Guide to Updating State Crash Data Systems

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16. Abstract

The Guide to Updating State Crash Data Systems provides crash data collectors, managers, and users of State crash data systems with tools that help with processes, procedures, and noteworthy practices to update their crash data systems. The guide gives States the opportunity to perform exercises related to engaging stakeholders, examining gaps in the crash database, and creating action plans for deploying a new system. States can use the guide to complete their crash system update process.

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Acronyms

CARTS	Center for Analytics and Research in Transportation Safety
CDIP	Crash Data Improvement Program
CDUG	Crash Data Users Group
CODES	Crash Outcome Data Evaluation System
CRSS	Crash Report Sampling System
DPPA	Driver's Privacy Protection Act
DPS	Department of Public Safety
ED	emergency department
EDT	Electronic Data Transfer
EMS	emergency medical services
EWL	Early Warning Letter
FARS	Fatality Analysis Reporting System
GHSA	Governors Highway Safety Association
IRB	Institutional Review Board
IT	information technology
MMUCC	Model Minimum Uniform Crash Criteria
MOA	memorandum of agreement
MOU	memorandum of understanding
PCR	police crash report
SDLC	system development lifecycle
SHSO	State Highway Safety Office
TRCC	traffic records coordinating committee
VIN	vehicle identification number

1. Introduction

Crash data are the core data set for connecting all the traffic records systems. States use crash data to prioritize highway safety improvements, design and evaluate safety campaigns, educate the public, allocate enforcement resources, and target improved medical services.

A State's crash data system—referring to all forms and database contents—provides useful data to safety stakeholders at the State, Tribal, regional, local, and National levels. *The Model Minimum Uniform Crash Criteria* (MMUCC) *5th Edition* (GHSA & NHTSA, 2017) defines data elements and attributes that States can use as a model for the data collected. *The MMUCC 5th Edition* focuses on the State's ability to capture the data within the database. This edition makes no distinction between the collected-at-the-scene data and the linked or derived data.

In 2018, the National Highway Traffic Safety Administration completed a national MMUCC mapping to establish a baseline for measuring how well States align to the guideline. The results showed that States have an opportunity to increase their use of MMUCC data elements and attributes. Upon request, a State could obtain the results of the mapping. States could use the information to support crash report changes and promote the use of advanced technologies to complete the at-scene investigation, transmit the report, and conduct real-time quality assurance of the data.

NHTSA developed the Guide to Updating State Crash Data Systems for State crash data collectors, managers, and users to update the State crash data system. This updating guide contains noteworthy practices, resources, and tools States can use to update the crash report and database to increase their alignment to MMUCC.

Project Background

Starting in the late 1990s, NHTSA collaborated with the Governor's Highway Safety Association to publish the MMUCC voluntary guideline on crash reporting and database contents. The *MMUCC 5th Edition* (GHSA & NHTSA, 2017), jointly published by NHTSA and GHSA in 2017, is the latest update to that guideline. MMUCC provides a common set of data elements that could be used for State and National crash analyses. NHTSA encourages States to adopt the MMUCC data definitions to support data sharing. Because MMUCC is a voluntary guideline, States can create crash reports and databases that vary from the MMUCC-defined data elements and attributes. NHTSA and GHSA developed a mapping process that compares a State's crash report and database contents to the MMUCC data elements and attributes.

In July 2015, NHTSA and GHSA jointly published the *Mapping to MMUCC: A Process for Comparing Police Crash Reports and State Crash Databases to the MMUCC*. It details a set of mapping rules for comparing State crash data to MMUCC. NHTSA and GHSA updated the mapping process along with the *MMUCC 5th Edition* (GHSA & NHTSA, 2017) release. Unlike previous editions, the 5th edition does not prescribe which data elements are to appear on the crash report versus which ones are in the crash database. Now, the guideline applies to the crash data system. This change means that MMUCC mapping depends more strongly on the data elements available in a State, and not on whether the police crash report or database contains that information. This allows for much greater flexibility in database design and may encourage States to be more efficient in how they manage related safety data (e.g., collect once and use many times).

Against this background of continued refinement of MMUCC, States are developing newer, more capable data systems—both for crash data and for other components of their traffic records systems. Example efforts include collecting data electronically at the scene, providing real-time data linkage to other safety databases, and supporting more efficient and effective processes for integrating data across multiple sources. States now operate in a data-rich environment that is more complex than the older single database containing all crash-relevant information. This richer environment has implications for how States manage their traffic records systems (not just crash, but traffic records in general), and the inclusion of (sometimes multiple) software products in any update makes the crash update process more time-consuming and complex.

MMUCC offers a solution that States may willingly adopt because it includes detailed data definitions and suggested edit checks. This works well as an aid to crash data system design and management because a major part of system documentation is already done. Adopting MMUCC data definitions and edit checks can save States time and effort in a crash data system update effort. In particular, it helps States work efficiently with information technology staff and vendors by supporting standardization across multiple products.

With NHTSA's commitment to providing ways to assist States in improving their crash data system, they developed this updating guide to offer assistance to traffic records stakeholders who are involved in the development, use, and deployment of a State crash report and database. The publication's objective is to have State crash data stakeholders:

- Identify how national guidelines can help.
- Develop ways to improve and measure the increased quality of the crash data.
- Use noteworthy practices for data collection and integration from other States.
- Develop new technology aimed to improve the processes regarding crash data collection and analysis.

The updating guide presents items for consideration as a State updates its crash data system. The updating guide contains a set of tools and templates a State could adapt and use to support its system update processes.

Identifying the Need for Updating Crash Reports and Database Information

The State crash report and database are the backbone of the State crash data system. The State crash report is the primary entry point for the data collector—typically a law enforcement officer—to input the who, what, where, when, why, and how of the crash. The crash database contains the data elements and attributes stored for a user to conduct analysis on those fields.

In 2018, NHTSA performed a *MMUCC 5th Edition* GHSA & NHTSA, 2017 mapping of all 50 States, the District of Columbia, and Puerto Rico. One of the requirements for performing a mapping is to have the State crash documentation available for review. The NHTSA team reviewed the following documents on the next page.

- State crash report.
- State crash report manual (instructions for law enforcement on how to complete a crash form).
- State crash data dictionary (documentation of the State's centralized crash database).

Following the mapping, States had the opportunity to request the results. During the review, the team reminded the States that the *MMUCC 5th Edition* GHSA & NHTSA, 2017does not distinguish among elements collected, linked, or derived. The review team noted this as an opportunity for States to consider data linkages to populate the crash database; or, demonstrate analyses that jointly use crash and the other data sources without duplicating the data in both databases.

The MMUCC mapping gives States a way to identify data gaps. The results of the report-out could be used as discussion points for a State traffic records coordinating committee to update components of the State crash data system. Subject to the provisions of the grant program, States may use grant funds under § 405 (c) of Title 23, United States Code to support the implementation and development of effective State programs. Other funds may also be available to support State data programs. For example, these funds could be used to improve interfaces between agencies (e.g., linking occupants involved in a crash to an emergency medical services (EMS) patient care report).

Within this updating guide, traffic records stakeholders will find models for updating elements of the State crash data system, noteworthy practices, and helpful tools. This updating guide is designed for any State to create a system that addresses the needs of traffic records stakeholders.

NHTSA encourages States to consider the relationship between the State crash system and the NHTSA crash data programs like the Crash Report Sampling System and Fatality Analysis Reporting System. States can electronically transfer data from their crash records system to NHTSA's crash data programs using Electronic Data Transfer to support traffic safety research and analysis. States can find further information in Appendix A.

Methodology

This updating guide brings together the ideal crash data system described in NHTSA's *Traffic Records Program Assessment Advisory, 2018 Edition* (2018)—hereafter referred to as *The Traffic Records Advisory*—and feedback from TRCC roundtable discussions at the Association for Traffic Safety Information Professionals Traffic Records Forum. NHTSA also reviewed existing documentation from the 2018 national MMUCC mapping effort to determine common areas in the guideline where States have opportunities to align with MMUCC.

NHTSA reviewed existing State practices for data collection, linkage, and documentation for inclusion in the noteworthy practices section. The updating guide references *Model Performance Measures for State Traffic Records Systems* (2011), *Crash Data Improvement Program (CDIP) Guide* (Scopatz et al.,2017), and *MMUCC 5th Edition* GHSA & NHTSA, 2017 in developing edit checks and performance measures. NHTSA incorporated software development and deployment best practices throughout the updating guide.

Audience

The primary audience for the updating guide includes the following:

- State and local crash data collectors
- State and local crash data system managers
- State and local crash data users
- State traffic records coordinators
- State TRCC chairs
- TRCC members
- Traffic records and safety stakeholders
- Information technology staff
- Oversight groups—e.g., data governance councils

These groups provide the business case for the updates needed for the State crash system.

Crash data collectors can use this updating guide to:

- Identify how the agency can use crash data to deploy law enforcement personnel more efficiently. Realize new opportunities to expand their data through integration.
- Gain a better understanding of how law enforcement collects the crash data for the State traffic records system.
- Identify ways to streamline the data collection process.
- Recognize the necessity of edit checks and articulate how to better implement them for the data collector.

Crash data system managers can use this updating guide to:

- Articulate the need for updating components of the State crash data system.
- Address the business need for improving the State's alignment to MMUCC.
- Develop performance measures to evaluate system improvements.
- Identify new members for a State crash data user group.
- Engage existing TRCC members and other traffic records stakeholders.
- Incorporate new stakeholders into the update process.
- Develop or improve relationships with IT and vendors supporting the crash data system.

Crash data users, TRCC members, and other traffic records stakeholders can use this updating guide to:

- Improve the understanding of how the crash data system supports their safety initiatives.
- Discover innovative ways that the core traffic records systems can integrate with the crash data system.
- Identify how their agency can collaborate with others.
- Communicate the business case for data sharing.

Oversight groups can use this updating guide to:

- Develop a better understanding of how technology supports the crash data system.
- Improve data governance of the crash data system.
- Communicate business requirements in support of the update process.

Crash Data Stakeholder Roles and Responsibilities

NHTSA supplies resources to help crash data stakeholders determine their role in updating the State crash report and database. The *MMUCC 5th Edition* GHSA & NHTSA, 2017provides States with data elements, attributes, and edit checks that can be used as a model for crash data collection, analysis, and quality control. NHTSA has encouraged stakeholders to use this model to increase data sharing opportunities among crash data users. Stakeholders are able to support safety campaigns, engineering improvements, and State and Federal analyses in the interest of reducing motor vehicle crashes.

Crash data are essential to a data-driven approach for improving highway safety. As a condition of receiving Federal grant funds under the National Priority Safety Grant Program (23 U.S.C. § 405), States are required to have a TRCC that represents each of the six core traffic records systems including the crash data system. As described in the *State Traffic Records Coordinating Committee Noteworthy Practices Guide* (Scopatz et al., 2015), the TRCC establishes the strategic vision and mission for the State traffic records system. As part of the requirements in 2015's Fixing America's Surface Transportation Act, the TRCC is responsible for creating the State traffic records strategic plan (23 CFR 1300.22(b)(2)), which:

- Describes specific, quantifiable, and measurable improvements, that are anticipated in the State's core safety databases;
- Provides a list of all recommendations from the most recent traffic records assessment;
- Identifies which assessment recommendations the State intends to address, along with which Highway Safety Plan projects will address each recommendation, and the performance measure used to track progress; and
- Identifies which recommendations from the assessment the State will not address and provides reasoning.

Effective TRCCs may create a subcommittee to address specific needs in the State traffic records system. A subcommittee of crash data stakeholders, for example, can bring attention to the benefits of updating the crash data system and increasing the alignment with MMUCC.

Expectations for Implementation

The State crash report and database are the two core components in a State's crash data system. This updating guide provides an effective approach for implementing updates to the crash data system. As considerations for these systems are developed, a State could look beyond the data currently being collected and stored within the database. Updating the crash data system involves the State TRCC, crash data collectors, managers, users, and other stakeholders. Throughout the process, stakeholders must be engaged so that the needs of each group are considered. An effective update process will consider validation edits to reduce errors at the point of entry, methods to improve data sharing among agencies, and the business cases for analyses in support of data-driven decision making.

Roadmap to the Guide

The updating guide is organized around the sequence of major activities involved in completing an update to the State crash data system. The updating guide contains six chapters and appendices. Throughout the updating guide, easy-to-use tools supplement the primary content. The six chapters are:

1. Introduction: This includes the purpose and history of the updating guide, an overview of the updating guide, the methodology used for its development, audience, roles and responsibilities, and expectations to set when conducting an update.
2. Crash Data Stakeholders: This chapter informs States of effective strategies for identifying and engaging crash data collectors, managers, and users. The chapter discusses the roles and advantages of engaging stakeholders from the six core traffic records systems.
3. Increasing Alignment to the MMUCC: The chapter includes instructions for reviewing a MMUCC mapping report and prioritizing changes to improve the data and its quality.
4. Noteworthy Practices in Crash Data Collection, Linkage, and Documentation: This chapter provides States with descriptions of state-of-the-practice, effective technologies for obtaining and managing crash data. It includes the effective integration of crash data with other traffic records sources.
5. Building Edit Checks and Performance Measures: This chapter outlines a methodology for States to create edit checks and performance measures as part of the crash update.
6. Deploying a New Crash System: This chapter describes implementation and training for data collectors, managers, and users when deploying the updated crash data system.

2. Crash Data Stakeholders

This chapter focuses on effective strategies States can use for identifying and engaging data collectors, managers, and users. It presents the roles of crash system stakeholders and the advantages of drawing broad representation from the six core traffic records systems of crash, driver, vehicle, roadway, citation and adjudication, and injury surveillance.

Crash Data System Stakeholders

The Project Management Body of Knowledge Sixth Edition (Project Management Institute, 2017) defines a stakeholder as an individual, group, or organization that may affect, be affected by, or perceives itself to be affected by, a decision, activity or outcome of a project. For the crash system, a stakeholder is any person or group who collects, manages, benefits, or uses the data stored and maintained within this system. In this updating guide, crash data system stakeholders are grouped into three major categories: data collectors, data managers, and data users.

Crash Data Collectors

Crash data collectors provide the data stored within the State system. Law enforcement officers are the primary collectors of crash data. Other traffic records areas (e.g., driver, vehicle, roadway, citation and adjudication, and injury surveillance) may supply information for the State to link to the crash database (e.g., injury information and roadway descriptions).

Crash Data Managers

Crash data managers are responsible for gathering crash data into a central repository, controlling the quality of the data, and making it accessible to various stakeholders. The crash data manager may lead the staff responsible for crash report intake, imaging, data entry, data quality assurance, and post-acceptance processes like location coding and meeting reporting and data sharing requirements. Alternatively, a contractor or supporting staff from IT or another State agency may perform some or all of these activities.

Crash data managers control how the State system stores the data and moves information through a defined process flow. An agency may have this responsibility by State statute or through a memorandum of agreement between agencies. Crash data managers may also have the responsibility of creating performance measures and setting goals addressing the quality of the State data system. The data quality topic is presented in greater detail in Chapter 5.

Crash Data Users

Crash data users are stakeholders who perform analysis on the data for a business or research need. This includes resource allocation for law enforcement efforts, highway safety problem identification, infrastructure improvements, program evaluation, and safety campaigns. The crash data user category covers a large group of people at the State and local levels as well as the general public (e.g., State TRCC, State business analysts, researchers, public officials, and media). Policy makers, for example, direct their agencies in designing and implementing programs that turn legislated authority into regulations and actions. They often use data to address the legislature's questions and justify the need for policies and programs.

Bringing Crash Stakeholders to the Discussion

With the development of a new crash system, the State has an opportunity to improve how it addresses the needs of the data collectors, managers, and users. To begin the process, the State could appoint a crash system coordinator to manage the crash system update process (discussed in Chapter 6). The State may also assign this individual as the primary point of contact for items related to the update.

The list of individuals who were involved in the most recent traffic records assessment is another good source of potential participants. Using this information, a State can identify areas where a gap in the represented stakeholders exists. The crash system coordinator could work alongside the traffic records coordinator/chair to find the best people for the task.

Lastly, the State may use members of an established CDUG to encompass a body of stakeholders. The updating guide will discuss the CDUG in greater detail in the *Using or Creating the CDUG* section.

Figure 1 shows the six core traffic records systems and a sample of traffic records stakeholders with potential interest in a crash system update. Stakeholders in the center of the diagram are those with expertise in more than one traffic records system component. The crash system coordinator can document how each of the stakeholder types is involved with the crash data.

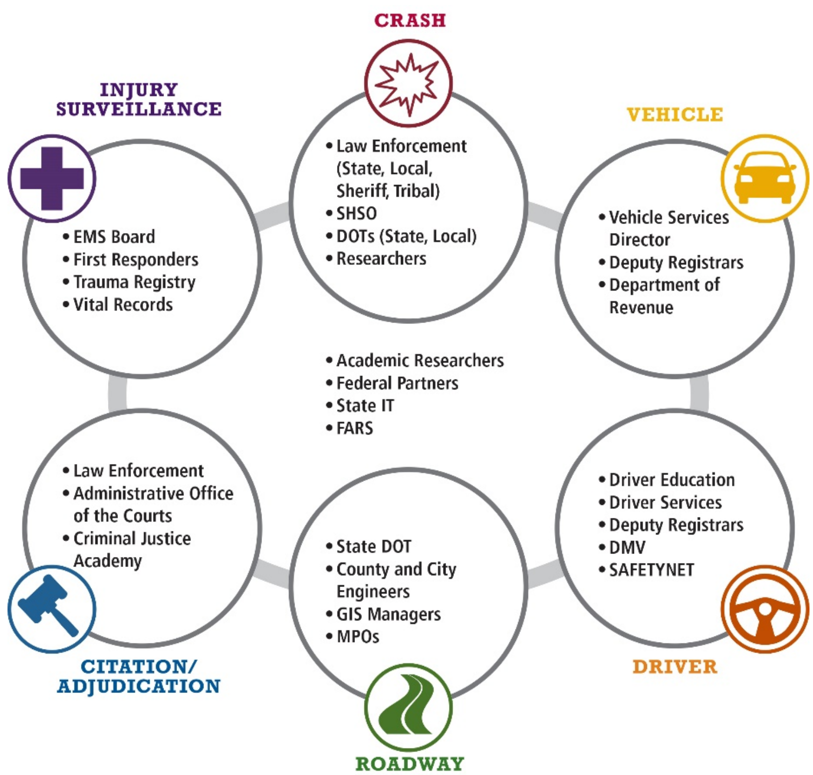

Figure 1. Sample Traffic Records Stakeholders

This document would include the following pieces of information:

- How the stakeholder interacts with the crash system.
- How the update may affect the business needs of the people and agencies identified.

This effort expands the list of collectors, managers, and users to include the full array of traffic records stakeholders. These stakeholders can be tasked, as a group, to advise on the crash system update. Using this expanded view of stakeholders, the following sections describe the types of people and roles that could be important in a crash system update.

Data Collectors

Data collectors are the stakeholders who obtain the data that makes up the crash database. The list of data collectors may include:

- Law enforcement officers. This group is often considered the primary data collectors for the crash system. They are responsible for the completion of the police crash report. Most of the information collected is by the officer from the crash scene. Some departments may employ clerks to complete crash reports, especially when the crash involved property damage only.
- Crash data entry units. This group is responsible for taking the paper PCR and keying the information into the electronic State crash database. Depending on the process, an agency may also have the data entry clerk provide fields that were not previously identified by the law enforcement officer (e.g., location of the crash).
- Roadway data collection units. This group collects information describing roadway locations. The data include details on the roadway characteristics, traffic volume, and data regarding the ownership and location of the roadway. States may integrate roadway data into the crash data system using a linkage based on the crash location information and the State's linear referencing system.
- Emergency medical technicians. This group collects data about the people injured in crashes. They collect the patient's injuries, transport location, and time of transport. The crash system may link to the patient information through a unique identifier stored in the crash database and through probabilistic linkages that allow analysts to match crash and medical cases even when personally identifiable information is not available for use.
- Driver and vehicle systems entry clerks. This group collects information about drivers and vehicles within those State systems. A State may use this data to populate or validate the driver and vehicle information in the crash database.

As the State updates the crash system, those operating in a data collection role may help identify which data fields can be collected at-scene by law enforcement and those the State can link from other data sources. Stakeholders who are knowledgeable in data collection can help the State review the needs and sources for information as well as identify any gaps.

Data collection is also the first critical point for data quality management.

In updating its crash system, a State may find opportunities to add or refine the validation rules governing important data elements. The improved validations will correct the data at the point of entry and reduce the time needed for quality reviews. The updating guide presents more detail on validations in Chapter 5.

Data Managers

Stakeholders who maintain the crash system and other traffic records systems keep the data quality at a level deemed satisfactory by the users. These stakeholders also monitor the performance of the system and enable users to obtain the necessary information. The list of these stakeholders and their roles include:

- Data managers. Within each of the traffic records systems, this group handles organizing, maintaining, and guiding their organizations' databases. They evaluate how well the system is performing by using data quality measures to assess and improve timeliness, accuracy, completeness, uniformity, integration, and accessibility.
- Law enforcement supervisors. This group conducts quality reviews for police crash reports. As law enforcement officers submit the police crash report, the supervisor uses their knowledge and experience to make sure the report meets the department's standards. If the report contains errors, the supervisor can send it back to the original officer to correct it.
- Data quality analysts. This group has a similar role to law enforcement supervisors. They review the crash report for inaccurate or incomplete information following the State guidelines. This process can occur both at the State and agency level.

Those who maintain the various traffic records systems may have suggestions on how to avoid common errors and ways to improve processes. A State may see new opportunities to create tools that can display how certain data elements are entered into the system (e.g., data visualizations). MMUCC provides data element definitions that a State can reference for its crash data system. Chapter 3 presents MMUCC in greater detail.

Data Users

Data users are the largest group of stakeholders. This group includes those who routinely link crash data to other sources of information. A crash system update can support the many uses and address the need to link crash and other data sources. Key participants and their roles as users include:

- State and local law enforcement agencies. These agencies are responsible for the investigation of crashes. This stakeholder group uses the data to allocate resources and conduct enforcement activities based on trends of crashes within their respective jurisdictions. Law enforcement may also link crashes and other reports to develop a more comprehensive picture of crime and traffic safety in their jurisdiction.
- State Department of Transportation. This agency is responsible for the design, planning, construction, maintenance, and operation of the roadway network. For the crash system, they can provide data related to the crash location and use the linked data to plan for engineering improvements. The DOT is responsible for safety engineering and is a primary user of crash and roadway data to measure safety performance, perform target setting, and conduct a safety management program.

- State Highway Safety Office. The SHSO works with the State DOT engineering office and other State and Federal partners to set safety performance targets for fatalities and injuries. The SHSO also strategically selects countermeasures that will help the State achieve the performance targets and administers behavioral grant programs associated with the identified countermeasures. The SHSO can use crash data to support grant initiatives related to the proposed countermeasures.
- Health Departments. These agencies maintain injury surveillance data (e.g., EMS, emergency department, trauma registry, hospital discharge, and death certificates). This includes records of those who were involved in a crash. A State can link crash data to the injury data stored within the agency's databases to develop an accurate picture of crash outcomes in terms of injury types, severity, prognosis, treatments, and costs.
- State Department of Driver and Motor Vehicles. This agency is responsible for maintaining the driver licensing and history file and the registration of vehicles. This agency can use crash and driver data to identify at-risk sub-groups and behaviors (patterns of convictions) most associated with increased crash risk.
- State Administrative Office of the Courts. This agency maintains the State case management system for the courts. This agency may have a record of pre-adjudication citations and arrests that can help complete the picture of risky behaviors and at-risk populations that is developed using the driver history file.
- Policy Makers. This group directs agencies in implementing programs. Crash data is used to support the policies this stakeholder group may develop.
- Researchers. This group of users analyzes safety and shares the results with stakeholders through reports and publications.

During the update process, the stakeholders in this section can describe the operational benefits of using the data to support more evidence-based approaches to highway safety. As the State considers updates to the crash system, these stakeholders can offer ideas on how the system can support their specific uses and help to make sure that important linkage opportunities are supported and maintained.

The next section provides information on using the stakeholders mentioned above as a CDUG and tasking the group to review and recommend changes to the crash system.

Using or Creating the CDUG

A CDUG is a multidisciplinary team formed to discuss problems and improvements to the State crash system. A State may task a CDUG with the following functions:

- Review the crash system quality control reports.
- Participate in crash strategic planning projects.
- Offer suggestions to identify new crash edits/validation rules.
- Develop and support data integration projects.

If a State already has a CDUG, it may consider that group as a good starting point for discussions about the crash system update. If a CDUG does not already exist, the State may wish to create one and task it with, among its other roles, hosting the crash system update discussions. The reason for including the CDUG in this chapter is to point to a longer-term role for a group dedicated to ongoing discussions of the crash system and its improvement.

The State could choose to create a temporary group tasked only with planning and overseeing the crash system update; however, a CDUG can serve as a more sustained voice for system improvement. If the State decides to use an existing CDUG or create one for this purpose, the stakeholders described earlier in this chapter are good candidates for participation.

The CDUG can evaluate the data elements stored within the system and prioritize the data collection and linkage efforts.

Potential Barriers

Commonly cited barriers that constrain or prevent stakeholder participation, engagement, or action and corresponding messaging to address each barrier include the following:

- Misunderstanding the use of the crash data. This tends to be a barrier to obtaining a consensus on the data elements to be collected. Having a broad range of disciplines in the CDUG creates the opportunity for members to discuss with their peers how they use the data. This group may also keep in mind the data elements required to link crash data with other components of the State traffic records system.
- Agency priorities. An agency participating in the CDUG may have priorities that require resources that could address the items listed by the group. Obtaining better data to support the improvements in the safety of roadway users may offer a common approach to how each of the agencies views the data stored within the State system. By participating, the group can evaluate how an agency's mission and vision align and provide the services necessary to support the system.
- Lack of endorsement from an oversight group and executives. An oversight group and executives may not provide the CDUG with enough influence to guide the development of the State crash system. Working with the State TRCC offers an opportunity for the CDUG to be an active participant in the State traffic records strategic planning process. This type of participation builds influence and allows executives to understand more easily how the agency uses crash data so that further opportunities to contribute, support, and cooperate among departments can be identified.

Recommended Objectives for the CDUG

A CDUG could be a vital component in the development of the State crash data system. As this group serves as a set of stakeholders, the State can adopt procedures that keep the group engaged throughout the update of the system. The following list highlights practices to maintain a useful CDUG:

- Obtain an endorsement from a standing committee. Having this endorsement lends credibility to the group. Ideally, the State TRCC will support this group as there may be overlapping membership between them. Another avenue is support from the State and local law enforcement associations. This type of support creates a direct relationship between those collecting the roadside information with those who are establishing the data needs for the State.

- Create a vision and mission for the group. This approach sets a target of how the group will make considerations for the State crash system going forward. The vision will outline how the group would see the ideal outcome of crash data users and the associated data. The mission statement would identify how the group will work towards the vision.
- Establish a primary point of contact. The CDUG should have a person that is considered the central point of contact. The crash data system manager or the crash system update coordinator may occupy that role. This person will be someone stakeholders will contact for information about the crash system or to provide new information to the group.
- Incorporate the CDUG into the TRCC. The CDUG has multiple users that can give input into how the State stores and maintains the crash data. It is ideal for the TRCC coordinator to engage with this group. This group could function as a working group of the TRCC, where they would have the ability to recommend changes to the crash system.
- Recommend crash system updates. The review of the crash data system may provide the crash system coordinator enough information to identify the ways that the State can improve its crash data system. They would have the ability to recommend changes to the crash system. A broad representation of users allows for a comprehensive view of the system and has users driving the capabilities of the system. This approach also allows members that serve on both the CDUG and the TRCC to be able to provide the status of the crash system.

A Tool for Engaging Crash Data Stakeholders

The crash system is the central hub of safety data and analysis in the traffic records system. The crash system coordinator should be prepared to work with stakeholders from all areas of traffic records. Data collectors, managers, and users can provide feedback and support for improving the crash data system. If engagement with these three core groups is high, the resulting system will achieve a higher level of user confidence and satisfaction with the final product.

MMUCC divides the crash system into eight data element groups (crash, vehicle, person, roadway, fatal, large vehicle/hazardous materials, non-motorist, and dynamic). As a part of engaging stakeholders, the coordinator can verify that the State has engaged the appropriate people with knowledge of the crash system element groups. This section presents a tool States can use to review the list of involved stakeholders. It can help the crash system coordinator identify any gaps in participation. The tool has columns grouped by the eight sections of data types in MMUCC. Within each group are columns labeled C, M, U. These stand for:

- C: Collector: A stakeholder who collects data related to one of the data element groups.
- M: Manager: A stakeholder responsible for maintaining the quality and readiness-for-use of the data element group.
- U: User: A stakeholder who uses the data within the element group for a defined and supported business need.

The tool allows the crash system coordinator to enter the names and agency affiliation of the people filling each of the roles. The spreadsheet page shown in Table 1 records each person's expertise in each area of the MMUCC data groupings.

This level of detail is useful because it allows for a State to see if there is an area of the crash system that lacks input from an expert. If one of the knowledge areas is underrepresented, there is an opportunity to reach out to the TRCC to coordinate with someone with an understanding of that topic. Once the crash system coordinator completes this document, they can engage the list of representatives in the update process.

Summary

Engaging stakeholders when updating a State crash system will create a system that serves the needs of the State traffic records data collectors, managers, and users. The resulting system will serve the needs of the groups involved with a comprehensive crash database. The Crash Data Element Stakeholder Gap Analysis tool can help the State engage a broad range of stakeholders as the update process moves from initiation into the deployment phase.

Table 1. Crash Data Element Stakeholder Gap Analysis Tool

Stakeholder, Agency	Crash			Vehicle			Person			Roadway			Fatal Section			Large Vehicle/ Hazardous			Non-Motorist			Dynamic		
	C	**M**	**U**	**C**	**M**	**U**	**C**	**M**	**U**	**C**	**M**	**U**	**C**	**M**	**U**	**C**	**M**	**U**	**C**	**M**	**U**	**C**	**M**	**U**
CIO, State IT																								
CMV Section, Highway Patrol																								
County Engineer			X						X	X	X			X										
Crash Data Supervisor, State Public Safety		X				X		X				X					X			X			X	
Deputy Director, Injury Prevention									X												X			
Director, SHSO			X			X									X			X						
Director, State Public Safety																								
Director, University Research Center			X			X			X			X			X			X			X			X
Emergency Medical Technicians, EMS Agency																			X					
Epidemiologist, State Health Department							X		X												X			
Executive Director, State EMS									X															
FARS Analyst, Traffic Safety	X		X						X				X		X				X		X	X		
FHWA, Division Representative[1]			X				X																	
Field Officer, Local Police Agency	X			X									X			X			X			X		
Field Officer, State Highway Patrol	X			X			X						X			X			X			X		
Financial Responsibility Manager, State DMV						X	X		X									X						
GIS Analyst, State DOT			X								X													
Major, State Police																								
Region Representative, NHTSA[1]			X			X			X						X						X			
Research Analyst, State DOT			X						X															
Research Analyst, State Health Department			X					X						X	X					X	X			
Research Analyst, Traffic Safety																								
State Safety Engineer, State DOT											X													
Titling and Registration Clerk, State DMV				X																		X		
TRCC Coordinator			X			X			X			X			X			X			X			X
TOTAL	3	1	10	3	0	6	4	2	10	1	3	3	3	2	6	2	1	4	4	2	7	4	1	2

Note: Federal Partners may not be able to participate if the group's purpose is to provide official direction to the State.

3. Increasing Alignment to the Model Minimum Uniform Crash Criteria

This chapter focuses on effective strategies States can use to increase alignment of their crash database—and the associated crash report—to MMUCC. This chapter explains the mapping to MMUCC process, how States can use and interpret a MMUCC mapping report, and a process for prioritizing changes that would yield improvements to data collection and data quality. The chapter also includes an MMUCC Gap Analysis Tracking Sheet that States can use to identify and prioritize potential changes to data elements and attributes.

Benefits of Using MMUCC

The GHSA and NHTSA developed MMUCC to help increase data uniformity. MMUCC is a voluntary guideline. It provides a minimum set of data elements and attributes States can adopt in their crash reports and databases.

The primary benefit of using the MMUCC Guideline is increasing the uniformity of crash data that is essential to improving highway safety.

Other benefits for States using MMUCC as a guide for defining crash data elements and attributes include:

<u>Data Collectors</u>

- Increased accuracy and efficiency of the data collection process by identifying which data fields can be collected at-scene by law enforcement and those the State can link from other data sources.
- Streamlined collection of elements that apply to only some crashes (e.g., non-motorists).
- Improved relational functionality between crash data elements and other sections of the crash report (e.g., body type element and large vehicle/hazardous materials section).
- Predefined, ready-to-use definitions and descriptions for training and instruction manual content.

<u>Data Managers</u>

- Improved quality of crash data that are essential to improving highway safety.
- Improved creation of uniform datasets that can provide the opportunity for data integration.
- Increased ability to share and compare data with other States and Federal partners.
- Specified reasoning behind the elements and attributes collected.
- Established format and context for a State crash database data dictionary.
- Defined edit checks and validations are provided rather than creating them from scratch.
- Improved efficiency in data transfer using the MMUCC Extensible Markup Language (XML).

Data Users

- Tested common data and definitions across jurisdictions, States, and at the Federal level.
- Vetted data elements and associated attributes.
- Increased opportunities for data linkages.
- Used high-quality data to direct funding, evaluate projects and programs, identify trends, and prioritize countermeasures.

Mapping to the MMUCC Guideline

Requesting an MMUCC Mapping

NHTSA encourages States to include a review of MMUCC as part of their crash update process. This can be accomplished by completing a MMUCC mapping. The MMUCC mapping methodology, developed by NHTSA and GHSA and published in the MMUCC Guidelines, describes how to measure the alignment of all elements and attributes contained in a State crash database to the MMUCC elements and their attributes.

States can request NHTSA technical assistance to conduct an MMUCC mapping at no cost to the State. The MMUCC mapping serves as an external, objective review of a State's crash data elements and attributes by an MMUCC Analyst. Figure 2 displays the sequence of events a State can expect if they request an MMUCC mapping.

Typically, a State crash database contains data from the following sources:

- Data collected at-scene on the State police crash report.
- Data derived from the State police crash report.
- Data obtained through linkage (e.g., a roadway database).

The State requesting a MMUCC mapping provides NHTSA with documentation of all the data elements, attributes, and definitions used in the State crash database. The items used to complete a mapping are listed in order of importance:

- State crash database dictionary.
- Police Instruction Manual providing definitions and attributes for elements on the crash report.
- Police crash report identifying all data elements and any attributes defined on the form.
- Any associated crash report overlay(s) listing attributes for elements on the form.
- Any other documents the State identifies as relevant to the MMUCC Analyst's understanding of how the State collects, manages, and links the crash data.

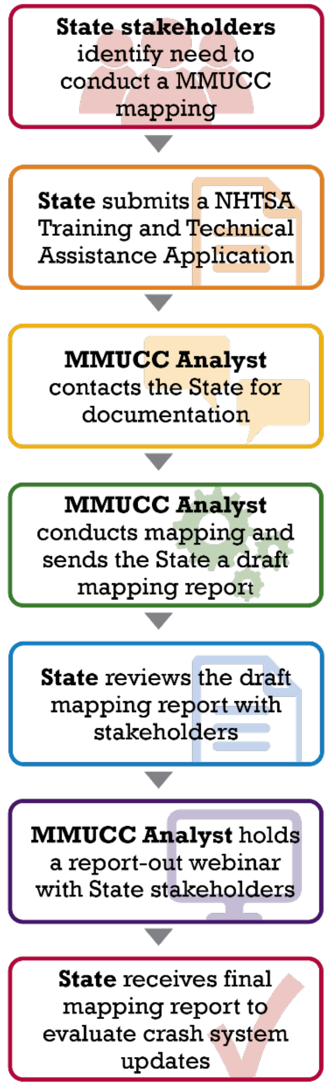

Figure 2. MMUCC Mapping Process Flow

Mapping Process

Using the State crash documentation, the MMUCC Analyst builds a complete model of the State's crash data structure in NHTSA's mapping module. Figure 3 shows a State structure example from the mapping module. Next, the Analyst conducts a thorough evaluation using the mapping rules, specific notes, and mapping considerations described in the MMUCC Guideline. Mapping is evaluated at the attribute level using State crash documentation to determine whether each MMUCC attribute has a corresponding State attribute. Terminology is less important than meaning, manner of collection, and the number of occurrences. The mapping module calculates the mapping percentages for each element by dividing the number of positive mappings by the total number possible.

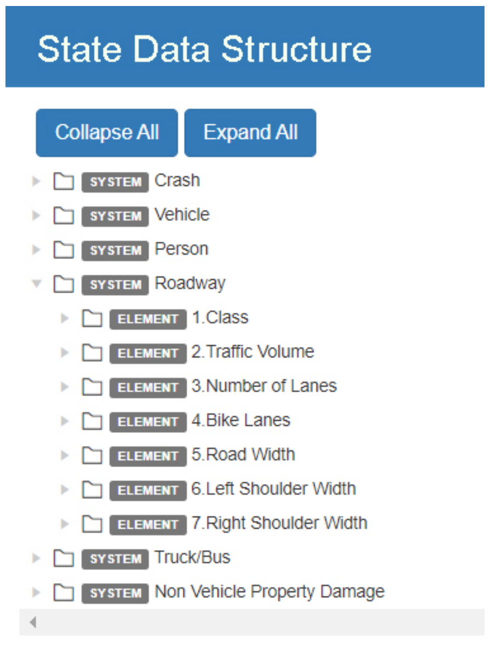

Figure 3. Example of State Data Structure

For States that have developed a State crash database dictionary that includes detailed information on the elements and attributes included in the State crash database, no further documentation is needed. Figure 4 is an excerpt from New Mexico's crash database dictionary that includes the information required for a MMUCC mapping: a database name, the data source, the data type, definitions for the element and attributes, and a list of attributes for each element.

NHTSA shares the completed draft mapping report with the State and allows for the option of a report-out webinar. The webinar provides the States and MMUCC Analyst an opportunity to understand the mapping report, ask questions, and identify errors. Following the webinar, the

Analyst incorporates any noted changes, provides answers to questions, and finalizes the report before sharing it with the State.

This field indicates the most severe injury to the occupant, as observed by the officer at the crash scene. If the occupant dies within 30 days due to injuries sustained from the crash, the injury is considered fatal. When injury code is left blank, it is changed to code "O" during cleaning. The narratives of these crashes show they are mostly minor fender-benders or hit-and-run crashes.

- ✓ Code K is also known as a Class K injury, fatal injury and fatality.
- ✓ Code A is also known as a Class A injury, suspected serious injury and incapacitating injury.
- ✓ Code B is also known as a Class B injury, suspected minor injury and visible injury.
- ✓ Code C is also known as a Class C injury, possible injury, complaint of injury, and non-visible injury.
- ✓ Code O is also known as a Class O injury, and represents no injury.

In 2014, the FHWA revised the MMUCC definition for suspected serious injuries (Class A injuries). It is now defined as any injury other than fatal that results in one or more of the following:

- Severe laceration resulting in exposure of underlying tissues/muscle/organs or resulting in significant loss of blood
- Broken or distorted extremity (arm or leg)
- Crush injuries
- Suspected skull, chest, or abdominal injury other than bruises or minor lacerations
- Significant burns (second and third degree burns over 10% or more of the body)
- Unconsciousness when taken from the crash scene
- Paralysis

Variable Options
K = Killed (K)
A = Suspected serious injury (A)
B = Suspected minor injury (B)
C = Complaint of injury (C)
O = No apparent injury (O)

Figure 4. Example Data Dictionary

Using the MMUCC Mapping Report to Improve the State Crash System

The MMUCC mapping report provides each State with an objective measurement of how the State's crash database maps to MMUCC. States can use these reports to identify and prioritize changes to their State crash system, crash reports, and documentation.

MMUCC Mapping Report

The final MMUCC mapping report contains two distinct scorings:

- Scores for each MMUCC system group (e.g., crash, vehicle, person).
- Scores for each data element.

These scores report the percentage of mapping to MMUCC at the system level and element level, respectively. The State could conduct a thorough review of their attributes, subfields, elements, and systems, pinpointing which mapped fully, partially, and not at all by using the mapping scores and mapping details presented in the MMUCC mapping report.

System Mapping Table

Table 2 displays a screenshot from the MMUCC mapping module. This example shows the average mapping scores for each MMUCC system group in a State, which the online mapping module calculates using Equation 1.

Table 2. Total Percent Mappable for All Elements

Data Structure Name	System	Percent (%)
20XX State Crash Database Data Dictionary	Crash	91.72%
20XX State Crash Database Data Dictionary	Vehicle	68.88 %
20XX State Crash Database Data Dictionary	Person	64.47 %
20XX State Crash Database Data Dictionary	Roadway	26.12 %
20XX State Crash Database Data Dictionary	Fatal Section	45.03 %
20XX State Crash Database Data Dictionary	Large Vehicles & Hazardous Materials Section	25.46 %
20XX State Crash Database Data Dictionary	Non-Motorist Section	44.2 %
20XX State Crash Database Data Dictionary	Dynamic Data Elements	5.08 %

$$MMUCC\ System\ \ Mapping\ Score = \frac{\sum MMUCC\ Element\ Mapping\ Score\ in\ the\ System}{Number\ of\ Elements\ in\ the\ System}$$

Equation 1. Calculation of MMUCC System Mapping Score

The scores represent a percentage of alignment to MMUCC. For example, the MMUCC crash system has 27 elements. The online mapping module calculates the crash system percentage by summing the State's mapping scores for all 27 elements and then dividing the total score by the number of system elements (i.e., 27) in MMUCC.

Mapping Table

Table 3 displays the detailed mapping results for a portion of a MMUCC element and its attributes.

The first column lists the MMUCC elements and attributes as they appear in the MMUCC guidance. These are compared to the documentation provided by the State.

The second column presents the mapping score for each MMUCC element calculated at the attribute level within the element. The online mapping module calculates an element mapping score using Equation 2.

Table 3. Detailed Mapping Table

Guideline Elements & Attributes	Mapping Score (%)	State Elements/ Attributes That Map	Mapping Comments
[E] C11. Weather Conditions	**90.91**		
[A] 98.Other			No Mapping Comment: The State does not contain this information.
[A] 99.Unknown			No Mapping Comment: The State does not contain this information.
[S] 1.1Selection 1			
[A] 01.Blowing Sand, Soil, Dirt			No Mapping Comment: The State does not contain this information.
[A] 02.Blowing Snow		[S] Crash –> [E] 53.Weather Conditions => [S] 1.1st Weather Condition => [A] 09.Blowing Snow	
[A] 03.Clear		[S] Crash –> [E] 53.Weather Conditions => [S] 1.1st Weather Condition => [A] 00.Clear	
[A] 04.Cloud		[S] Crash –> [E] 53.Weather Conditions => [S] 1.1st Weather Condition => [A] 06.Cloudy	

$$MMUCC\ Element\ Mapping\ Score = \frac{\begin{array}{c}Number\ of\ Attributes\ for\ State\ Element\\ that\ Map\ to\ MMUCC\ Element\end{array}}{Total\ Number\ of\ MMUCC\ Elements\ and\ Attributes}$$

Equation 2. Calculation for Overall Mapping Score Using the Mapping Score (%)

Conducting a Gap Analysis of the State Crash Database to the MMUCC Guideline

The MMUCC mapping report can serve as a tool to help a State complete a detailed analysis and evaluation of the gaps in their data. Figure 5 displays five steps to conduct a gap analysis using the MMUCC mapping results. A State may consider elements and attributes other than those included in the MMUCC Guideline. The State can use the structure report to identify those elements and attributes in a separate analysis.

Step 1. Understand the State's Mapping Between the Crash Database and MMUCC

The MMUCC mapping scores represent the State's calculated alignment to MMUCC. The State can use mapping scores to understand how closely aligned the crash database is to MMUCC at the system and element levels. The State could also use details provided in the "State Elements/Attributes That Map" and "Mapping Comments" columns of the MMUCC report to fully understand the mapping between the State crash database and MMUCC at the attribute and subfield levels. States can review the mapping between their crash database and MMUCC at all levels to complete the gap analysis process. Table 4 provides advantages for understanding the mapping process at each level.

Figure 5. Gap Analysis Process

Table 4. Advantages of Understanding the Mapping at Each Level

Level	Advantages
Attribute	It is the basis of the mapping process. Any change that happens at the attribute level would cause consequent changes in other levels. Understanding why some State attributes cannot be mapped to MMUCC is essential in identifying and closing gaps.
Subfield	Understanding why and which subfields mapped partially or not at all is important for identifying and closing gaps.
Element	Understanding why and which element mapped partially or not at all is important for prioritizing improvements.
System	It provides a quick overview of the State crash database in terms of how it maps to each MMUCC system. The State may be able to identify system improvements by incorporating them with other ongoing or emerging efforts.

Step 2. Identify Data Gaps

The MMUCC mapping report documents the difference between MMUCC and the State crash database at the element and attribute level. In general, there are two types of gaps—a partially mapped element and a non-mapped element. The following six basic scenarios will help States understand how each type of gap has occurred.

Partially Mapped

First, examine the partially mapped elements in the mapping report that are identified by a mapping score higher than 0 percent but less than 100 percent. There are three scenarios when a State has partially mapped elements.

<u>Scenario One – Missing Attribute</u>: A State has an element that is completely missing one or more attributes, an entire subfield, or a cluster.

- For example, MMUCC includes two subfields "Within Interchange Area?" and "Specific Location" for the data element Relation to Junction. If a State element collects all MMUCC attributes for the subfield "Within Interchange Area?" but not for the subfield "Specific Location," the State is considered missing an entire subfield.
- For example, a State may have an attribute "Pedestrian" for their element Person Type but defines it differently from MMUCC. In this case, the State is missing the MMUCC attribute "Pedestrian." An attribute is missing if the State crash database does not contain an attribute that can unambiguously map to the respective MMUCC attribute.

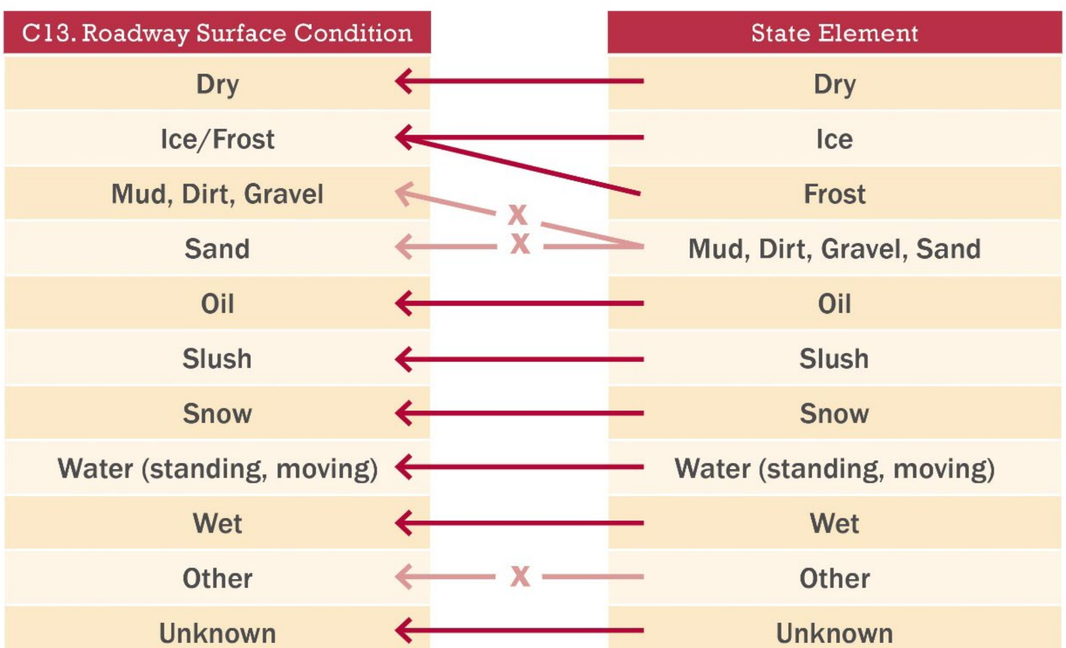

Figure 6. Illustration of Scenario Two

- <u>Scenario Two – Combining Attributes</u>:
  A State collects all MMUCC attributes for an element but combines two or more MMUCC attributes into one attribute. Figure 6 shows an example of a State that has an

element that does not fully align with the MMUCC data element Roadway Surface Condition because it combines two MMUCC attributes (e.g., “Mud, Dirt, Gravel” and “Sand”) into one attribute (e.g., “Mud, Dirt, Gravel, Sand”). This causes “Other” not to map. Conversely, a combination of separate State attributes can map to one MMUCC attribute.

- Scenario Three – Missing Selections:
  A State allows fewer selections on the police crash report and the crash database than MMUCC. For example, MMUCC allows two types of weather conditions for a crash on the police crash report form and the crash database. A State only allows one entry even though their attributes match the MMUCC attributes.

Many States have a combination of these three basic scenarios. States can use the mapping report to determine where they are missing MMUCC attributes, combining MMUCC attributes, or missing selections.

Not Mapped

The next step is to look at MMUCC elements not mapped from the State crash database (i.e., the mapping score is zero percent). Information presented in the “Mapping Comments” column can help the State understand the three basic scenarios for why this type of gap has occurred.

- Scenario Four – Missing Data Element:
  A State entirely misses a MMUCC element. In this scenario, the State does not collect values for the MMUCC element at the scene and cannot derive attributes from any other information in the State crash database or through linkage to other data resources.
- Scenario Five – Data Collected for Different Systems: A State collects a MMUCC element for a different system. In this scenario, the State collects the MMUCC element but not for the same crash variables as MMUCC. For example, MMUCC suggests collecting element Traffic Control Device Type for each involved vehicle. A State collects traffic control device type only at the crash level, not for each vehicle.
- Scenario Six – Combine MMUCC Elements: A State combines two or more MMUCC elements into one State element, and the State allows a limited number of selections for entry in the crash database. For example, the State combines MMUCC elements Distracted by and Condition at Time of the Crash into one State element Contributing Factors – Person and only allows one entry for the element. In this scenario, the State’s element does not agree with MMUCC.

MMUCC Gap Analysis Tracking Sheet

As a State reviews the MMUCC mapping report, they can record the gaps and corresponding scenario(s) for each MMUCC element using the MMUCC Gap Analysis Tracking Sheet. Table 5 shows an example of how a State can use the tracking sheet to record the following information for each MMUCC element:

- Level(s) of Gap: Use this column to record the level(s) of the identified gap at the element, subfield, cluster, or attribute level. For example, as shown in Table 5, a State receives a score of 40 percent for mapping to MMUCC element Relation to Junction. Upon reviewing the MMUCC mapping report, a State may find they have not mapped to the MMUCC element's subfield "Within Interchange Area?" and miss an attribute within the subfield "Specific Location". In this case, a State will have both "Attribute" and "Subfield" for the "Level(s) of Gap" column. Additionally, the State can record the corresponding level(s) of gap and scenario for each subfield.
- Improvement(s): Use this column to record the needed improvement(s) to close the identified gaps, as discussed in step 4.
- Implication(s): Use this column to record the implication(s) (e.g., need to develop and schedule additional training for law enforcement, costs to reprogram database, and need to integrate data from other sources) for making the listed improvement(s).
- Priority: Use this column to record the assigned priority for each gap as discussed in step 5.
- Action: Use this column to record how and when they will implement the improvement(s) based on the priority (e.g., implement now versus incorporate when next updating the police crash report).
- Complete (Y/N): Use this column to record whether the gap has been addressed.

Table 5. Sample MMUCC Gap Analysis Tracking Sheet

Guideline Elements & Attributes	Mapping (%)	Level(s) of Gap	Gap	Scenario(s)	Improvement(s)	Implication(s)	Priority	Action	Complete (Y/N)
[E] C13.Roadway Surface Condition	0	Element	Element Not Mapped	4 (Missing Element)					
[E] C14.Contributing Circumstances – Roadway Environment	40	Subfield Attribute	Partially Mapped Element	1 (Missing Attribute) 3 (Missing Selection)					
[S] 1.1.Selection 1		Attribute		1 (Missing Attribute)					
[S] 1.2.Selection 2		Subfield		3 (Missing Selection)					
[E] C15.Relation to Junction	40	Subfield Attribute	Partially Mapped Element	1 (Missing Attributes)					
[S] 1.Within Interchange Area?		Subfield		1 (Missing Attributes)					
[S] 2.Specific Location		Attribute		1 (Missing Attribute)					

Step 3. Define the State Targets to Align With MMUCC

The State may define MMUCC alignment targets that are specific, measurable, and timely. A target could be for a specific crash database system or for the overall crash database. The State defines its targets accounting for the State's needs, staff abilities, system capabilities, and available resources.

Sample Target Statements:

- We will increase the overall mapping score of the State crash database to MMUCC from 60 percent to 80 percent by 2023.
- We will reduce the number of elements that are not mapped to MMUCC from 10 to 0 by 2021.
- We will increase the mapping score for crash-level elements and attributes to MMUCC from 80 percent to 85 percent by 2025.

Step 4. Devise Improvements to Address the Gaps

This updating guide introduces six basic data gap scenarios regarding a State's agreement with the MMUCC Guideline. States can use the suggested improvements provided for each scenario below if they intend to close any data gaps. States can record improvements that would help close the gaps in the MMUCC Gap Analysis Tracking Sheet. Figure 7 provides general improvements for each scenario.

SCENARIO	IMPROVEMENT
1. Missing Attributes	Add missing attribute(s)
2. Combining Attributes	Break down into individual MMUCC attributes
3. Missing Selections	Add more selections
4. Missing Data Elements	Add the missing element
5. Data Collected for Different Systems	Change the definition to be aligned with MMUCC
6. Combine MMUCC Elements	Break down the element into individual MMUCC elements

Figure 7. Possible Gap Scenarios and Associated Improvements

When a State has a partially mapped element, the State may be able to increase the alignment to MMUCC without using a lot of resources. To address the gaps, a State may employ the following improvements.

If a State's element is identified with Scenario One – Missing Attribute, this provides an opportunity to add additional data element subfields or clusters to the police crash report and the crash database to increase data uniformity and completeness.

If a State's element identifies with Scenario Two – Combining Attributes, the State could divide their attribute into two separate MMUCC attributes. As shown in Figure 6, breaking down the State attribute into "Mud, Dirt, Gravel" and "Sand" would increase the alignment to MMUCC for this specific element to 100 percent. When a State's element falls under Scenario Three – Missing Selections, the State can consider adding the missing selections to the police crash report and the crash database. If a combination of scenarios causes the gap, the State can use multiple improvements to close it.

Missing MMUCC elements may require a larger effort to address the gaps. If a State is missing an element, the gap falls under Scenario Four – Missing Data Elements. The State may consider adding the MMUCC element to the police crash report or looking for sources from which to derive the MMUCC element (e.g., a roadway database, an EMS database).

If the State element falls under Scenario Five –Data Collected for Different Systems, the State could consider refining their element to be consistent with MMUCC. For example, MMUCC suggests a State collect distraction information for all drivers and non-motorists. If the State currently only collects distraction for drivers, the State could also consider collecting this information for non-motorists. For elements that fall under Scenario 6 – Combine MMUCC Elements, the State could consider separating their element into individual MMUCC elements.

In addition to the six scenarios for the gaps mentioned above, the State can also perform a traditional comparison of the labeling of elements and attributes by comparing the information captured in the "Guideline Elements & Attributes" column and the "State Elements/Attributes That Map" column featured in the mapping report. A State may discover that their data definition agrees with the MMUCC element or attribute definition even though their term for it is different. It is not a gap unless the definitions do not map to MMUCC. The terminology review would provide an opportunity to change the State labels to the uniform labels. Table 6 shows more detail on how a State could use the scenarios to devise improvements to address any gaps found in the MMUCC mapping.

Table 6. Sample MMUCC Analysis With Improvements

Guideline Elements & Attributes	Mapping (%)	Level(s) of Gap	Gap	Scenario(s)	Improvement(s)	Implication(s)	Priority	Action	Complete (Y/N)
[E] C13.Roadway Surface Condition	0	Element	Element Not Mapped	4 (Missing Element)	Create additional element on crash form	Selections may not be accurate to at scene selection Additional training for data collectors			
[E] C14.Contributing Circumstances – Roadway Environment	40	Subfield Attribute	Partially Mapped Element	1 (Missing Attribute) 3 (Missing Selection)	Complete dataset with additional attributes/ subfields				
[S] 1.1.Selection 1		Attribute		1 (Missing Attribute)	Create additional attributes (16,17,20,98)	The correct option may not be used at scene			
[S] 1.2.Selection 2		Subfield		3 (Missing Selection)	Create additional selections for subfield (02)	Only one subfield may be used			
[E] C15.Relation to Junction	40	Subfield Attribute	Partially Mapped Element	1 (Missing Attributes)	Create additional subfield				
[S] 1.Within Interchange Area?		Subfield		1 (Missing Attributes)	Create additional attributes (06,08)				
[S] 2.Specific Location		Attribute		1 (Missing Attribute)					

Step 5. Prioritize Improvements

A State may need to prioritize the intended improvements to close the crash data gaps in a logical sequence that takes the available resources into account. This step describes how the stakeholder groups identified in Chapter 2 of the updating guide can help prioritize changes for closing the gaps. Figure 8 shows a four-box analysis for prioritization adapted from the *State Traffic Records Coordinating Committee Strategic Planning Guide* (Peach et al., 2019). Stakeholders could use this modified four-box analysis in focusing the prioritization discussion on 1) the ease or difficulty of addressing the gap, and 2) the anticipated benefit of closing the gap with respect to supporting highway safety analysis that will help the State reduce the frequency and severity of crashes.

As shown in Figure 8, the top-left quadrant represents gaps that are considered at low difficulty to address and high benefit. These are crash system improvements that are easy to implement and will result in knowledge that is useful to reduce crashes.

The bottom-right quadrant represents gaps that are regarded as highly difficult to address and produce a low benefit. These are improvements that have significant barriers and would not produce much new or useful knowledge for safety decision makers. States may consider addressing gaps in the top-left quadrant first and gaps contained in the bottom-right quadrant last. Strategic discussion will be needed to set priorities for items in the other two quadrants. Some will have a high difficulty and high benefit. The State may wish to include the high priority changes in its traffic records strategic plan.

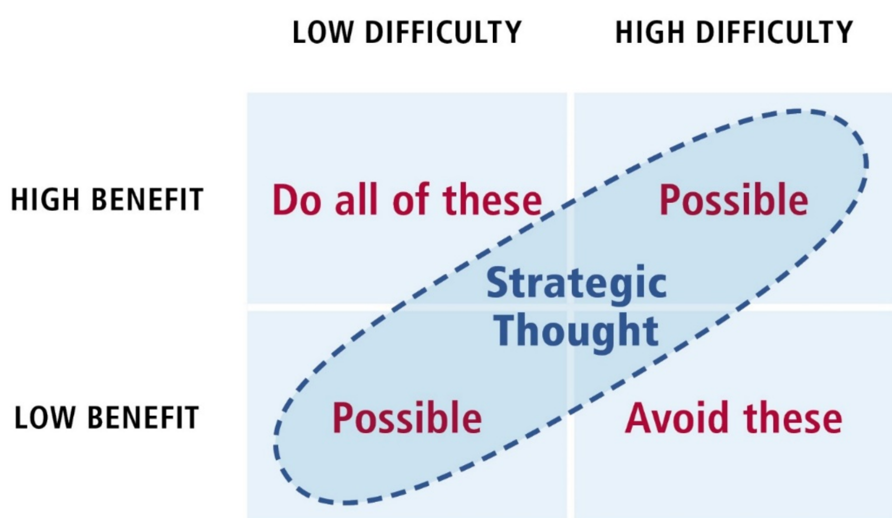

Figure 8. Four-Box Analysis

An example includes the collection of information related to the use of automated vehicle capabilities and their active status at the time of the crash. Stakeholders will need to understand what law enforcement can collect and the training that will be needed to obtain usable data. There may also be pushback from the data collectors noting that there may not be a reliable way to obtain that information, even if the vehicle identification number (VIN) can be decoded. However, having the information may create new behavioral countermeasures associated with vehicles that have automated features.

The State can use the four-box analysis as part of a prioritization exercise and record the results in the "Priority" column of the MMUCC Gap Analysis Tracking Sheet to help them determine how and when they will take action to implement the chosen changes as shown in Table 7. The State could differentiate priority levels as high (H), medium (M), and low (L). For example, if the priority is high, the State may consider acting as soon as possible. In this case, they can put "Make the change" in the "Action" column. If the priority is low, the State may want to wait until the next large effort for updating the crash database and incorporate the changes with other updates. If so, the State can enter "Incorporate the changes in the next round of crash database updates" in the "Action" column.

Table 7. Sample MMUCC Gap Analysis Tracking Sheet With Priority

guideline Elements & Attributes	Mapping (%)	Level(s) of gap	gap	Scenario(s)	Improve-ment(s)	Implica-tion(s)	Priority	Action	Complete (Y/N)
[E] C13.Roadway Surface Condition	0	Element	Element Not Mapped	4 (Missing Element)	Create additional element on crash form	Selections may not be accurate to at scene selection Additional training for data collectors	L	Make change at next database change	N
[E] C14.Contributing Circumstances – Roadway Environment	40	Subfield Attribute	Partially Mapped Element	1 (Missing Attribute) 3 (Missing Selection)	Complete dataset with additional attributes/ subfields				
[S] 1.1.Selection 1		Attribute		1 (Missing Attribute)	Create additional attributes (16,17,20,98)	The correct option may not be used at scene	H	Make change in this calendar year	N
[S] 1.2.Selection 2		Subfield		3 (Missing Selection)	Create additional selections for subfield (02)	Only one subfield may be used	H	Make change in this calendar year	N
[E] C15.Relation to Junction	40	Subfield Attribute	Partially Mapped Element	1 (Missing Attributes)	Create additional subfield				
[S] 1.Within Interchange Area?		Subfield		1 (Missing Attributes)	Create additional attributes (06,08)		M	Make change before next large agency update	N
[S] 2.Specific Location		Attribute		1 (Missing Attribute)			M		N

Summary

MMUCC is a voluntary guideline that provides States with standardized definitions for crash data elements and attributes as recommended by traffic safety subject matter experts to conduct crash data collection and analysis. The benefit of using MMUCC is increasing the quality of crash data that is essential to improving highway safety. The MMUCC mapping process provides States with a measure of their crash database's alignment to MMUCC, which States can use to conduct a gap analysis and identify areas where they do not align. The State can then identify and prioritize those areas it would like to address. For the most up-to-date version of MMUCC or to obtain the MMUCC mapping application, visit www.nhtsa.gov/mmucc.

4. Noteworthy Practices in Crash Data Collection, Linkage, and Documentation

This chapter focuses on noteworthy practices for crash data collection, linkage, and documentation. It also provides descriptions of effective technologies for obtaining and managing crash data.

Crash Data Collection Process

Chapter 2 of the updating guide details stakeholder analysis and identifies who should be involved. The analysis of mapping to MMUCC in Chapter 3 helps a State decide what will be collected and stored in the crash database. This chapter looks at effective technologies for collecting and linking data related to a crash event – how the State will obtain crash data.

As technology advances, there are opportunities to ease the data collection burden on law enforcement officers and improve the quality of crash data.

Most data collected to describe a crash event starts with a law enforcement officer dispatched to the scene of a crash. Data may be collected in the field using either a manual (paper) or electronic process. The officer reports on the environment, roadway, driver, vehicle, and people involved to collect a set of data elements that capture their determination of what happened in the crash. Technology can assist in many of the steps in the data collection process. States electronically collecting data have shown increases in timeliness and accuracy by using technology to make it easier to complete, validate, and submit reports. Technology is not an answer by itself, however; it must be effectively deployed using sound management and leadership that can motivate people and institutions to work together.

Noteworthy Practices Used for Crash Data Collection

Human Factors Design

Human factors analysis looks at how humans interact with their environment and, in this case, technology. This can take the form of observation and individual or group interviews. Human factors analysis at the beginning of the crash system update process can help design a user-friendly interface from the officer's perspective. Incorporating human factors into the design of a crash data collection form or software application has the potential for greater user acceptance and ease of use. The human factors analysis helps the developer organize the elements law enforcement officers collect in a logical order for the user completing the form. Users also have input into the form or application's look and feel during the development process with this approach. Such an approach may add time and expense at the beginning of a project, but it potentially leads to cost savings overall as the upfront feedback and input avoids the need for subsequent changes.

States that include law enforcement in designing data collection efforts will obtain critical input into what is liked and disliked by the primary users as well as which variables are misunderstood or difficult to capture. Human factors analysts can use this knowledge to develop a data collection format and workflow that reduces errors and increases uniformity. An example is Minnesota's MNCrash system. This solution was built entirely from the officers' perspective using human factors analysis. As a result of design improvements, the time to complete a crash report decreased from approximately 45 minutes to 10–5 minutes even though the amount of data collected nearly doubled. The MNCrash system and new crash report form had extremely high user acceptance.

Electronic Crash Report Submission

Electronic reporting eliminates paper reports. Paper crash reports are costly as money is spent on printing and mailing forms. Getting the data from the forms to the database requires a data entry process, one that may be repeated multiple times. The time lag between the day of the crash occurrence and the data being available for analysis may be large enough that the data's usefulness is limited. Manual data entry can introduce errors that may be difficult or costly to fix because of how much time has passed since the crash event.

Electronic crash report submission has many advantages. Data linkage can auto-fill fields and reduce the data input burden. Fields that do not apply to a specific crash can use skip logic to reduce the data input burden on officers. Edit checks can be built in that stop inaccurate or incomplete data from being submitted. Crashes can be located using smart mapping to improve location timeliness and accuracy.

Electronic data is easier to update versus paper forms. There are no out-of-date forms to contend with and any changes to the crash report can be imposed on the new electronic form's go-live date. The time lag attributed to data entry of paper forms can be eliminated as well.

After a 2015 change, Connecticut went from 30 percent to 100 percent electronic reporting. Prior to 2015, Connecticut was 16 months behind in processing paper crash reports. Today, the State is essentially day-current thanks to electronic reporting

At-Scene Data Collection

There are several opportunities to use technology to assist the officer with data collection. Moving to electronic crash reporting can reduce the burden on law enforcement officers. A State may consider designing the electronic crash reporting applications to skip over unnecessary fields based on crash type and guide an officer through the completion of the report.

The reporting officer's information, such as name, rank, and agency, can be auto-filled when logging into the form. Data linkages can help by auto-filling fields such as driver and vehicle information by pulling the data from State datasets. Officers could use a scanning device for the driver license and vehicle registration records to eliminate that step of data entry and improve accuracy. Information such as the driver's name, date of birth, and license status could be auto-filled in the crash report through scanning the license and validated through real-time linkage to the driver license file. The same process could be used for vehicle information such as make, model, and owner. Table 8 shows examples of driver and vehicle variables that could be auto-filled through linkage.

Crash location data collection is another area that a State could enhance with technology and data linkages. Electronic crash reporting can include a digital map that the officer clicks on to identify the crash location. This is often referred to as smart mapping. When linked to roadway data and the State's linear referencing system, a smart map tool can auto-fill crash report data elements such as City, County, Street Name, Functional Class, and Latitude/Longitude Coordinates or location codes. Table 8 shows some of the vehicle, driver, and roadway variables that States should be working to auto-fill through linkage. The system can be designed to auto-fill as much location information as the State has available.

Table 8. Possible Variables to Auto-fill Through Linkages to Other Systems

Traffic Records System	MMUCC Variables for Auto-fill
Vehicle	VIN, License Plate Number, Registration State and Year, Make, Model, Owner Information
Driver	Driver License Number, Name, Date of Birth, Sex, License Jurisdiction, Restrictions, Endorsements, Status
Roadway	City, County, Street Name, Functional Class, and Latitude/Longitude Coordinates or Linear Referencing System Location

Crash Data Linkage

NHTSA defines key concepts of data linkage to establish common terminology. *The NHTSA Advisory* (NHTSA, 2018) describes the terms data linkage, data interface, and data integration as follows:

- Data linkages: The connections established by matching at least one data element from a record in one file with the corresponding element or elements in one or more records in another file or files. Linkages may be further described as interface linkages or integration linkages depending on the nature and desired outcome of the connection.
- Data interface: A seamless, on-demand connectivity and a high degree of interoperability between systems that support critical business processes and enhances data quality. An interface refers to the 'real-time' transfer of data between data systems (i.e., auto-populating a crash report using a bar code reader for a driver's license).
- Data integration: The discrete linking of databases for analytic purposes.

Additional Considerations

- Availability: The system must be available to the officer when needed. Providing access to the application with and without internet connectivity is desired. This can be accomplished by having a web version to enter crashes when there is internet connectivity. When an internet connection is not available, the officer could use a standalone version of the software which can submit the data once a connection is established.
- Portability: Officers are increasingly conducting business in a mobile environment. States can accommodate the advances in field data collection technology by providing the application on multiple platforms such as laptops, tablets, and other mobile devices.
- System Response Time: Incorporating data linkage to auto-fill crash report fields requires a process that is fast enough to allow the officer to fill out the report form while

avoiding unacceptable delays in obtaining the linked information. Developers work with managers of the linked systems to attain acceptable performance.

The technology used during crash reporting to auto-fill fields is an example of an interface. The data is pulled from one system to populate another on-demand. Roadway data and crash data may be linked both as an interface to capture location data at the scene or as an integration when combining all the roadway data with crash data into a merged dataset that supports safety management analyses. Crash data combined with injury surveillance data to form a new dataset is another example of integration.

Data elements common to both systems are used to make linkages. The crash dataset may contain key elements in common with the other traffic records systems. Where no overlap between data systems exists, a crash system update project can address those gaps by adding linking data elements.

Figure 9 shows an example of the flow of linking crash data to other data systems. Steps 1 and 2 depict the crash event and law enforcement arriving on scene. Steps 3 and 4 depict the use of real-time data interfaces to fill in the crash report form. Steps 5-7 illustrate integrating the crash data with other datasets to create a new, more robust dataset for analysis.

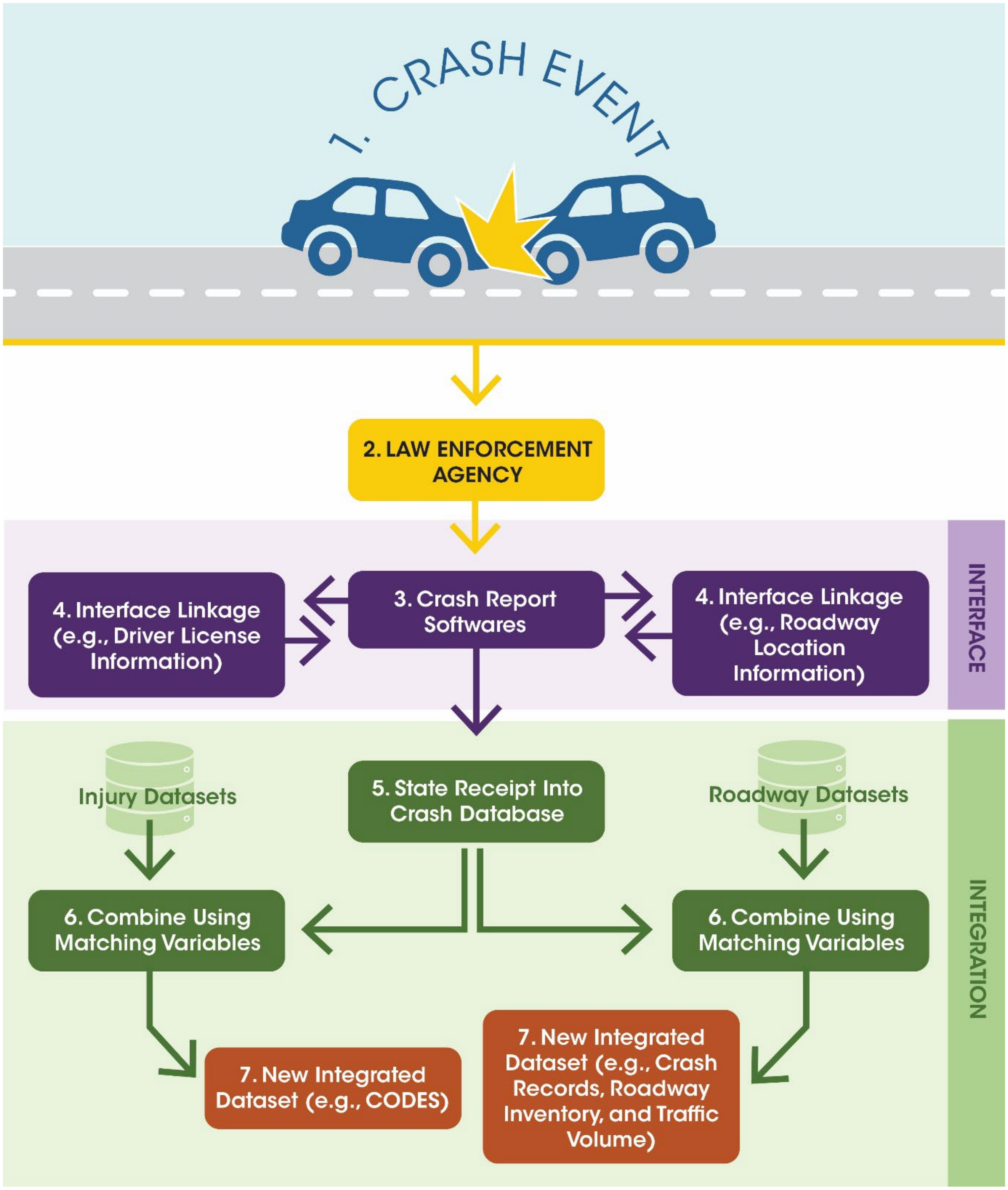

Figure 9. Example Crash Data Linkage Flow Chart for Electronic Report Submission

Data Quality Considerations Necessary to Link the Data

Good data quality, especially sufficient levels of accuracy and completeness, is essential for successful linkage. The quality of the combined data is limited by the quality of the individual datasets. Records missing in either dataset will be missing in the final combination of two datasets.

Crash Data Enhancement Through Linkage

Integrating crash data with other datasets enables a more complete understanding of circumstances and outcomes. The more datasets integrated into one system, the more complete the picture. Driver history prior to the crash, crash data, roadway inventory, injury outcomes, and citation and adjudication consequences combined into one dataset could lead to more robust analyses and more effective countermeasures to reduce fatalities and injuries. Figure 10 illustrates the possible traffic records linkages.

Data Sharing Agreements

Data used for integration come from different sources and have different data owners, so data sharing agreements are often necessary. The stakeholder partnerships like those described in Chapter 2 can assist in this process. The TRCC can also help establish the relationships necessary to facilitate data sharing. Cooperation between State agencies is the critical component to making all the data linkages work. Data sharing agreements may take the form of a memorandum of understanding, memorandum of agreement, or an Institutional Review Board approval. IRB approval may be needed if the data sharing is part of a project involving sensitive data and university-based research support. Written agreements maintain the data linkages through changes in personnel and spell out the purpose, roles and responsibilities, requirements, and timeframe the agreement is valid. Figure 11 on the next page lists common components in these agreements.

Figure 10. Crash Data Linkage Opportunities with Other Traffic Records Data Systems

Data Sharing Agreements typically include the following components:

Purpose
Describes the collaboration that two or more agencies will maintain

Sample Text: The purpose of this MOA is to establish a citation data exchange between the State Department of Public Safety (DPS) and State Courts Administration for sharing initial charges and final dispositions of all traffic cases managed in the State, County, and Appellate courts.

Roles and Responsibilities
Details the tasks each agency is responsible to perform

Sample Text: State DPS will be responsible for providing the XML schema for the State traffic records data repository—wherever possible, the NIEM will be used as the schema. State Courts Administration will adhere to the State DPS schema as published.

Reporting Requirements
Describes the data that needs to be reported, responsible party(ies), and the reporting interval

Sample Text: The State Courts Administration will provide an electronic record for every traffic citation and every charge entered into the State Court Administration's Case Management System on a nightly basis. A summary report of total citations and charges will be sent separately for use as a completeness check.

Timeframe
Defines the period in time that the document will be valid

Sample Text: This MOA shall be effective on the date of the last signature of the parties to the agreement. This will be in effect for the 3 years from the date of execution.

Figure 11. Common Components in Data Sharing Agreements

Additional Considerations

- TRCC: The TRCC can play an active role in encouraging and enacting integration agreements.
- Executive-level support: Support from all levels of management and communication with stakeholders will play an essential role in reaching agreement.
- Data privacy: Some data falls under Federal legislation such as the Driver's Privacy Protection Act or the Health Insurance Portability and Accountability Act so additional security measures may be needed.
- Data ownership: Some agencies that host the data are not the data owners and cannot approve data sharing.
- Centralized IT: States may have a statewide IT office that will coordinate some aspects of data integration.
- Research agreements: Establishing an overarching protocol with the IRB facilitates using the data for multiple analyses. This typically includes what data will be used, how it will be used, and data security. The IRB is a step in some research projects involving University-based researchers and collecting, storing, using, or publishing sensitive data. IRBs may impose safeguards beyond those required under State or Federal privacy laws. They may also impose specific protocols for data protection as a precondition for use of University resources.

Noteworthy Practices in Crash Data Linkage

Crash Data Linkage and Integration from Other Sources

Injury Surveillance Data Linkage

States are linking crash, EMS, ED, and hospital discharge data to determine crash outcome and economic cost data for crash types as well as the impact of educational programs addressing risky behaviors. Some noteworthy programs include:

- Utah's Crash Data Initiative links data to understand injury severity, seat belt use, and distraction.
- Maryland's Crash Outcome Data Evaluation System project links hospital, driver license, citation, and vehicle registration data to target education and outreach in areas with high impaired-driving rates.
- The Centers for Disease Control and Prevention's Linking Information for Nonfatal Crash Surveillance allows States to combine crash data with injury data.
- The U.S. DOT's Safety Data Initiative can be a resource for States pursuing data integration, analysis, and visualization.

Data Visualization Linkages

States are developing new ways to display their data to enhance stakeholder engagement. Using crash, driver, and other data, Louisiana State University's Center for Analytics & Research in Transportation Safety created a website with dashboards like that shown in Figure 12 addressing the performance measures outlined in its Strategic Highway Safety Plan. The website presents dynamic displays of data about traffic safety problems such as driver distraction and contributing factors for pedestrian-involved crashes. The information is used for problem identification, resource allocation, and countermeasure selection.

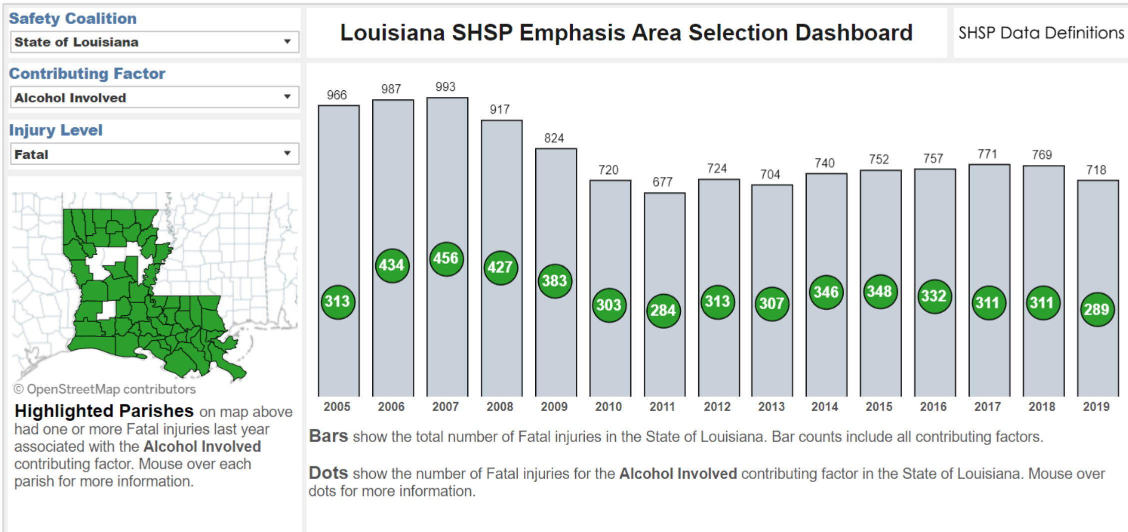

Figure 12. CARTS Example

Nevada produces a quarterly Traffic Research and Education newsletter with safety infographics that the State disseminates to the public via a website and social media platform. The newsletter provides summaries of linked data from crash, EMS, and trauma centers that focus on injuries, outcomes, and the economic consequences of crashes for a variety of road user types.

The Michigan Traffic Crash Facts website provides users with annual official Michigan crash data. The site has data visualization tools, customizable widgets, fatal crash analytics, and reports tailored to its multiple safety program areas.

Citation and Crash Data Linkages

States are also linking crash and citation data to generate driver alerts. In North Dakota the parents of teen drivers receive “early warning letters” when their novice drivers commit traffic violations or are involved in crashes within nine months after receiving driver licenses. The EWL details how their teen is at greater risk of being involved in a fatal crash because the incident occurred early in the driving career. The initiative, which is the result of linking crash, citation, and adjudication data, aims to reduce teen driver violations and fatal crashes.

Ohio and Virginia link crash and citation information to manage behavioral programs, support law enforcement planning and resource allocation, and identify roadway infrastructure improvement locations. Virginia uses its Traffic Records Electronic Data System to perform linkages giving the State the ability to analyze high-crash locations and unsafe behaviors at a level of detail not possible using separate data systems. Ohio’s DPS Driver’s Records Retrieval System links driver and citation data to reduce errors and produce more complete records.

Minnesota has linked crash data with impaired driving arrest data and combined them with roadway data and liquor sales establishment locations to combat impaired driving. Law enforcement officers compare the locations of alcohol-related crashes and driving while intoxicated arrests to plan resource allocation. Policymakers can view the data surrounding liquor establishments and compare policies in jurisdictions.

Michigan has linked crash data with the Department of Health and Human Services' Medicaid/Medicare health care client base. The State uses probabilistic methods to assist in processing their claims and the cost of EMS, trauma, and hospital care as a result of motor vehicle crashes.

Data Collection and Linkage Tracking

A State could use several different data quality measurements to track data linkage (e.g., the number of systems linked, the number of records linked, or the percentage of records linked). NHTSA's *Model Performance Measures for State Traffic Records Systems* (2011) contains an example of this type of linkage tracking showing how the percentage of appropriate records in the crash database are linked to another system or file. Specifically, the example (in Table 9) demonstrates how crashes with in-State drivers are linked to the driver or crash file with EMS response linked to the EMS file. The first line shows data taken from the crash file where an officer indicates a person was treated by EMS and is matched with the EMS file. The second line looks at individuals in the EMS file with a motor vehicle injury who are then linked to the crash file. This number is often higher because injuries that are not apparent at the crash scene may be treated later.

Table 9. Tracking Percentage of Linked Records

System	Total Records	Number of Records Expected to Link	Number of Records Linked	Percent Linked
Crash	90,687	9,069*	7,896	87%
EMS	530,733	26,536**	17,637	66%

** Number of people in crashes that the crash report indicates were treated by EMS.*
*** Number of people in the EMS system with a motor vehicle crash injury.*

Continuing the example, Table 10 represents the number of other systems that link with the crash system.

Table 10. Tracking Data Systems Linked With Crash

System	MOU Status	Start Date	End Date	Linkage Status
Driver License	Current	01/01/2017	12/31/2021	Active, interfaces with crash report
Vehicle Registration	Current	01/01/2017	12/31/2021	Active, interfaces with crash report
Roadway	Current	01/01/2017	12/31/2027	Active, interfaces with crash report (location)
Citation/Adjudication	In Process			Desire crash-related citations to be linked with the crash report data

System	MOU Status	Start Date	End Date	Linkage Status
Injury Surveillance (EMS)	Lapsed	01/01/2017	12/31/2019	Waiting for new MOU to link EMS times to crash report
Injury Surveillance (Hospital Discharge)	Stalled			Desire injury severity for people involved in crashes

Crash Data System Documentation

A crash data system provides details about the who, what, when, where, how, and why of all crashes accepted into the crash database. The data collected and stored needs to be managed and documented effectively to meet the needs of stakeholders with varying interests in safety data. The crash data dictionary defines each data element and documents important details of how the data is collected and managed. A comprehensive crash data dictionary can help States:

- Improve accessibility and understanding of safety data by a broad group of stakeholders.
- Provide a reference to coordinate improvements to traffic records systems.
- Avoid gaps of institutional knowledge that can occur through staff turnover.
- Identify and bridge safety data gaps that can be caused by solitary collection, maintenance, and use of data.
- Aid users in the identification of safety concerns and evaluation of countermeasures.
- Increase data reliability across multiple years to support data-driven, performance-based planning.
- Implement and track data quality performance measures and metrics.

Developing a Crash Data Dictionary

The NHTSA Advisory (2018) describes an ideal crash data system and provides a description of essential components for each data element within a data dictionary. This section highlights those descriptions and provides additional components and considerations States can use when developing a comprehensive crash data dictionary to increase its usefulness and functionality for crash system stakeholders.

Ideally, the State maintains a crash data dictionary documenting the following:

- All data elements, definitions, and attributes in the crash data collection form/software;
- All data elements, definitions, and attributes in the crash database, to include linked and derived variables; and
- All system edit-checks and validation rules (e.g., rules that are applied to prevent improper or inconsistent data from being entered).

-Scopatz et al., 2018

Data dictionaries should be kept up-to-date and consistent with other materials while providing access to the dictionary and related materials for data collectors, managers, and users. The data dictionary explains each data element by outlining what is included and not included, rules of use, and any exceptions to the rules.

The MMUCC provides standardized definitions for crash data elements and attributes. States may choose to adopt the MMUCC data elements and attributes and use the guideline as a source for their crash data dictionary.

Additional Considerations

States can use the information in this section to construct a comprehensive document that can be distributed to and understood by a broad audience. For the crash data dictionary to be comprehensive and serve a wide range of uses and audiences, information beyond what is documented for each data element is necessary.

States can consider including this supplementary information as front matter or appendices in their crash data dictionary:

- Clear and concise table of contents
- Publication date and version controls
- Contact information for data managers
- Information about the crash data system and its role in the States traffic records system
- Description of how the data is used for State and local planning and programs
- Data process flow charts
- Links to databases that are integrated with the crash data system
- Change log to track updates to data elements
- Relevant data governance processes

Noteworthy Practices in Creating a Crash Data Dictionary

Relevant and Uniform Documentation

The data in the crash data system is used by agencies, business units, and throughout all levels of government. Developing a standard workflow and timeline for updating the crash data dictionary and corresponding documents is good practice.

Having a police crash report, crash report user manual, and data dictionary with varying publication dates can make data inconsistencies more likely.

Data Relationships

Data analysts and researchers need to understand the meaning of the data elements and how they were collected. States may include a numerically coded police crash report as an appendix in the dictionary so fields can easily be identified. States can add descriptions to provide context to how a data element was populated, when applicable. For example, the New Mexico DOT produces crash, vehicle, and occupant-level user guides that serve as data dictionaries. The data dictionaries provide information on the source for each data element and describe how data elements can be used in analyses. As a specific example of this, the user guides document how coded values for Vehicle Body Style are used to derive the Vehicle Type values.

Derived and Linked Elements

Data collected and stored in the crash data system or other traffic records systems can be used to populate additional elements in the crash data system. States can use their crash data dictionary to describe how derived and linked elements are used. For example, Wisconsin's crash database data dictionary contains codes that identify if a data element is obtained from the police crash report, derived from other data, or linked from another dataset. Example linkages include driver license and roadway data elements.

Attribute Descriptions and Scenarios

Police instruction manuals or help functions in an electronic crash system can include information about each of the data element attributes to help officers record accurate data consistent with the established data definitions. Some States include graphics, diagrams, and examples of the correct use of data elements and attributes. States can use the crash data dictionary as system documentation for data users.

The Wyoming Electronic Crash Reporting System Data Dictionary includes graphics, illustrations, clarifying statements, scenarios, and attribute definitions throughout the document to help data users.

Crash Data System Element Components

This section describes crash data system element components States could include in their crash data dictionary and provides examples that apply the guidance from *The NHTSA Advisory* (2018) and other noteworthy practices. States may choose to include additional or fewer crash data element components than described in this document. The examples included are not exhaustive but document information that is valuable to data collectors, managers, and users.

The data dictionary entries for each element are presented at the data element level (similar to MMUCC). Each crash data element component described in this section provides information about a data element within the crash system database. Figure 13 displays the data element components and their purpose.

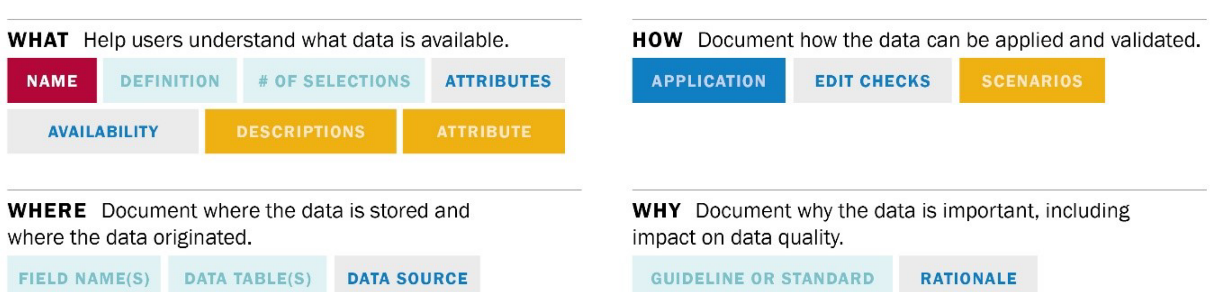

Figure 13. Data Element Components

Crash Data System Element Component Descriptions

Using the components shown in Figure 13, information about the data element could be successfully cataloged. Figure 14 on the next page shows an example based on a data element describing distractions.

Each section of the data dictionary contains the following information:

- <u>Name</u>: A State may use this entry to state the displayed data element name and any standardized coding.
- <u>Field Name(s)</u>: A State may use this entry to record the name of the element within the crash system database.
- <u>Definition</u>: A State may use this entry to include a brief description that defines the element. Descriptions should be clear and accurately describe the information that the data element contains.
- <u>Guideline or Standard</u>: A State may use this entry to indicate the corresponding MMUCC element name if the crash data element is aligned to a MMUCC element. If the element aligns with a different guideline or standard, that can be included in the crash data element entry too.

P.18. DISTRACTED BY

DATA TABLE(S) **tblPERSON** | **tblNONMTRS** | **tblUNIT**

FIELD NAME(S) **distractedByAct, distractedBySrc**

DEFINITION Distractions that may have influenced driver/non-motorist performance, involving both an action taken by the driver/non-motorist and the source of the distraction.

OF SELECTIONS **2**

APPLICATION **Applies to all drivers and non-motorists.**

GUIDELINE OR STANDARD The data element is aligned to the MMUCC 5th Edition Guideline.

ATTRIBUTES

Action
00 Not Distracted
01 Talking/Listening
02 Manually Operating (texting, dialing, playing game, etc.)
03 Other Action (looking away from task, etc.)
99 Unknown

Source
01 Hands-Free Mobile Phone
02 Hand-Held Mobile Phone
03 Other Electronic Device
04 Vehicle-Integrated Device
05 Passenger/Other Non-Motorist
06 External (to vehicle/non-motorist area)
07 Other Distraction (animal, food, grooming)
97 Not Applicable (Not Distracted)
99 Unknown

DATA SOURCE Collected from police crash report from field: Distracted By (#18)

RATIONALE Important to identify specific driver behavior during a crash and understand and mitigate the effects of distracting activities. The element is used in analysis for the Strategic Highway Safety Plan Non-Motorist and Motorist Behavior emphasis areas.

AVAILABILITY The attribute values are in use for reporting crashes collected as of the 2018 calendar year.

EDIT CHECKS **E(P)18.01** If “P18. Distracted By” Subfield 1, Action = 02 (Manually Operating (texting, dialing, playing game, etc.)), then Subfield 2, Source should not = 05 (Passenger/Other Non- Motorist), 06 (External (to vehicle/non-motorist area)) or 07 (Other Distraction (animal, food, grooming)). **E(P)18.02** If “P18. Distracted By” Subfield 1, Action = 00 (Not Distracted), then Subfield 2, Source must = 97 (Not Applicable (Not Distracted))

Figure 14. Example Crash Data Dictionary Page

- Application: A State may use this entry to indicate the relevant crash record or file. Some data elements collect the same information, but for different person or vehicle types. For example, the MMUCC element "P18. Distracted By" that is collected for both drivers and non-motorists. A crash data element for driver's license may have a separate data element for drivers and non-motorists, even though the attributes for the element are the same. In this case, the entry should note that the element is applied to drivers or non-motorists involved in the crash. Ideally, the business process for using this data element is included as well.
- Database Tables: A State may use this entry to indicate the table and other IT information needed to locate the element within the crash data system. Information can include the field name and may include references to multiple tables.
- Data Source: A State may use this entry to indicate where the data originated. The information contained in this entry will vary based on whether the data was collected, derived, or linked. For elements that are collected, a State may use this entry to provide the name of the field on the police crash report. Some States have included a quick and easy reference for each field by assigning a number or alphanumeric identifier for each field on the police crash report.
    - For elements that are derived from other data, a State may use this entry to include a brief description of how the data is derived, and from which elements it is derived.
    - For example, the severity of a crash can be derived from the highest level of injury from the injury severity element in the person record.
    - For elements that are linked from other data sources, a State may use this entry to indicate if the linkage is achieved through integration or an interface. Other information that could be included are:
        - Data owner (e.g., the State DOT).
        - Data element name from the linked database (may be different than the name in the crash data system).
        - Linkage methodology (e.g., how does linkage occur, what data elements are used to provide the linkage capabilities).
- Number of Selections: This entry can be used to indicate the number of times the crash data system element can be reported. For example, MMUCC allows one to four attributes to be selected to describe the sequence of events of each vehicle in a crash. This may be represented as additional fields within a table.
- Attributes: A State may use this entry to provide a list of acceptable values (attributes) for the crash data system element. It can be appropriate to include definitions or figures to help communicate the intention of each attribute. The attribute definitions and figures could be integrated into this entry or later. Another alternative would be to provide a link for each term to a definition and/or figure in the glossary of the crash data dictionary.
- Rationale: A State may use this entry to express why the element is essential to the crash data system. The information includes the business need and relevance to other crash data system elements or other traffic records systems. A State may also use this entry to note data quality performance measures the element is used to track.

- Availability: A State may use this entry to document the timeframe the element and its attributes are available for analysis. Data elements can be removed, added, or the definition can change over time. This information is vital to make a comparative analysis over multiple years to measure uniformity.
- Edit Checks: A State may use this entry to document edit checks used to validate data or provide a range of acceptable values. MMUCC introduces suggested edit checks with an alphanumeric coding system. The edit checks help keep the data internally consistent and usable for analysis. The edit checks in MMUCC are a starting point and can be adopted or modified to meet a State's needs.
- Scenarios: A State may use this entry to provide examples of how the element would be used in the field or analysis (e.g., examples of work zone crashes, limitations of the data for analysis).
- Attribute Descriptions: A State may use this entry as an opportunity to provide additional information to data users about each attribute. Examples include text definitions, figures (e.g., pictures, illustrations), or other information to increase understanding of the data.

NHTSA is in the process of developing the Crash Data Dictionary Noteworthy Practices Guide. This document will describe the state-of-the-practice for State crash data dictionaries.

Summary

There are many opportunities to assist officers' crash data collection efforts. Creating a crash reporting system using a human factors approach will improve usability and acceptance, and it offers opportunities to improve accuracy. Electronic crash reporting can take advantage of real-time data linkages to auto-fill data fields by scanning driver license and vehicle registration information. These linkages reduce officer workload and improve accuracy. Smart mapping technology that is tied to a State DOT's official base map can be used to link crash data with the roadway system. States can document the data that is collected, maintained, and used for analysis in a crash data dictionary. This effort can complement the creation of a traffic records inventory that documents the six core systems.

The stakeholder relationships cultivated from work described in Chapter 2 can assist in crafting and implementing data-sharing agreements. These may take the form of Memorandums of Understandings, Memorandums of Agreement, or IRB approval. The resulting integrated databases can be used for more robust analysis to identify countermeasures and reduce injuries and fatalities from motor vehicle crashes.

A well-crafted data dictionary serves multiple purposes and stakeholders. Crash data collectors can use it to accurately code a data element on the crash report form. Data managers can use it to document the authoritative sources, definitions, and descriptions for each element in the crash system. Data users need the dictionary to help them understand the contents and proper interpretation of the crash data in support of analyses and decision making.

5. Building Edit Checks and Performance Measures

This chapter focuses on the concepts and best practices for developing edit checks, validation rules, and performance measures as part of the crash system update. It describes the benefits of implementing automated data editing processes and performance measurement as part of crash data management.

Crash Data Edit Checks Overview

Edit checks are part of a formal, comprehensive crash data quality management program as defined in *The NHTSA Advisory* (2018). Edit checks are also a critical component of a modern crash records system. They work to identify errors, omissions, and logical inconsistencies in a crash report or database record. Ideally, a State would include edit check capabilities when planning, designing, and implementing a new or updated crash system. Edit checks establish a set of criteria for data acceptance by requiring values to be of the correct data type (e.g., numeric versus text), disallowing blank or missing values in key data fields, checking that entered values are within the defined range for each data element, and by maintaining logical consistency among values in related data elements.

Edit checks may be applied at the following three points:

- <u>Crash data collection</u>. This step is when the law enforcement officer is creating the report before submitting it to their supervisor or the statewide crash database.
- <u>Crash report data intake</u>. This step occurs as the crash report is processed for acceptance into the State crash reporting database.
- <u>Final production</u>. This step involves running the edit checks on the full dataset as a final check to identify any values that should not have been accepted. This can be important if the database includes a path for data acceptance that may bypass the first two data reviews (e.g., if prior year data is merged into the dataset without going through the report intake process).

States have options on how to treat an edit check that results in a failure. Two common options are to treat failed edit checks as a critical error or a warning.

Critical Errors

Critical errors are those that must be corrected before the crash report is accepted into the database. These typically result in stopping the report from being sent for supervisor review, rejecting the report back to the submitting law enforcement agency, or adding to a queue for data quality control technicians to correct. Common edit checks may include the following:

- <u>Prohibit null entries</u>. This edit check prohibits a crash data collector from leaving a specified field blank. A State may apply this check to the crash data collection at-scene or as the data is processed post submission.
- <u>Outside of the expected range or data type</u>. This edit check confirms that a value is within an expected range and that the entered value is the correct data type. An example would be only numeric values within a field or character limit for a field (e.g., 17 characters for a VIN for vehicles after 1981).

- Logic Checks. This edit check reviews for logical consistency within a data element. For example, if the value of "C11. Weather Conditions" is checked as 06 (Freezing Rain or Freezing Drizzle), 07 (Rain), 09 (Sleet or Hail), or 10 (Snow), then "C13. Roadway Surface Condition" cannot be 01 (Dry). Another example is if the officer indicates that a truck is involved in the crash, the choices of vehicle body type must make logical sense, constraining the list of acceptable body type attributes. These can become quite complex as the list of compatible attributes in one data element changes depending on the choices already recorded in other data elements.

Crash reports with critical errors are often sent to a staging table in the database where the information resides until corrections are made. The data from reports in the staging table are generally not available for analysis until corrected. Promptly addressing critical errors will help maintain crash data integrity.

Warnings

Warnings are possible errors where the coded value or blank may be allowed under specific circumstances but is unlikely. Warnings may result from the following:

- Outside of the expected range. This edit check asks an officer to confirm that a value outside an expected range is accurate. An example is if the driver's calculated or reported age is under the legal driving age at the time of the crash.
- Logic Checks. This edit check asks an officer to compare the values in two or more data elements because of an apparent disagreement. An example is shown in Figure 15. An edit check comparing the time of day and lighting condition might set the expectation that it should be daylight or dark by specific times of day. For some combinations of time and lighting condition (e.g., 2 a.m. and daylight), the disagreement is truly impossible and should result in a critical error. For other combinations of time and lighting condition, the State might prefer to issue a warning rather than reject the crash report.

In these cases, the State may program the edit check to flag the crash for an additional review either by the officer before the crash report submission or for quality control technicians as part of data acceptance. Since the edit produces only a warning message, the system can post the crash report to the crash database and include it in the analysis. If the warnings are flagged in the database, the State can follow up with quality control reviews, and analysts can determine if they need to adjust values.

Figure 15. Warning Based on Lighting Condition and Time of Day

Implementation

In addition to critical and warning errors, States might find it helpful to assign an edit classification flag to the edit checks. A State may use these edit classifications to replicate the Fatality Analysis Reporting System and SAFETYNET edits in the State's crash processing system. By including the FARS and SAFETYNET edits in the electronic field data collection systems, data collectors can capture more accurate data at the point of entry. Adding a FARS and SAFETYNET flag to the appropriate crash reports could assist FARS and SAFETYNET analysts and quality control technicians process those crash reports. A subset of all edits could be used for performance measures and reporting. By flagging those edits, it helps communicate the rationale within the crash data system. *The NHTSA Advisory* (2018) details the following ways States use the information:

- Notify law enforcement agencies of errors in their reports.
- Develop content describing common and serious errors in crash reporting training and instruction manuals.
- Develop accuracy, completeness, and uniformity performance measures and reporting.
- Assess the need for additional edit checks so that the errors are corrected during field data collection by law enforcement and confirmed as a process during central processing acceptance.

Typically, crash systems include hundreds of edit checks. The State may run these checks as part of the data quality process even if edit checks are also run by law enforcement before data submission. This process can be automated and include reporting that shows, for each crash report, the errors that it contains. According to *The NHTSA Advisory* (2018), States have the option of correcting the errors centrally, rejecting the reports so that the law enforcement agency makes the corrections, or leaving the errors uncorrected in limited circumstances.

Edit Checks ✓

E(C)11.01 If the value of "C.11 Weather Conditions" = 06 (Freezing Rain or Freezing Drizzle), 07 (Rain), 09 (Sleet or Hail), or 10 (Snow), then "C13. Roadway Surface Condition" cannot=01 (Dry).

E(C)11.02 If 03 (Clear) is selected, a second occurrence of this element should not be selected.

Figure 16. Edit Checks for Weather Conditions Using MMUCC

Edit Checks ✓

E(V)06.01 The value of "V6. Motor Vehicle Model Year" cannot exceed current year.

Figure 17. Edit Checks for Vehicle Model Year Using MMUCC

Using MMUCC Edit Checks

A State's crash system provides useful data to safety stakeholders at the State, Tribal, regional, local, and national levels. The *MMUCC 5th Edition* (GHSA & NHTSA, 20172017) defines edit checks for data elements and attributes that States can use as a model. Figure 16 provides an example of a critical data check featured in MMUCC.

MMUCC also includes examples where a State may choose to allow for an edit to be considered a warning. Figure 17 provides an example using the vehicle model year. In some cases, a vehicle's model year may exceed the calendar year. States can decide which edit checks should be designated as critical errors and which should result in a warning.

The MMUCC edit checks are not intended as an exhaustive list. States are encouraged to develop edit checks as needed to address the errors experienced in the crash data. The MMUCC examples show how edit checks can be included in the crash system documentation.

Developing Performance Measures

Overview of Data Quality Performance Measures

NHTSA has developed several useful guides for data quality measurement including:

- Model Performance Measures for State Traffic Records Systems (NHTSA, 2011).
- The NHTSA Advisory (2018).
- CDIP Guide (Scopatz et al., 2017).

The *CDIP Guide* is the most comprehensive document to date as it includes all the model performance measures and additional suggested data quality measures. It shows calculations of data quality performance measures using sample data. Figure 18 provides an abbreviated list of examples featured in the *CDIP Guide*. The performance measures in Figure 18 are examples of high-level quality management indicators. The State is encouraged to develop additional performance measures that address their specific needs.

Crash Data System Data Quality Performance Measures	
Timeliness	The median or mean number of days from (a) the crash date to (b) the date the crash report is entered into the database.
Accuracy	The percentage of crash records with no errors in critical data elements (e.g., 95% of reports with no critical data error).
Completeness	A decrease in the percentage or number of missing data elements from the crash database for a given time period (e.g., 1 year).
Uniformity	An increase in the number of crash data elements collected as part of a State's PCR that are mappable to MMUCC (e.g., 95% of data elements and attributes map successfully to MMUCC 4th Edition).
Integration	The percentage of appropriate records in the crash database that are linked to another system or file. Examples: crash with-in State driver linked to driver file, crash with EMS response linked to EMS file (e.g., 85% of crash-involved persons coded as "transported" matched to EMS run report data).
Accessibility	Identify the principal users of the crash database. Query the principal users to assess (a) their ability to obtain the data or other services requested and (b) their satisfaction with the timeliness of the response to their request. Document the method of data collection and the principal users' responses (e.g., 90% of respondents rate their satisfaction as "satisfied" or "extremely satisfied").

Figure 18. Examples of Crash Data Quality Performance Measures From the CDIP Guide (Scopatz et al., 2017)

The NHTSA Advisory (2018) includes these model performance measures as part of a formal, comprehensive crash data quality management program. The description and success of this formal, comprehensive data quality management program are derived from experiences in dozens of States throughout the decades of NHTSA traffic records assessments and the experience of several subject matter experts working with the NHTSA Traffic Records team during the 2012 and 2018 updates to *The NHTSA Advisory*.

States can tailor data quality performance measures to the needs of data managers and data users. The performance measures can be vetted by crash stakeholders (including the data collectors) through the State TRCC. Ideally, a State will have at least one data quality performance measure in each of the six data quality attributes of timeliness, accuracy, completeness, uniformity, integration, and accessibility.

States can choose to report data quality performance in several ways and for a variety of purposes. Data managers, for example, might want to look at daily reports on the quality of the data entering the system. Users may only need to know the quality of annual data files used for analysis. Data collectors—the individual law enforcement agencies—may benefit from knowing how their crash data quality compares to other agencies and the statewide average. For reporting purposes, States can set data quality targets and compare the values of data quality performance measures to those targets. States can also use the performance measures as a way to evaluate projects aimed at improving crash data quality by calculating a project-specific value (e.g., timeliness of electronic data for a new software tool compared to a baseline value without the tool).

Data quality performance measurement calculations can be automated to lower the cost of reporting.

Automated tools also help by providing flexible reporting across time and jurisdictions. For example, the crash database managers may want to receive daily data quality reports to help them identify potential problems with the database. Data collectors may need a report that presents just their individual agency's performance or presents a comparison to other agencies of a similar size or statewide averages. Crash data stakeholders and the TRCC may be interested in periodic reports of statewide measurements compared to a baseline and indicating progress toward an established goal. Reducing the staff time required to generate the expected variety of reports can help the State manage crash data quality without adding a large manual effort for calculating the performance measures. A good opportunity to implement new, automated data quality reports is when the State is updating its crash reporting system. Data quality reporting functions can be added to the system design from the start rather than attempting to add that functionality to an existing system.

Timeliness

States can develop a variety of timeliness performance measures to assess their overall efficiency in creating the crash database or individual steps in the process of collecting, submitting, and posting data. In developing a timeliness performance measurement, data managers might consider the likely sources of delay and how-to best measure performance. For example, monitoring timeliness of records in the system and providing specific feedback to law enforcement agencies on their performance measure two different things and support different solutions to timeliness problems.

Based on State reports, the most common timeliness measure is the time between the crash date and when the data is entered into the crash database as shown in Table 11.

Table 11. Average Timeliness of Crash Reports (Adapted from the CDIP Guide, Scopatz et al., 2017)

Record	Crash Date	Entry Date	Timeliness (Days)
1	4/1/2020	4/5/2020	4
2	4/2/2020	4/5/2020	3
3	4/3/2020	4/3/2020	0
4	4/3/2020	4/15/2020	12
5	4/8/2020	4/15/2020	7
6	4/9/2020	4/12/2020	3
7	4/10/2020	4/18/2020	8
8	4/11/2020	4/22/2020	11
9	4/19/2020	4/24/2020	5
10	4/24/2020	5/7/2020	12
		Mean	6.5 days
		Median	6 days

Accuracy

In developing accuracy performance measures, system managers may prioritize what is most important to State stakeholders and themselves as managers of the system. While the goal is to identify and correct errors in the crash report, selecting the most critical data elements when assessing overall accuracy will reduce the amount of data to process for each report and increase the utility of the accuracy report.

The *CDIP Guide* (Scopatz et al., 2017) defines two measures of crash data accuracy. The first relies on a pre-defined set of critical data elements and tests accuracy using internal validation. The second relies on external validation using the vehicle registration database. In practice, States need many more measures of accuracy than the minimum suggested. A State may develop accuracy measures based on its needs. If both paper and electronic reports are collected, the State may wish to track accuracy separately for the two data sources.

Data managers may wish to track all errors (not just those in critical data fields) and provide specific feedback to each law enforcement agency. Location coding failures may generate several related accuracy measures, which are important to those who manage the process and provide training and feedback. Data managers may consult with data collectors and users to determine which accuracy measures are most meaningful and relevant. Ideally, the crash data management system will calculate each measure automatically. Where automation is not possible in an existing system, the State may plan to consider adding this capability in the requirements and system design of the next crash data system update. Specific accuracy example performance measures are shown in a section later in this chapter.

Completeness

The CDIP Guide (Scopatz et al., 2017) defines three performance measures of crash data completeness. Ideally, States may go beyond the minimum completeness performance measures. Completeness performance measures are especially important during changes or updates to the crash database. Measuring these changes help data collectors (law enforcement officers) and vendors correctly understand and implement the system updates. If both paper and electronic reports are collected, the State can track completeness separately for the two sources. The CDIP Guide (includes a ratio measure that can help data managers identify under-reporting by law enforcement agencies.

Uniformity

Performance measures of internal uniformity are designed to compare data collected by law enforcement to the State's standards, especially in key data elements. A lack of uniformity may point to agencies using a non-standard reporting threshold or incorrect or out-of-date data definitions. Ideally, uniformity performance measurements point to actions that will improve data quality such as training officers on the State's standards, new edit checks that can result in rejecting non-compliant data forms, and enforcing the State's reporting threshold.

Data Integration

Measuring data integration provides information for data managers, those performing the linkage, data users, and the TRCC. A State may choose to measure changes in integration success over time by comparing current to past performance.

States may wish to measure the number of systems that are integrated and the current status of inter-agency agreements formalizing those data-sharing arrangements. The *CDIP Guide* (Scopatz et al., 2017) describes the following types of data-sharing arrangements:

- The number of data owner agencies that have currently signed memorandums of understanding or data sharing contracts allowing their data to be used in the linkage.
- Institutionalizing data sharing agreements formalizes the process. This is especially helpful in addressing turnover in agency leadership as well as staff. Maintaining a formal data sharing agreement can keep data integration efforts going even as key staff changes.

Another performance measure for crash data integration focuses on the quality and usability of the linked data set. NHTSA recommends that States ask users about their satisfaction with the data as it applies to their specific use (e.g., data quality monitoring, in-depth analysis).

Since the linked dataset may reside outside the control of the crash data manager or custodian, it is important to consider it independently. The organization conducting the linkage—which may be another State agency or an external entity such as a university—is likely responsible for user satisfaction with the linked data.

Accessibility

Accessibility is one of the most difficult quality attributes to understand and measure, but it is also one of the most critical. The efforts to improve a crash database's timeliness, accuracy, completeness, uniformity, and integration are a missed opportunity if the data is not accessed and used by the decision-makers who need it.

Furthermore, providing access to the crash data for a variety of users gives data managers valuable feedback on other data quality attributes, especially accuracy and completeness. If the users identify errors and missing data, the State can use that information to determine if and how the problems should be addressed.

Measuring crash data accessibility will allow data managers to:

- Quantify how well users are served by the crash data system;
- Demonstrate compliance with existing laws and policies regarding data access and security;
- Identify unmet user needs;
- Assess the need for new technologies and access methods to better serve users;
- Document the value of the crash data system to users and senior managers; and
- Communicate information about crash data access to users and potential users.

Summary

Comprehensive crash data edit checks are a critical component of crash records systems. When edit checks are included in the planning, design, and implementation of a new or updated crash system the cost of these critical system functions can be included in the update effort. Adding edit checks and data quality measurement capabilities can represent a major investment.

As States revise their crash database, they can automate data editing processes and crash data quality performance measurement and reporting. Instituting automated crash data edit checks and performance management lead to efficiencies and proven reductions in costs. This is most successful when the crash form and database revision are well planned and consider quality control functions in the updated system design and new database model. Adding edit checks and performance measures to existing established systems requires added costs, system re-work, increased manual effort, and staffing to conduct routine data quality management and reporting. Well-designed crash data systems also give States the flexibility to easily add or update edit checks and performance measures as needed and provide the ability to run reports for multiple layers of the crash data (e.g., filtering by agency, system vendors, type of crash event).

NHTSA encourages States to consider adopting the MMUCC data element definitions, attribute lists, and edit checks. As part of a crash system update, using MMUCC can save time and effort in documenting the system and creating edit checks. State TRCCs can promote data quality management best practices as described in The NHTSA Advisory, (2018) and by completing a periodic review of the edit checks and data quality performance measures.

6. Deploying a New Crash System

This chapter focuses on the deployment of a State crash system using industry practices for large-scale software solution implementation. The chapter describes the deployment process, from designing the solution to implementing the software to training future users.

Crash Systems Deployment Overview

Deployment of the new crash system uses the practices identified in this updating guide to achieve a successful implementation. Crash system deployment is the transition from a conceptual or test environment to full operation within a State's traffic records system. The deployment process uses the stakeholder involvement techniques in Chapter 2, the gaps identified using the MMUCC guideline in Chapter 3, and the noteworthy practices for developing documentation from Chapters 4 and 5.

A suggested system development lifecycle is shown in Figure 19 and explained in greater detail below. Each segment in the diagram can be considered a phase in development and, as shown, the phases repeat as needs change.

1. Requirements Analysis – A State will review requirements to define the intended capabilities and features of the crash data system.
2. Design – A State will determine how the proposed crash system will meet the requirements.
3. Development – Developers and system architects create system components.
4. Testing – A State will test the system using a formal quality control process.
5. Implementation – A State will move the crash system into the production environment. This phase may also include planned migration away from legacy applications.

Figure 19. SDLC

6. Maintenance – The State will continue to adapt the system to meet user needs and specifications. This may include adding new features to address the changing requirements of the system. As the requirements evolve, the process begins again.

The next section discusses the design step in more detail.

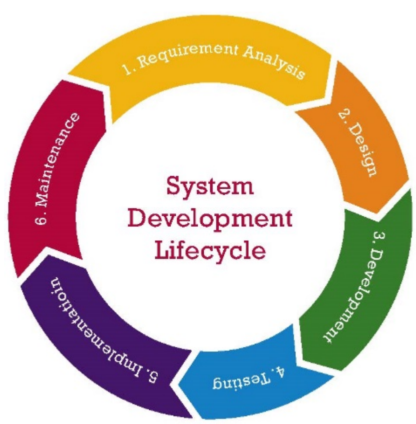

Figure 19. SDLC

Designing a Crash Data System

The design phase of system development includes designing the data collection process, updating the database schema, creating interfaces, identifying storage considerations for updated crash data, and defining the transmission parameters for crash data.

Designing the Data Collection Process

A State must determine several conditions before designing a data collection process. A State's first step, as listed in the SDLC and shown in Figure 19, is determining the system requirements. Once the requirements are confirmed, the project can move into the design phase. As part of this first step, the State will gather all documentation of the existing crash system. A State can use the documentation to help identify the ways that the existing system meets business needs. An adequately defined data dictionary and crash data flow diagrams may have this information. Knowing how the existing system supports business-critical uses of crash data will inform the State's decisions on how to support those needs in the new system.

Importantly, a State can use the data dictionary and crash data flows to evaluate the potential to improve efficiency by changing the information a law enforcement officer obtains at-scene versus data that the system can obtain through linkage to other traffic records data sources. A State may choose to use a data dictionary like the one shown in Table 12 to identify data elements and attributes for the crash information.

Table 12 provides an example data dictionary in a grid format—other formats and greater levels of detail are possible.

Table 12. Example Fields for a Crash Data Dictionary

Data Element Name	Definition	Information Collected	Source
C6. Crash Location	The city/place (political jurisdiction) in which the crash physically occurred.	Latitude/longitude	At-scene investigation
C7. First Harmful Event	The first harmful event is defined as the first injury- or damage-producing event of the crash.	Code from the attribute list	At-scene investigation
V1. Vehicle Identification Number	A VIN is a unique combination of alphanumeric characters assigned to a specific motor vehicle designated by the manufacturer.	17-character code assigned to the vehicle (less for vehicles manufactured before 1981)	At-scene investigation
R2. Roadway Curvature	The measurement of the curvature in the roadway expressed in terms of its radius, length, and superelevation. The unit of measurement is feet.	Value of curve radius, length, and superelevation	Linked from roadway file
P25. Injury Area	The primary or most obvious area of the person's body injured during the crash. Area of injury as indicated in a matrix or narrative in the EMS records or as a hospital discharge code (ICD-9- CM, or ICD-10, if implemented) in the emergency department, hospital, or insurance records.	Code noting the primary or most obvious injury area	Linked from NEMSIS

By reviewing data dictionaries and data flows, the State may identify possibilities for improvement. If the State is considering using the MMUCC, the tool for gap analysis referenced in Chapter 3 can help the State develop revised data definitions and identify gaps or possible barriers to obtaining the desired information. As the State defines appropriate fields for data collected at-scene versus linked or derived, they can draft a mockup of the crash data collection process.

Updating Database Schema

A database schema displays the structure of the data in the tables, fields (data elements), and relationships among these objects within the crash system. Updating the crash system will likely include updating the database schema. This presents the State with an opportunity to reduce redundancy and optimize the database structure to support queries and analyses. Figure 20 shows a database schema in the form of an entity-relationship diagram.

This representation presents an opportunity for the State to focus on optimizing the design of the data for the intended purpose. In Figure 20, the example shows each table linked by a single field referred to as a primary key (PK in the figure). This unique identifier identifies each available record. A State may consider linking most fields by the State crash number. Data tables may also have a foreign key (FK in Figure 20) which identifies, in crash systems, individual vehicles and people. Primary and foreign keys support necessary linkage among the data tables so that, for example, the driver and other occupants of a vehicle are associated with just that vehicle and not others involved in the crash.

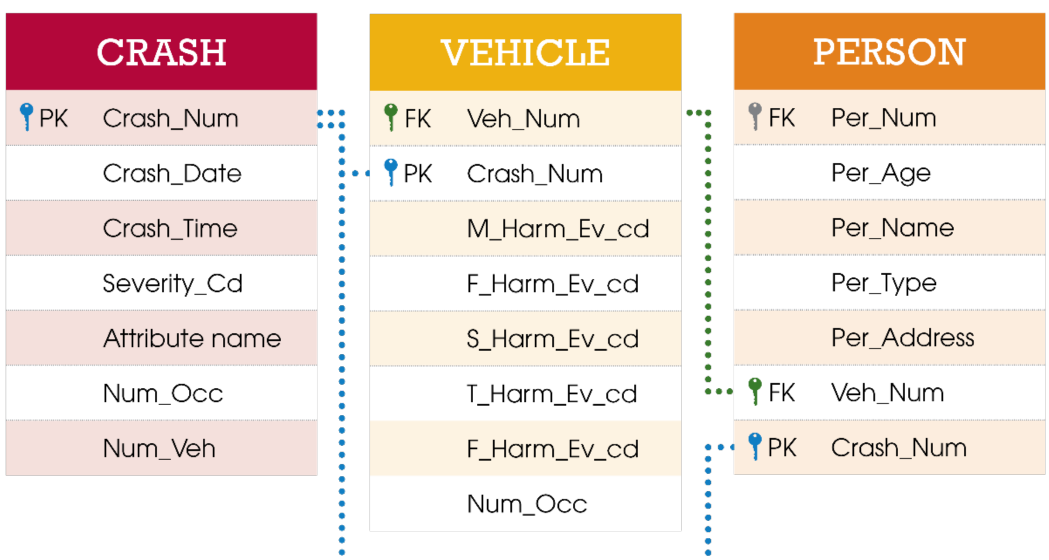

Figure 20. Crash Data Schema Example

While designing the database, the project lead may ask data users to describe the data queries they use most frequently now and which new queries they would like to use. The answers to those questions help designers optimize the database structure to make them faster and more reliable (i.e., less complex for users to build). The design process should be iterative. As the State learns more about users' needs, there will be an opportunity to revise the schema before the later phases of the SDLC.

Creating Interfaces

The NHTSA Advisory (2018) defines a data interface as "a seamless, on-demand connectivity and a high degree of interoperability between systems that support critical business processes and enhances data quality" (NHTSA, 2018, p.51). An interface refers to the 'real-time' transfer of data between data systems. Ideally, when following the design steps mentioned previously, a State may have the layout of both the crash data process and how the State organizes crash data. When consulting traffic safety stakeholders, a State may ask the following questions.

What data do you need?

- What is the job, and what data does the job require?
- What do you do with the data that cannot be done without the data?

What do you need to enhance your services?

- Are there requests for information that you cannot meet now?
- What additional data would meet those needs?
- What additional data would allow you to be more efficient and provide more relevant support for decision making?

A State may decide, for example, to create an interface that connects the driver file with the electronic crash reporting software used by law enforcement officers. This could allow officers to validate and verify drivers' personally identifying information in real time based on State records.

Identifying Storage Considerations for Updated Crash Data

Crash data systems are central to traffic safety analysis. The system's storage should have attributes that database management professionals refer to as reliability, availability, and serviceability.

Reliability is achieved when the system storage performs as expected. This consideration also has security implications. Crash data should be secured so the system blocks unauthorized access and potential damage to records.

Availability is the amount of time that the storage is expected to function. This is the period that the State requires the system to be in operation and accessible to users.

Serviceability is the amount of effort it takes to replace a storage unit. In most modern systems, the storage can be recovered as a backup from a previous point in time. With the crash system, a State may consider the cost of maintaining the data that it needs to determine the appropriate solution that safeguards data from loss should a storage unit fail.

Defining the Transmission Parameters for Crash Data

Sharing data reduces redundancy, helps establish single authoritative sources for data and supports data enhancements through integration. A State may use a data governance group with responsibility for all enterprise data, safety data specifically, or even the crash system in isolation. Data governance is an approach for data management that implements policies and enforces data quality standards cooperatively with all partner agencies and key stakeholders. A data governance group may also be charged to establish data exchanges and guidelines for systems that intend to connect with the crash system. Data sharing may be formalized through an MOU. As identified in Figure 11 in

Chapter 4, an MOU among partner agencies can outline the contents and schedule for data transmissions.

Deploying a New Crash System

Creating an Implementation Plan

Agencies use an implementation plan to transition the system from the development phase into live operational use. As part of system implementation, the State may need to consider how it will phase out legacy systems (e.g., previous crash system or older data interfaces). Ideally, the deployment of the crash system is a topic of discussion for the State TRCC and the data governance group, if one exists. A well-constructed and communicated implementation plan is key for successful deployment. The transition to the new system will be smoother when all stakeholders are aware of the steps that will take place during the transition. Frequent progress updates can keep users engaged and supportive during the transition.

Scheduling Major Tasks for the Deployment

The overall project schedule should include the deployment schedule. There are many methods and processes States can use for project management. This report does not endorse any particular methodology. States may be familiar with the five elements from the *Project Management Body of Knowledge, Sixth Edition* (Project Management Institute, 2017) as outlined below. These or similar organizing steps can be used to create a harmonized schedule.

1. Plan Schedule Management

In this step, a State can document how the project was initiated or authorized (e.g., project charter, project scope, environmental analysis, or existing documentation). This step creates the consideration for "establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the schedule" (Project Management Institute, 2017, p. 173).

2. Define Activities

This step is the process of identifying the actions a State will perform to produce the crash system and documenting them in list form. Items such as the project plan or existing documents within the organization can help define those activities. Exercises previously mentioned in the updating guide (e.g., stakeholder analysis and MMUCC gap analysis) can be used here as well. Stakeholders can also provide their expertise and help to identify the tasks.

3. Sequence Activities

This step uses the defined tasks and attempts to create a relationship between the tasks the State is performing. This establishes the assembly line of how a State designed the crash system. The State may wish to connect activities to show which ones much precede or follow which others in the project sequence. As with other steps in project management, there are many ways to accomplish this task. The *Project Management Body of Knowledge, 6th edition* (Project Management Institute, 2017) provides one way that States may already be familiar with. The important aspect of the task is to document task dependencies and account6 for them in the schedule by setting appropriate start and end dates for each activity in relation to those that must precede or follow it.

Once a State identifies those relationships, they can create a diagram to display the tasks visually. This diagram shows the overall order of the tasks as presented. Figure 21 shows an example of a network diagram.

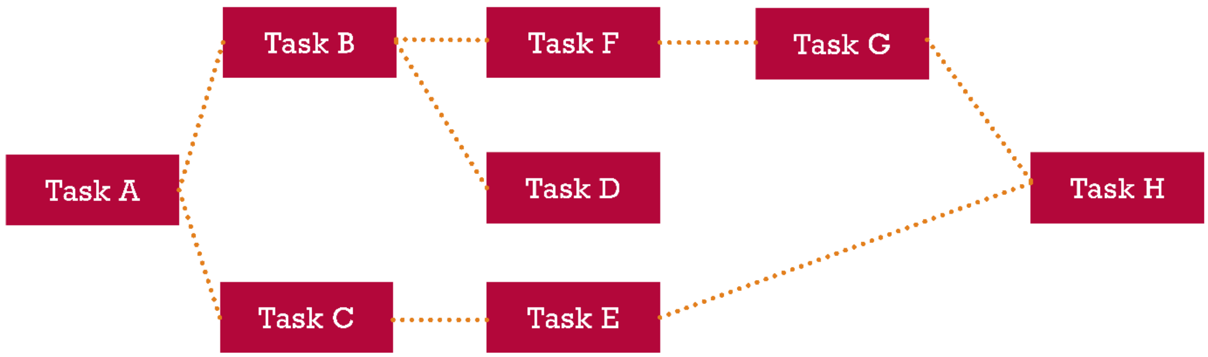

Figure 21. Sample Network Diagram

4. Develop Schedule

This step is the process of taking the previous steps of defining the activities, analyzing the durations, and considering the constraints to create a schedule. This schedule is what the State will use to conduct the crash system implementation. To create the durations for each task, a State may use historical information from similar projects to develop the estimate. Another technique is to use a three-point estimate. A State can then add the duration for each proposed task to the project's implementation chart.

5. Control Schedule

The State will monitor the project schedule to make any updates based on any change in status of any of the steps. The schedule impacts all of the crash data system partners on the replacement project. The project manager (or State Coordinator) tracks all parts of the project and adjusts the schedule as necessary.

Identifying the Critical Path for a New Calendar Year Implementation

To deploy the system, the State must decide on the roll-out date. Most States run a January 1 – December 31 calendar year for analysis. When deployment includes new crash report data elements (i.e., a new form), the State may wish to schedule the release of the new crash system to coincide with a new calendar year. To meet critical deadlines like this, a State can identify the critical path.

The critical path is the longest duration of tasks sequentially through a project. This path determines the shortest possible duration that the State should plan to complete the implementation on time. If any task on the critical path becomes delayed, so will the entire project. Thus, the critical path methodology also helps a State monitor progress by focusing attention on the tasks that could upset the planned schedule for completion.

To determine the critical path, a State may use the techniques identified in the Scheduling Major Tasks for the Deployment section. Once complete, a State can incorporate the estimated completion times into the network diagram. With the addition of details on the timing of each task, the network diagram shown in Figure 21 helps to identify which tasks are on the critical path. Figure 22 builds on the previous example by adding the estimated task durations. The critical (longest) path is shown with larger dots on the path including tasks A, C, E, and H.

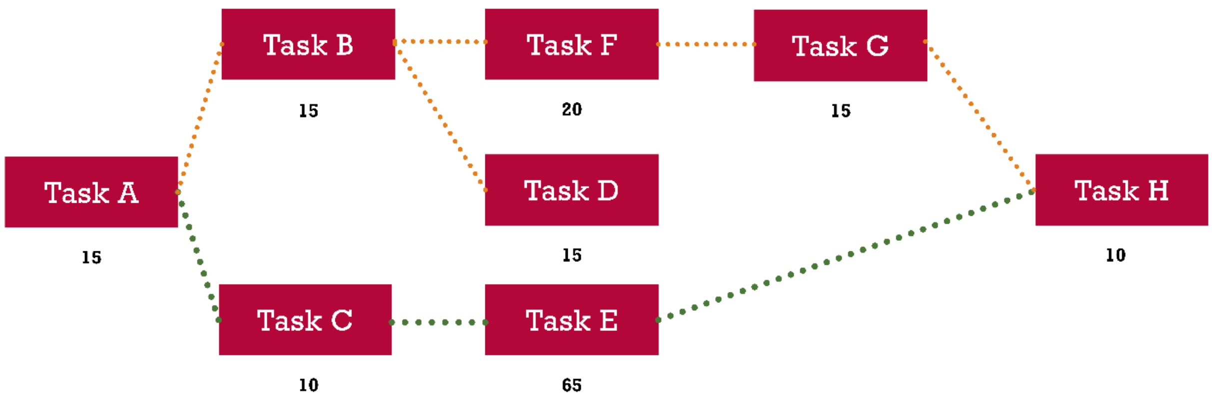

Figure 22. Network Diagram with Defined Critical Path

Using the estimated duration, the State can set the project's start date to achieve the desired completion date. The State can update the critical path to account for new schedule variance as the project moves through implementation. If there are multiple critical paths, there is a higher risk of the schedule changing. This will require more control over the project schedule. Another way of saying this is that it is possible for the critical path to change unexpectedly from the path you were monitoring to the one you were assuming was at low risk for making the project late. If, as depicted in Figure 22, the critical path is clearly along path A-C-E-H, the project managers might feel justified in paying less attention to the schedule for tasks on path A-B-F-G-H. If the completion dates for tasks B, F, and G start to slip, however, that path could become critical. The critical path method is intended to help project managers notice and adjust to schedule slippage, not become complacent. Updating the task sequences with new completion dates will immediately alert project managers to changes in the critical path.

Coordinating With State and Local Law Enforcement Records Management Systems

Law enforcement agencies supply data to the State crash system and their needs for training and equipment must be addressed in the implementation plan. A State may engage the law enforcement community in the requirements, design, development, and testing phases of the deployment. A State can use surveys, the State Law Enforcement Network, and the CDUG to coordinate with law enforcement stakeholders. Training and equipment delivery should be timed so that officers receive them as near in time as possible to the planned go-live date. In a State with a large number of law enforcement agencies and officers, this could still require a great deal of lead time where the system must be ready to go (for training purposes) long before the actual implementation date.

Surveys

A State can use surveys to obtain quantifiable feedback on the crash data collection process and how to improve its efficiency. Example survey questions include:

- What is the name of the agency?
- How does the crash data impact your day-to-day operation?
- Does your agency have a records management system? If yes, are you using an outside vendor?
- Are your officers having to complete dual data entry for crashes?
- Are there any fields that are difficult to collect at-scene?
- What pieces of information can be collected from other data sources?

State Law Enforcement Networks

Another possible way to reach law enforcement is through a State's law enforcement networks. These networks are composed of State and local enforcement officers that meet regularly. These meetings provide networking opportunities with fellow agencies, training, and a myriad of law enforcement-related information. The crash data systems coordinator could attend these meetings to learn ways that law enforcement officers and agencies are using the data and understand the opportunities to add new content to the crash reporting training that agencies are performing. As the State is designing the crash system, law enforcement feedback may also create new functional requirements of the system. This may include data collection tool tips or interfaces that will auto-populate crash records during the at-scene investigation. A human-centered approach to data collection interfaces for officers as described in Chapter 4 is a good way to capture these design considerations that will result in increased user acceptance as the new system rolls out.

Coordinating Vendor Relationships

A State may have to look outside of the lead agency to provide services to develop and deploy the crash system. Outsourcing is the process of obtaining goods or services from an outside entity. Ideally, the State will have a method that fosters a good relationship with the potential team. A State may make considerations for external (e.g., private firms not adjacent to State government) or internal vendors (e.g., a State IT department). Examples include using a human factors expert to help design the crash reporting form and interface and using the State IT department to support data governance efforts and supply system designers, programmers, and procurement support. A State may perform the following steps to manage that relationship once external resources have been selected and approved.

- Understand the business goals. The vendor has to have a clear understanding as to what the State means to accomplish. As the State sets up the task within the overall project, a kickoff meeting will minimize the risk of ambiguity. The goals should be specific, measurable, achievable, relevant, and timely. This allows the crash data system coordinator or project managers to reinforce how the work the vendor does impacts the project and provides a roadmap on how to achieve the project goals.

- Communicate with the vendor. The vendor should perform the task as identified in the signed agreement. This is an exercise that revolves around consistent communication between the project team and the vendor. The vendor should communicate with the State if there are any deviations or decisions that may impact the project outcome. This includes, but may not be limited to, any approvals, release feedback, and changes to the scope. Ideally, communication with the vendor occurs regularly.

Managing Expectations

A crash data system coordinator may be selected to manage the expectations of stakeholders throughout the system development lifecycle. Ideally, this person will begin meeting with the stakeholders at the onset of the project. The system outcomes should be well defined so the stakeholders can understand them. A coordinator may communicate the goals of the system by creating data quality performance measures and targets. Using these performance measures, a State can evaluate the system and note any issues with any of the affected areas. Chapter 5 covers potential performance measures in greater detail.

Training

Training data collectors, managers, and users on the updated crash system is a critical part of the implementation and, for as long as the system is in use, training is one of the most important factors in maintaining data quality.

A State needs to invest resources in training users to ease the transition to the new system.

At initial deployment, this training can reflect the differences from the old to the new system and incorporate its benefits.

Crash Data Collectors

As the primary crash data collectors, law enforcement officers are the key source of information. A successful training program is likely to include initial classroom instruction with hands-on and interactive use of the crash data collection software with supplemental training experiences available through video and online resources. Tutorial videos are helpful in that a crash data collector can view them during the initial training and at any time afterward as needed. The State could also make law enforcement training content available online so that field officers can review concepts and ideas. The State may also consider offering refresher courses as short (e.g., 30 minutes or less) online classes available whenever crash data collectors need them. Ideally, this training should be performed through a State-level training academy; however, it is not uncommon to develop “roadshow” and train-the-trainer style experiences as part of the pre-deployment for a new crash system.

A State may consider the following outline to create a course for law enforcement.

Lesson 1: Course Overview

The objective of Lesson 1 is to inform the participants how the State will use the crash data to improve safety, reduce the number of crashes, and save lives. This is an opportunity to have officers understand that the data collected goes beyond insurance purposes.

Sample Lesson Outline

- ☑ Welcome and introductions.
- ☑ Sign-in sheet and tent cards.
- ☑ Ground rules.
- ☑ Housekeeping items.
- ☑ Course goals and objectives.
  Lesson objectives, course structure, what is MMUCC?, course agenda, roll call video, lesson wrap-up

Lesson 2: Critical Data Elements

The elements the State deems critical are those used most often for supporting safety decisions and data quality reviews. Ideally, the TRCC and data governance groups will have input into the selection of critical data elements. The objectives of Lesson 2 are to help the officer-trainees understand the PCR critical data elements and to promote accurate and complete crash reporting. In this lesson, the instructor could review the overall structure of the electronic PCR and promote an understanding of the data structure.

Sample Lesson Outline

- ☑ Lesson objectives.
- ☑ Traffic safety takeaways.
  PCR overview, critical data elements
- ☑ Crash summary.
- ☑ Motor vehicle information.
- ☑ Driver information.
- ☑ Passenger information.
- ☑ Non-motorist information.

Lesson 3: Software Functionality

The objective of Lesson 3 is to train officers in how to use the State crash data collection software. This could include the following:

- Logging in.
- Starting a crash report.
- Recording location and other crash-level items.
- Adding vehicles.
- Adding drivers.
- Adding passengers.
- Adding witnesses.
- Adding non-motorists.

Sample Lesson Outline

- ☑ Lesson objectives.
- ☑ State crash data collection software functionality.
  Instructor-led demo of State crash software.
- ☑ Lesson wrap-up.
  Q&A.

Lesson 4: Small Group Exercise

The objective of Lesson 4 is to give trainees some practical experience completing a crash report with only minimal input from the instructor. The trainees break into groups of two to four people and work together to complete a crash report. This group exercise is an opportunity to promote discussion and build trainees' confidence in their ability to record the required information. The instructor could provide each group with at least two crash scenarios and access to a copy of the officer's crash reporting instruction manual. The examples could be different crash types and involve different situations to allow officers to explore the software functionality and the report form. After completing the lesson, the trainees could print their reports and then compare them to a completed example of the same

Sample Lesson Outline

- ☑ Lesson objectives.
- ☑ Crash scenario samples.
- ☑ Practical experience – State crash data software.
- ☑ Data quality review.
- ☑ Lesson wrap-up.
- ☑ Q&A.

Lesson 5: Supplemental Data Elements and Special Crash Cases

The objective of Lesson 5 is to train officers on crash data elements that are not recorded for every crash. These data elements may include items like commercial vehicle information, pedestrians, bicyclists, or school busses. This would be a continuation of Lesson 4. This lesson could be interactive and officers could describe a crash that they have witnessed or investigated. The instructor can outline how to collect and document the data. The instructor could be prepared to provide two to three examples if the training participants are new to crash reporting or are reluctant to provide examples from their own experience.

Sample Lesson Outline

- ☑ Lesson objectives.
- ☑ Commercial vehicles.
- ☑ Bus information.
- ☑ Bicycle information.
- ☑ Pedestrian information.
- ☑ Witness information.
- ☑ Lesson wrap-up.
- ☑ Q&A.

Lesson 6: Recap and Wrap-Up

The objective of Lesson 6 is to provide trainees an opportunity to give feedback on the course. Lesson 6 also allows the instructor to revisit the critical data elements. Before closing the session, the trainees have the opportunity to discuss the what they liked and what they would change. The instructor could provide each trainee with an evaluation form to complete before leaving. The State may consider using the evaluations to revise the content and delivery of the course.

Sample Lesson Outline

- ☑ Lesson objectives.
- ☑ Recap.
  - Quiz questions, Q&A.
- ☑ Feedback, input for improvements.
  - Group discussion, course evaluation.
- ☑ Lesson wrap-up.
  - Resource for help, contact info, website with training materials, thank trainees for their active participation.

Class Title:	eCrash Software Training	Lesson Plan #:	001
Status (New/Revised):	New	Training Department:	Training Academy
Time Allocation:	8 Hours	Primary Instructor:	
Alt. Instructor:		Lesson Prepared By:	
Date Lesson Prepared: April 25, 2020			
Lesson Plan Purpose: Train a team of Local Law Enforcement officers to use State's eCrash software. The officers go through the operational procedures for the preparation, submission and data retrieval of electronic police crash report.			
Evaluation Procedures: Student application, field preparation police crash report. Submission of electronic reports for approval and final processing to the law enforcement agency, Department of Motor Vehicles and Department of Transportation.			
Training Aids, Supplies, Equipment, Special Classroom/Instructional Requirements: • Projector, Screen, Flip Chart • Laptop Computer with software installed. • GPS Units. • Diagram Training Aids.			

Figure 23. Sample Lesson Plan

The State can use a lesson plan to organize the information. Figure 23 provides a sample lesson plan.

Crash Data Managers

Crash data managers will have the responsibility for maintaining the system after its launch. Another key responsibility is keeping the documentation up-to-date throughout the system's lifecycle—this may be shared with IT support staff and the data governance group. Crash data managers are aware of the system capabilities because they are part of the system's design process. Because of their system-specific knowledge, crash data managers may also be the best choice for who will document the system's features in the crash data user guide and instructions for law enforcement.

The crash data manager may work with the TRCC, CDUG, and the data governance group to create a critical data element list to use in monitoring system performance. A State could incorporate these elements into the law enforcement training program and create validation rules to warn officers of errors during data collection. As the system is developed, the crash data manager can work with designers to establish a requirement to automate reporting of data quality measurements and standardized reports.

Crash Data Users

Crash data users rely on the data in the crash data system for analyses in support of decision making. These users will need training on new system contents and reporting tools. The reporting tools may also have documentation that can support how users obtain data from the crash system. A State can include a requirement to add a set of canned reports within the reporting tools that authorized users can access. A State can identify the most desired reports from user feedback during the design process and from logs of previous requests. A State may choose to place these reports and relevant visualizations on a website as described in Chapter 4.

IT Support

Ideally, the IT group designated to provide ongoing maintenance and support of the new system will have been involved throughout its design, development, and implementation. Data governance would help to include this group by defining its role in supporting users and data managers. The crash data system coordinator can help the IT support staff develop and document to triage support issues and establish priorities for system maintenance and enhancements. An IT group can use their standard procedures to determine who can best address the reported problem.

Summary

Deploying a State crash data system is a process that involves multiple groups to complete the system's lifecycle development from analyzing the requirements to the completed implementation and maintenance. As discussed earlier in this chapter, stakeholder input is an essential component of the overall development of the system.

As the State designs the proposed solution, having the goals of the system in mind when communicating with stakeholders and considering how the data will be stored and interfaced is key. As the project moves into scheduling, the State may recognize the relationships among the tasks and identify the critical path. Monitoring progress for tasks on the critical path will help the State meet critical target dates for deployment. Since this is a new platform, the State must train its stakeholders on the benefits and features. Good documentation can help support all users and take advantage of the system's capabilities.

The information and strategies detailed in this updating guide can help States who are considering updating their crash data system. The State should select a systems implementation process that is achievable and supported by its current structure, authority, and capabilities. Before engaging in the update process, a State can refine and improve this process to address their needs for stakeholder management, data quality improvement, and system implementation.

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Appendix A: Data References and NHTSA Data Relationship Considerations

Data References

Figure 24 displays two important foundational references, the American National Standards Institute *Manual on Classification of Motor Vehicle Traffic Crashes* (ANSI D.16) and NHTSA's *Model Minimum Uniform Crash Criteria Guideline*.

Figure 24. Crash Data References

ANSI D.16 identifies, defines, and classifies the specific terminology and concepts associated with motor vehicle traffic crashes. Properly identified and defined vocabulary are necessary for a common language among the traffic safety community.

MMUCC provides a common set of data elements that can be used for State and National crash analyses using the terminology, classifications, and concepts from ANSI D.16. A State's crash data system collects and stores data to support State and local agency needs. NHTSA encourages States to review MMUCC as a part of their crash update process and adopt MMUCC data definitions to support data sharing.

NHTSA Data Relationship Considerations

When updating a crash system, NHTSA encourages States to consider the relationships between the State crash system and the NHTSA crash data programs, the Fatality Analysis Reporting System (FARS) and the Crash Report Sampling System (CRSS). FARS is a census of fatal motor vehicle traffic crashes from all 50 States as well as Washington, D.C. and Puerto Rico. CRSS is a nationally representative sample of all police-reported crashes drawn from 30 participating States.

NHTSA collects crash data to support its mission to reduce the frequency, severity, and economic costs of traffic crashes. The CRSS and FARS programs include many of the MMUCC data elements. CRSS relies on trained analysts to interpret State crash reports to create a national sample of motor vehicle traffic crashes ranging from property-damage-only to fatal crashes. FARS goes beyond the information found in a crash report and relies on trained analysts to interpret crash reports and supplemental materials to create a national census of fatal crashes. NHTSA uses CRSS and FARS to estimate the overall crash picture, identify highway safety problem areas, measure trends, and assess the effectiveness of motor vehicle safety standards and highway safety programs.

Electronic data transfer is the automated data acquisition process NHTSA uses to retrieve data from State data repositories. NHTSA uses EDT to support the CRSS and FARS programs. States can electronically transfer data from their crash records system to NHTSA's crash data programs to improve the uniformity, accuracy, and timeliness of the NHTSA systems, traffic safety research and analysis. Figure 25 displays the EDT process as a one-way transfer of data, usually nightly, from the State to the U.S. DOT.

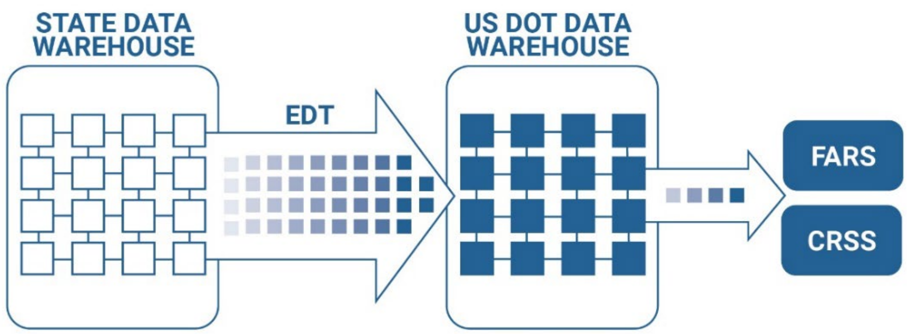

Figure 25. Electronic Data Transfer Process

The EDT process starts with NHTSA using information from the State to map the State variables to the CRSS and FARS data elements and attributes. NHTSA works with the State to develop the mapping and agree on a confidence level for how well each State data element and attribute maps to CRSS and FARS. NHTSA, together with the State, creates the IT structure to link the State data to the US DOT data warehouse. Once the EDT is successful, the process pre-codes case variables into CRSS and FARS (where applicable).

When designing or updating their crash records system, the closer the State aligns to MMUCC, the easier it is to share data and there is less work to do in translating between the State's data definitions and NHTSA's. The primary benefit of using MMUCC is increasing the uniformity of crash data that is essential to improving highway safety.

States interested in requesting an MMUCC mapping or participating in EDT should contact their NHTSA Regional Program Manager.

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